

# Iron Ore

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U.S. production of iron ore declined slightly in 1985, as the recovery of the basic industries sector from the 1982-83 recession began to slow. Demand for pellets from the iron and steel industry leveled off in mid-year compared with 1984 levels, but firmed in the fourth quarter. The domestic ore industry suffered from excess production capacity and was forced to schedule a number of shutdowns ranging from 4 to 15 weeks as well as production cutbacks. One mine was closed and the future of several others was uncertain. Both the ore and steel industries underwent more restructuring as part of the continuing struggle since 1982 to reduce production costs and improve efficiency. Production of usable ore in 1985 was about 56% of productive capacity. Yearend stocks of iron ore at U.S. docks and furnace yards were at their lowest levels in more

than 30 years.

In the rest of the world, iron ore production and trade were slightly higher in 1985 as consumption stabilized in both the European Communities (EC) and Japan. New markets for ore from market economy countries continued to grow in China, the Republic of Korea, Taiwan, Eastern Europe, and the Middle East. Nevertheless, worldwide overcapacity remained a serious problem for most producers and was expected to worsen when the 34-million-ton-per-year<sup>2</sup> Carajás project in Brazil, the 7.4-million-ton-per-year Kudremukh project in India, and the 4.9-million-ton-per-year San Isidro Mine in Venezuela are brought into full production. International iron ore prices firmed, while ocean freight rates for spot charterings, in constant dollars, declined to their lowest levels in 7 years.

**Table 1.—Salient iron ore statistics**

(Thousand long tons and thousand dollars unless otherwise specified)

	1981	1982	1983	1984	1985
<b>United States:</b>					
Iron ore (usable, <sup>1</sup> less than 5% manganese):					
Production	73,174	35,433	37,562	51,269	48,751
Shipments	72,181	35,756	44,596	50,883	49,411
Value	\$2,915,239	\$1,491,809	\$1,944,988	\$2,247,686	\$2,076,730
Average value at mines					
dollars per ton	\$40.39	\$41.72	\$43.61	\$44.17	\$42.03
Exports	5,546	3,178	3,781	4,993	5,033
Value	\$244,685	\$150,522	\$182,744	\$239,257	\$240,557
Imports for consumption	28,328	14,501	13,246	17,187	15,771
Value	\$947,977	\$470,847	\$445,731	\$529,065	\$452,240
Consumption (iron ore and agglomerates)	104,385	63,916	70,629	72,514	70,575
Stocks, Dec. 31:					
At mines <sup>2</sup>	12,734	12,129	<sup>3</sup> 4,122	<sup>3</sup> 5,265	<sup>3</sup> 5,951
At consuming plants	36,203	29,923	25,494	24,017	21,290
At U.S. docks	6,571	5,750	3,174	2,942	2,404
Manganiferous iron ore (5% to 35% manganese):					
Shipments	156	28	30	79	18
World: Production	<sup>†</sup> 844,606	<sup>†</sup> 768,011	726,399	<sup>‡</sup> 817,428	<sup>‡</sup> 845,251

<sup>‡</sup>Estimated. <sup>†</sup>Preliminary. <sup>‡</sup>Revised.

<sup>1</sup>Direct-shipping ore, concentrates, agglomerates, and byproduct ore.

<sup>2</sup>Excludes byproduct ore.

<sup>3</sup>These stocks are not comparable to those of previous years owing to the reclassification of some stocks from the usable to the byproduct category.

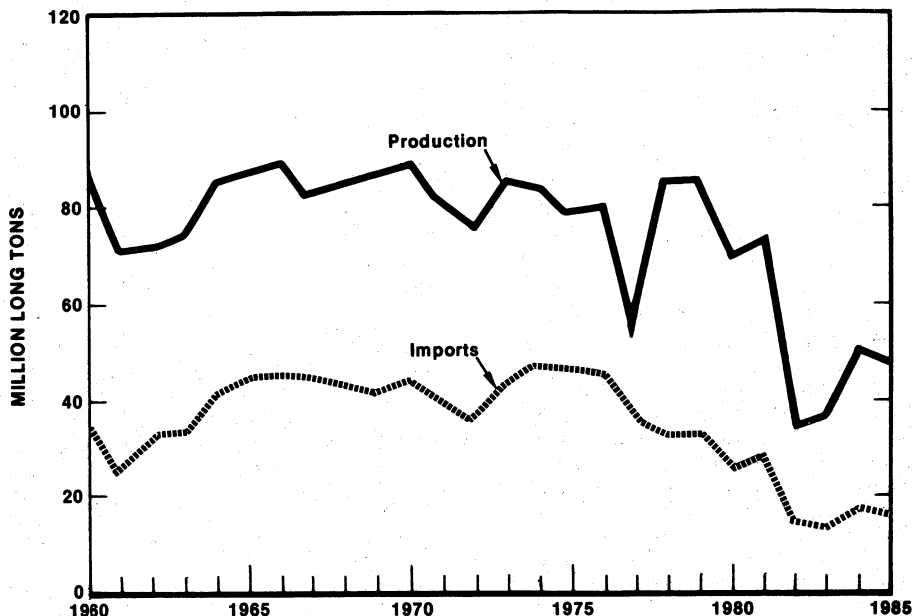


Figure 1.—U.S. iron ore production and imports for consumption.

**Domestic Data Coverage.**—U.S. production data for iron ore are developed by the Bureau of Mines from three separate voluntary surveys of domestic operations. The annual "Iron Ore" survey (1066-A) provides the basic data used in this report. Of 55 addressees to whom the 1066-A form was sent, 52 responded, representing 78.3% of total production shown in tables 1 through 4. Production for nonrespondents to the

annual survey was estimated from monthly surveys (1066-M), using data from railroad reports and reported production levels in prior years, supplemented by employment data, mine inspection reports, and information from consumers. Consumption data were mostly provided by the annual "Blast Furnace and Steel Furnace" survey (1067-A). Data coverage for this survey is reported in the "Iron and Steel" chapter.

## EMPLOYMENT

Statistics on employment and productivity in the U.S. iron ore industry in 1985, shown in table 2, were derived from quarterly employment data supplied by the Mine Safety and Health Administration (MSHA) of the U.S. Department of Labor, and from production data derived from Bureau of Mines surveys. Both sets of data were obtained from producers' reports.

The statistics include production workers employed at mines, concentrators, and pelletizing plants, and in repair and maintenance shops, but do not include 1,014 persons engaged in management, research, or office work at mines and plants. Employees engaged in ore preparation, such as sintering, at blast furnace sites are not included.

Because employment data reported to MSHA are primarily for safety analysis, hours spent by salaried employees in mines or plants may be included by operators in the total number of hours worked at individual mines or plants. This has resulted in understatement of calculated productivity by 10% to 25% for some operations, but its effect on others is not known. If company reporting practice is consistent, however, comparison of productivity from 1 year to the next should be reasonably valid.

Average quarterly employment decreased slightly compared with that of 1984, with total hours worked and output of usable ore decreasing by 16% and 5%, respectively. In the Lake Superior district, which accounts

for the bulk of U.S. output, average productivity for usable ore was only 14% higher than that of 1984 but 59% higher than that of 1981. The significant gain since 1981 is the result of drastic reductions in employment made by the principal producers in

1982, which have allowed the potential productivity of highly mechanized operations to be increasingly realized. The concentration of production in large-scale taconite operations of the Lake Superior district was an important contributing factor.

## DOMESTIC PRODUCTION

A leveling off of demand from the iron and steel industry in midyear was largely responsible for the 5% decline in iron ore production from the 1984 level of 51.3 million tons. A small increase in demand from Canada helped moderate the decline. Output of usable ore in the first half of the year was 8% lower than that in the comparable period of 1984, shipments were down 6%, and production of pig iron decreased 10%. In August, demand began to recover and, during the last 5 months of the year, monthly production of pig iron was above 1984 levels. Several mines and pelletizing plants were closed for periods of 4 to 15 weeks during the second half of the year. By December 1, four of the eight taconite operations in Minnesota had been shut down for an indefinite period, and one had been permanently closed. The patterns of production, shipments, and plant closings were similar to those experienced in 1984 and reflected a continuing weakness in demand for domestic iron and steel. Total output of usable ore was equivalent to about 56% of installed production capacity on January 1.

Iron ore was produced by 19 open pit mines and 1 underground mine. Fifteen mines produced ore for the iron and steel industry but only 2 mines were operated throughout the year and only 1 of the 2 produced at its rated capacity. One taconite mine and associated pelletizing plant remained idle, while one large, permanently closed "natural ore" mine shipped pellets and concentrates from stocks. Installed production capacity for usable ore at yearend was estimated at 86 million tons per year, including 82 million tons of capacity for pellets. Effective production capacity for pellets was at least 15 million tons less than installed capacity.

An average of 3.1 tons of crude ore was mined in 1985 for each ton of usable ore produced. This ratio does not take into account the tonnage of waste rock or overburden removed. The ratio of total materials mined to usable ore produced was probably greater than 5 to 1. Low-grade ores of

the taconite type mined in Minnesota and Michigan accounted for 97.9% of total crude ore production. U.S. production of pellets totaled 47 million tons in 1985, 96% of usable ore output. Average iron content of usable ore produced was approximately 64.2%, while that of usable ore shipped was 63.8%.

Inland Steel Co. combined the activities of its former Raw Materials Department (iron ore, coal, limestone, and fleet operations) with those of its coke, ironmaking, and materials control operations to form a new Materials and Energy Group. The company continued to restructure its iron ore operations in order to reduce costs and match the downsizing of its steelmaking operations. Inland Steel retained its wholly owned Minorca Mine and pelletizing facilities at Virginia, MN, along with its shares in the Empire Mine at Palmer, MI, and the Wabush Mines operations in Labrador and at Pointe Noire, Quebec. However, the Butler Taconite project, in which Inland Steel has 38% ownership, was permanently closed on June 29.

The closure of the Butler Taconite project at Nashwauk, MN, was the first permanent shutdown among the eight taconite operations on the Mesabi Range. Butler Taconite had an annual production capacity of 2.7 million tons of pellets. The decision to close was precipitated by the bankruptcy filing in April of Wheeling-Pittsburgh Steel Corp., which owned 24.5% of the venture. The remaining 37.5% share was held by The M. A. Hanna Co. (formerly Hanna Mining Co.), which managed the project. With the closure of Butler Taconite, Hanna no longer has ownership in any operating U.S. iron mine. As recently as 1980, Hanna was among the leading iron ore producers and merchants in the United States. However, the company continues to manage the National Steel Pellet Co. project at Keewatin, MN. Hanna is also manager and a major shareholder of the Iron Ore Co. of Canada, the largest iron ore producer in Canada, as well as a major shareholder in Minerações Brasileiras Reunidas S.A.

(MBR), the second largest iron ore producer in Brazil.

Minnesota produced 72% of the national output of usable ore in 1985. Production of pellets totaled 33.4 million tons, equivalent to about 53% of installed production capacity of the State's eight taconite plants. The remainder of the output consisted of hematite concentrates produced from "natural" ores by LTV Steel Co. and Rhude & Fryberger Inc. Pittsburgh Pacific Co. shipped 29,000 tons of concentrates recovered from stockpiled ores. All of the taconite plants were operated in 1985 but most were idle for part of the year.

National Steel Pellet was operated throughout the year, except for a 21 day period in April and produced 4.4 million tons of pellets, a level slightly lower than that of 1984. However, in mid-December, the company announced that it would close for a total of 3 months in 1986 because of a planned cutback to 4.0 million tons.

Butler Taconite was operated from March 4 until June 29, when it was permanently closed. During the 4-month period, the operation produced about 960,000 tons of pellets. Approximately 450 employees were affected by the closure.

Reserve Mining Co., a joint venture of Armco Inc. and LTV Steel, recalled an additional 145 employees on January 6 and restarted the second of eight pelletizing lines at its Silver Bay plant. Ore was provided by the Peter Mitchell Mine at Babbitt. The company had been operating only one of its lines since September 1984 when production was cut and 200 employees were laid off. Both lines remained in operation until June 30, when Reserve shut down both Silver Bay and Babbitt for 4 weeks and temporarily laid off 1,000 employees. The company produced only 3.2 million tons during the year, slightly less than 33% of capacity.

Erie Mining Co. resumed production of pellets at Hoyt Lakes on March 3, after a 3-month shutdown, and produced 5.0 million tons before being shut down again on November 30.

Hibbing Taconite Co. was operated from March 17 to October 26 and produced 5.1 million tons of pellets, about 18% less than in 1984.

The Minntac facility of United States Steel Corp. was operated from January 13 to June 30 and from July 28 to December 1, producing about 9.9 million tons of pellets or 53% of installed capacity. The pelletizing

plant operated only three of its seven production lines, as in 1984. The work force varied from 1,450 to 1,700 and was somewhat smaller than before owing to streamlined operations.

Oglebay Norton Co. suspended production at Eveleth Mines on June 30 for 15 weeks because of reduced demand for pellets. Only 735 of the 750 laidoff workers were recalled when operations were resumed on October 13. Because of the summer shutdown, Eveleth produced only 3.0 million tons, 50% of capacity. A 380,000-ton production run was made at Eveleth Mines' Fairlane plant using the organic compound "Peridur" as a substitute pellet binder. These lower silica pellets were used by two of the operation's partners in closely monitored blast furnace trials with encouraging results.

The Minorca Mine of Inland Steel Mining Co. was operated from February 24 to June 29 and from August 4 to November 16, producing 1.9 million tons of pellets. Approximately 405 workers were laid off when the mine and pelletizing facilities were temporarily shut down in November. The shutdown was triggered by cutbacks in steel production at Inland Steel's Indiana Harbor Works, which uses Minorca pellets exclusively. Only five of the nine blast furnaces at Indiana Harbor were running at the end of December.

More than 4,500 employees were out of work in Minnesota at yearend as a result of the permanent closure of Butler Taconite and the temporary shutdowns in the fourth quarter of four other taconite plants.

Michigan produced 26% of the national output of usable ore in 1985. Production consisted entirely of pellets produced from ores mined at the Empire and Tilden Mines in Marquette County. Both mining ventures are managed and partially owned by the Cleveland-Cliffs Iron Co. (CCI). The company's wholly owned Republic Mine remained idle throughout the year. Production of pellets totaled 12.5 million tons, of which 6.9 million tons was produced at the Empire plant and 5.6 million tons was produced at Tilden. The Empire facility was operated all year except for a 7-week period between September 1 and October 20 and produced at 86% capacity. The average operating rate at Tilden was only 70%. CCI was forced to suspend all operations at the Tilden Mine and temporarily lay off 850 employees after a fire extensively damaged the mine's main conveyor system on June 12. On July 7, 300 workers were called back and assigned to

stripping operations and maintenance. Full operations were resumed on July 29.

In Missouri, Pea Ridge Iron Ore Co. produced about 1.1 million tons of iron ore products, including 1.03 million tons of self-fluxing olivine pellets, from magnetite ore produced at its underground mine near Sullivan. The mine and plant, wholly owned by St. Joe Minerals Corp., were operated throughout 1985.

In Wyoming, Universal Equipment Co.

purchased the Atlantic City iron mine from U.S. Steel. The sale included iron ore processing facilities, mining equipment, water rights, and a 76-mile railroad line from the mine to Winton Junction near Rock Springs. Universal Equipment will mine the site for road construction materials. U.S. Steel halted mining operations at Atlantic City in October 1983 and officially closed the mine on April 1, 1984.

## CONSUMPTION AND USES

Consumption of iron ore was about 3% less than that of 1984, owing to decreased demand from the iron and steel industry. Consumption for ironmaking and steelmaking totaled about 63.7 million tons, including 54.7 million tons in blast furnaces, 8.3 million tons in sintering plants, 0.2 million tons each in steelmaking furnaces and for production of direct-reduced iron (DRI), and 0.3 million tons for miscellaneous and unspecified purposes. Consumption of iron ore for manufacture of cement, heavy-medium materials, pigments, and miscellaneous products was approximately 1.2 million tons.

In the iron and steel industry, monthly consumption of ore averaged 5.3 million tons, compared with 5.5 million tons in 1984. The decrease in consumption occurred mainly in the first half of the year. Between January 31 and June 30, the number of operating blast furnaces actually increased from 49 to 53 to meet the traditional seasonal increase in demand for pig iron. Monthly consumption during the 6 months averaged 5.5 million tons and reached a peak of 6.0 million tons in May. In June, however, demand for ore began to slide. By September, monthly consumption had fallen to 4.9

million tons and remained low for the rest of the year. Consumption of ore for the second half averaged 5.1 million tons, with only 43 blast furnaces operating at the end of October. During the last 2 months of 1985, 4 additional blast furnaces were brought on-line, bringing the total at yearend up to 47.

Consumption of iron ore and agglomerates reported by integrated producers of iron and steel totaled 69.4 million tons, including 50.8 million tons of pellets, 16.5 million tons of sinter, and 2.1 million tons of natural coarse ore. Of the primary ore consumed, an estimated 72% was of domestic origin, 14% came from Canada, and 14% came from other countries.

Estimated consumption of other materials in sintering plants included 3.0 million tons of mill scale, 1.4 million tons of flue dust, 3.6 million tons of limestone and dolomite, 1.3 million tons of slag and slag scrap, and 0.8 million tons of coke breeze. Other iron-bearing materials charged directly to blast furnaces included about 74,000 tons of manganiferous iron ore, 1.2 million tons of steel-furnace slag, 0.3 million tons of mill scale, and 1.0 million tons of slag scrap.

## STOCKS

Stocks of iron ore and agglomerates reported at U.S. mines, docks, and consuming plants at yearend continued to decline in 1985 and were at their lowest level in more than 30 years. The decline of 8% in total stocks from that of 1984 was due primarily to a reduction of stocks of imported ore at U.S. docks and furnace yards. Stocks reported at these facilities at yearend included 18.5 million tons of domestic ores, 3.0 million tons of Canadian ores, and 2.2

million tons of other foreign ores. Mine stocks at yearend were about 13% higher than those of 1984, as the quantity of ore shipped from most Minnesota mines was less than production.

End-of-month stocks reported at mines peaked at 13.4 million tons in April and declined to 6.0 million tons at yearend, while stocks of ore reported at consuming plants ranged from a low of 13.8 million tons in March to a high of 21.3 million tons

in December. As in previous years, these variations were principally caused by the seasonal nature of ore shipping on the Great Lakes.

Stocks of unagglomerated concentrates reported at pelletizing plants totaled 331,000 tons at yearend. This material is not included in mine stocks of usable ore re-

ported in the accompanying tables because it is considered an intermediate product. Also, mine stock data after 1983 do not include byproduct ore, owing to the change in classification reported in this publication in 1983; data for previous years remain unchanged to avoid disclosing company proprietary information.

## TRANSPORTATION

Vessel shipments of iron ore from U.S. ports on the upper Great Lakes totaled 44.2 million tons, about 4% less than those of 1984. Nearly 90% was destined for U.S. consumers and the rest was destined for Canada. Shipments of iron ore through the St. Lawrence Seaway to U.S. ports on the Great Lakes totaled approximately 4.8 million tons and accounted for about 30% of U.S. imports. The balance of imports, about 11.0 million tons, was shipped through ports on the east and gulf coasts.

Ore shipments from four of the seven U.S. ports on the upper Great Lakes declined from the levels of 1984, with the largest decrease at Superior, WI. Shipments from Two Harbors, Taconite Harbor, and Marquette increased. Tonnage shipped from each port in 1985 was as follows:

Port	Date of first shipment	Date of last shipment	Total tonnage (thousand long tons)
Duluth, MN	Apr. 2	Dec. 15	6,133
Two Harbors, MN	Apr. 3	Dec. 21	8,719
Silver Bay, MN	Apr. 7	Dec. 14	3,426
Taconite Harbor, MN	Apr. 5	Dec. 21	4,972
Superior, WI	Apr. 5	Dec. 22	8,506
Marquette, MI	Apr. 3	Jan. 4	5,071
Escanaba, MI	Mar. 28	Dec. 26	7,385
Total			44,212

Source: Lake Carriers Association, 1985 Annual Report.

The number of vessel shipments from all seven ports totaled 1,283, indicating an average cargo of 34,460 tons. Individual cargoes of 60,000 tons or more were loaded at six of the ports during the year, although the average shipment from individual ports ranged from 24,264 tons at Marquette to 60,107 tons at Silver Bay. Relatively high water levels in Lakes Michigan and Superior permitted record loadings of iron ore at Escanaba and Silver Bay. The largest cargo shipped during the year was 69,701 tons,

an all-time high for the Great Lakes, loaded on Bethlehem Steel Corp.'s 1,000-foot carrier *Lewis Wilson Foy* at Escanaba for delivery to Indiana Harbor. A record high cargo of 64,188 tons was loaded on Oglebay Norton's *Columbia Star* at Silver Bay for transit through the Soo Locks to Toledo, OH. Previous records were about 68,000 tons at Escanaba and 63,000 tons at Silver Bay, both set in 1983.

Lake freight rates for iron ore, in effect since April 1984, were as follows, per ton: from the Head of the Lakes to lower lake ports, \$7.41; from Marquette to lower lake ports, \$6.11; from Escanaba to Lake Erie ports, \$5.64; and from Escanaba to lower Lake Michigan ports, \$4.45.

Published bulk vessel freight rates from the Gulf of St. Lawrence to Lake Erie and Lake Michigan were \$5.00 and \$7.00 per ton, respectively. Freight rates for self-unloading vessels were \$1.50 per ton higher. These rates may include toll charges on the St. Lawrence Seaway, which amount to about \$1.24 per ton.

The collapse of a 150-foot section of the west wall of Lock 7 in the Welland Canal blocked shipping on the St. Lawrence Seaway between Lakes Erie and Ontario from October 14 to November 7. By the time repairs were made and the lock was reopened, 118 vessels were waiting for transit, including 12 carrying iron ore from eastern Canada to U.S. lake ports. Although the closure did not cause significant shortages of iron ore at U.S. blast furnaces, and all waiting vessels were locked through by November 12, the delay called attention to the vulnerability of Seaway shipping to damage or obstruction of each of the many locks, bridges, or narrow channels that control navigation along the 1,340-mile route between Duluth and Montreal.

The principal issues concerning U.S. lake shipping in 1985 were proposed construction of a second Poe-class lock at Sault Ste. Marie, and proposed taxes (user charges) on shippers to recover the costs of operation

and maintenance of shipping facilities and most of the costs of new construction, which historically have been paid by the Federal Government.

As a result of the construction of 13 self-unloaders with a length of at least 1,000 feet in the last 14 years, and the retirement of smaller vessels, about one-third of the vessels in the U.S. Great Lakes fleet (comprising more than one-half of the fleet's carrying capacity) must use the Poe Lock to transit the St. Mary's River Canal. A malfunction of this lock could seriously disrupt lake shipping and increase costs. The cost of converting the aging and narrow Sabin and Davis Locks into a new Poe-sized lock was estimated to be \$227 million. The U.S. Army Corps of Engineers, which has studied the problem for many years, issued a feasibility report on March 29 recommending construction of a second lock that could accommodate all vessel sizes in the fleet.

Although the Lake Carriers' Association advocated construction of the new lock at Sault Ste. Marie, it was opposed to the imposition of user charges. The Office of Management and Budget has proposed that the Congress levy both Port User Charges and U.S. Coast Guard User Charges. The port tax would be used to defray the costs of channel dredging and other harbor maintenance, while the Coast Guard tax would help pay for icebreaking, navigational aids, and vessel documentation. The proposed port tax alone could cost lake shippers more than \$4 million annually; charges for new construction would greatly increase this figure. According to the Association, taxes of this magnitude would be an unfair burden on the lake shipping industry. Although the Association remains adamantly opposed to the proposed Coast Guard tax, it has reluctantly agreed to work with the Congress and the Administration to develop an equitable port charge in the form of an ad valorem tax on cargo that would be assessed only once and paid by the shipper. Proponents of the user charges feel that costs of shipping facilities should be largely borne by the shippers instead of by the Federal Government.

Published railway freight rates for pellets from mines to upper lake shipping ports increased in Minnesota in 1985 but were essentially unchanged in Michigan, compared with rates in late 1984. On April 1, the rate for pellets from the western Mesabi Range to the Allouez docks at Superior, WI, was raised from \$4.87 to \$4.96 per ton. On June 3, the rate was increased an additional \$0.03 to \$4.99. For pellets from the Marquette Range of Michigan, the rates to Presque Isle and Escanaba were \$2.40 and \$2.68 per ton, respectively. Dock charges at Duluth, Superior, and Escanaba ranged from 64 to 92 cents per ton. At Lake Erie ports, ore transfer charges from rail-of-vessel or dock receiving area direct into railway cars ranged from about \$0.96 to \$1.15 per ton, up slightly from those of 1984. Most rail rates from lower lake ports to consuming districts were also unchanged; the volume rate from Lake Erie ports to the Pittsburgh and Wheeling districts was \$10.16 per ton. Single-car rates for ore imported through east coast ports to inland consuming points were mostly unchanged. The rate to Pittsburgh from Baltimore and Philadelphia remained at \$14.93 per ton. All-rail rates from mines to consuming points rose in several instances. However, the volume rates to Granite City, IL, from the Mesabi Range and from Pea Ridge, MO, were unchanged at \$18.82 and \$6.41 per ton, respectively. The published volume rate to Geneva, UT, from the Mesabi Range was \$41.03 per ton. All-rail shipments of pellets from Minnesota by the Duluth, Missabe and Iron Range Railway and connecting lines totaled 1.5 million tons; the greater part of this tonnage was shipped to Geneva, UT, from the Minntac plant.

Published nominal ocean freight rates for iron ore from eastern Canada to U.S. east coast ports were \$3.50 to \$3.75 per ton, but spot rates quoted for cargoes of 50,000 to 60,000 tons ranged from \$1.85 to \$3.80 per ton. A few shipments reported from Brazil to east coast ports indicated freight rates of \$4.50 to \$5.50 per ton.

## PRICES

Producers' published prices for Lake Superior iron ores in the first 7 months of 1985 were unchanged from those quoted in August 1983. The pellet prices thus ranged from 80.5 cents to 86.9 cents per long ton

unit (ltu) of iron, natural, delivered rail-of-vessel at lower lake ports, with the lower price quoted by Pickands Mather & Co. and the higher price quoted by CCI, Hanna, Oglebay Norton, and U.S. Steel. The range

in unit price was equivalent to approximately \$50.71 to \$54.75 per long ton of pellets containing 63% iron.

Late in 1984, Mineral Services Inc. (MSI) of Cleveland, OH, began offering pellets at a published price of 66 cents per ton, on the same basis as the producers' prices. Although the source of pellets was not identified, the company said that at least 2 million tons per year would be available. This was the first time that a nonproducer had publicly quoted a price for Lake Superior pellets since commercial pellet production began in the district in 1955. The MSI price was equivalent to about \$41.58 per ton of pellets containing 63% iron.

On August 1, 1985, Pickands Mather effectively lowered its pellet price while changing its price base from the traditional "lower lake port" to "upper lake port," thus transferring charges for lake freight and some handling operations to the buyer. The new quotation was 59.4 cents per ton of iron, natural, delivered to hold of vessel at upper lake port. Although not specified by the company, the net reduction in price appeared to be about 12%, taking into account published lake freight rates and unloading charges. Inland Steel Mining later adopted the new price base and began quoting an identical price.

On August 16, U.S. Steel switched its price base from natural ltu to dry ltu. The new, effectively lower, price of Minntac pellets was 72.5 cents per dry ltu of iron, delivered rail-of-vessel at lower lake ports. Three weeks later, on September 1, MSI lowered its pellet price from 66 cents to 58 cents per natural ltu of iron, delivered at lower lake ports. At yearend, there were at least three different published price bases being used by Lake Superior producers. The range of prices was approximately equivalent to \$37.12 to \$55.62 per ton of pellets containing 64% iron, delivered rail-of-vessel at lower lake ports. The departures from traditional pricing and individual price cuts were believed to reflect declining produc-

tion costs as well as increasing competition between domestic and foreign producers in the U.S. market.

Published prices for other Lake Superior ores, per ton, basis 51.5% iron, natural, delivered rail-of-vessel at lower lake ports, remained as follows: Mesabi non-Bessemer ore, \$30.03 for coarse ore and \$31.53 for fines; and manganiferous ore, \$32.78. CCI continued to quote a price of \$28.75 for Old Range non-Bessemer ore, based on rail and lake freight rates and handling charges in effect on April 27, 1981. These prices were not very significant because most Mesabi non-Bessemer ore was produced and consumed by LTV Steel, and little or none of the other grades of ore was produced. Pellets made up more than 98% of ore shipped from the Lake Superior district.

Prices for most Canadian and other foreign ores marketed in the United States were not available. The published price of Wabush pellets, f.o.b. Pointe Noire, Quebec, remained at 63.5 cents per ton. The average f.o.b. value of all Canadian ores imported by the United States, as determined from data compiled by the Bureau of Census, was \$38.01 per long ton. Data from this source indicated average f.o.b. values of \$14.05 per ton for Liberian ores and \$19.42 per ton for Brazilian ores. Other sources indicated that most imported Canadian ore consisted of pellets; Liberian ores consisted of fines and washed lumpy ore; and about two-thirds of the ore imported from Brazil consisted of pellets. F.o.b. value data for Venezuelan ores were not determinable, because much of the ore was apparently valued on a c.i.f. basis.

Published f.o.b. prices for DRI were also unchanged from those quoted in 1984, and were as follows, per metric ton: at Georgetown, SC, \$125 to \$135; at Contrecoeur, Quebec, \$115; and at Point Lisas, Trinidad, \$120. The apparent f.o.b. value of some shipments of DRI imported from Venezuela ranged from about \$75 to \$102 per long ton.

## FOREIGN TRADE

U.S. exports of iron ore were only slightly higher than those of 1984, because of a leveling off of demand from the Canadian steel industry. Virtually all exports consisted of pellets shipped via the Great Lakes to Canadian steel companies that are partners in U.S. taconite projects in Minnesota and Michigan. Consumption of iron ore at Cana-

dian blast furnaces totaled 13.3 million tons, an amount identical to that of 1984.

U.S. imports of iron ore decreased 8% in 1985, partially reversing the 1984 gain of 30%. Tonnage decreased by 1.4 million tons compared with that of 1984. A sharp decline of ore imports into the Cleveland and Baltimore customs districts accounted for essen-



tially all of the decrease. Imports from Canada fell 24% from the 1984 level, but still accounted for more than one-half of total U.S. imports. Imports from Liberia and Venezuela rose 26% and 36%, respectively, while those from Brazil were unchanged. Brazil, the next largest supplier after Canada, retained its 16% share of U.S. imports.

On December 20, 1984, Pickands Mather, Oglebay Norton, CCI, and the United Steelworkers of America petitioned the U.S. International Trade Commission (ITC) for countervailing duties on imports of iron ore pellets from Brazil. The petitioners said that subsidies granted by the Brazilian Government allow Brazilian pellets to be delivered to U.S. consumers for at least 30% less than pellets produced in the United States, causing injury to the U.S. iron ore industry and particularly to U.S. merchant producers. Cia. Vale do Rio Doce (CVRD), through its U.S. subsidiary, Rio Doce America Inc., responded for Brazil.

U.S. imports of iron ore from Brazil in 1984 totaled 2.5 million tons, including an estimated 1.8 million tons of pellets. The pellet imports equaled an estimated 4% of U.S. consumption, but the petitioners stated that this quantity was equivalent to about 30% of the amount available for sale by U.S. merchant producers. CVRD claimed that it did not need subsidies to compete in the U.S. market because the high grade of its ore allowed pellets to be made in Brazil for about \$20 per ton less than what it cost U.S. producers. CVRD also stated that 75% of its 1984 pellet sales in the United States were under long-term contracts to U.S. Steel and Armco, and that about one-half of

the remainder was sold in areas of the United States where U.S. pellets could not compete because of high transportation costs. Armco is the principal shareholder in Eveleth Mines, a Minnesota producer operated by Oglebay Norton. U.S. Steel operates the largest pelletizing facility in Minnesota.

On January 28, 1985, the ITC unanimously agreed there was a reasonable indication that imports of Brazilian pellets were materially injuring U.S. pellet producers. The case was referred to the U.S. Department of Commerce on February 4 for investigation of the alleged subsidies granted to Brazilian producers and for recommendation of a countervailing duty. On March 19, Commerce recommended that an ad valorem duty of 5.15% be imposed on Brazilian pellets. This recommendation automatically returned the case to the ITC for a final decision. However, the countervailing duty investigation was suspended on May 29, following agreement by CVRD and the Government of Brazil to eliminate all benefits determined by Commerce to constitute subsidies on exports of pellets to the United States. The suspension agreement would have eliminated imposition of any countervailing duty, as well as any further action on the matter by Commerce or the ITC.

The countervailing duty investigation was unexpectedly reopened in mid-June at the request of CVRD. On December 18, the Government of Brazil formally notified Commerce of CVRD's withdrawal from the suspension agreement. The trade case was still active at the end of 1985.

## WORLD REVIEW

World production, trade, and consumption of iron ore increased slightly in 1985, compared with the levels of 1984, as output of iron and steel stabilized in most industrialized countries and in many developing countries as well after recovering from the 1982-83 recession. World trade was estimated at 360 million long tons, of which about 85% was oceanborne. Brazil was the leading exporter, followed by Australia, with each country shipping more than 87 million tons to world markets. Japan remained the principal importer, receiving 123 million tons in 1985, while countries of the EC imported about 118 million tons.

World production of pellets was estimated at 195 million tons, about 80% of installed

capacity. Several pelletizing plants were reactivated because of declining fuel costs, while most others operated close to rated capacity owing to relatively improved demand from their principal markets. A new plant was completed in Bahrain, while others were under construction in India, the Republic of South Africa, and Turkey.

World output of DRI was estimated at slightly more than 10.8 million tons, about 51% of installed capacity, as low prices for ferrous scrap continued to limit production. About 51% of the total output was produced in Mexico, Venezuela, and other countries in Latin America. New direct-reduction (DR) plants were completed in Iran, Malaysia, the Republic of South Africa, and the

U.S.S.R., while others were under construction in at least seven countries.

Most negotiations of 1985 iron ore prices under Japanese and Western European contracts with foreign producers were completed by mid-August. Overall, compared with 1984 prices, prices for lump ore and fines increased 1.5% to 6%, while prices for pellets declined slightly. Japanese prices for fines from Canada, Chile, and Peru were unchanged, while prices for Indian ores were increased despite an earlier agreement to maintain them at 1984 levels. Price declines for Peruvian pellets and for South African ores destined for Japan ranged from 4% to nearly 7%, possibly because of the relatively high alkali content of the ores. The price increases for lump ore and fines, which together made up about 85% of Japanese imports, were similar to those

negotiated between producers and Western European buyers earlier in the year. Negotiations in both consuming regions were protracted, as buyers were determined to hold prices down because of the strength of the U.S. dollar (in which prices are quoted), and producers held out for increased prices because of stronger demand, especially for lump ore and pellets. On an f.o.b. (shipping port) basis, most 1985 prices apparently ranged from about \$15 to \$17.50 per long dry ton (ldt) for fines, \$16 to \$20.50 per ldt for lump, and \$22.50 to \$25.50 per ldt for pellets. Delivered prices (at receiving port) were about \$2 to \$9 higher, depending on ocean freight costs. The Japanese contract prices listed below are f.o.b., in U.S. cents per dry ton of iron unless otherwise indicated:

Country and producer	Ore type	Prices	
		FY 1984	FY 1985
<b>Australia:</b>			
Hammersley Iron Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd.	Lump ore	30.87	31.55
Do	Fines	26.67	27.05
Cliffs Robe River Iron Associates	do	23.67	24.05
Savage River Mines Ltd.	Pellets	38.30	37.10
<b>Brazil:</b>			
Cia. Vale do Rio Doce and Minerações Brasileiras Reunidas S.A.	Lump ore	24.27	24.65
Minerações Brasileiras Reunidas S.A.	Fines	24.94	25.33
Samarco Mineração S.A.	Pellet fines	20.25	20.46
Cia. Nipo-Brasileira de Pelotização (Nibrasco).	Pellets	37.31	36.25
Canada: Iron Ore Company of Canada (Carroll Lake).	Fines	23.37	23.37
Chile: Cia. Minera del Pacifico S.A. (El Algarrobo).	Pellets	38.80	37.60
<b>India:</b>			
Minerals and Metals Trading Corp. (Bailadila).	Lump ore	30.06	30.73
Do	Fines	25.86	26.23
Liberia: LAMCO Joint Venture Operating Co	do	22.20	23.30
Peru: Empresa Minera del Hierro del Perú S.A.	Pellets	30.80	29.50
<b>South Africa, Republic of:</b>			
South African Iron and Steel Industrial Corp. Ltd.	Lump ore	<sup>1</sup> 27.19	<sup>1</sup> 25.86
Do	Fines	<sup>1</sup> 23.89	<sup>1</sup> 22.26

<sup>1</sup>Price per dry metric ton unit.

Source: TEX Report (Tokyo), v. 17, Nos. 4009 and 4013, Aug. 2, and 9, 1985.

**Australia.**—Shipments of iron ore by Australian producers in 1985 totaled about 94 million tons, including 87 million tons for export and 7 million tons for domestic consumption. Actual exports totaled about 84 million tons, of which 82% was destined for Japan and other Asian countries and 18% was destined for Western Europe. Exports consisted of about 58% sinter fines, 39% lump ore, and 3% pellets. Shipments by individual producers follow, in million tons: Hammersley Iron Pty. Ltd., 38.6; Mount

Newman Mining Co. Pty. Ltd., 28.5; Cliffs Robe River Iron Associates, 14.9; The Broken Hill Pty. Co. Ltd. (BHP), 5.2; Goldsworthy Mining Ltd., 4.5; and Savage River Mines Ltd., 2.6.

In June, Mount Isa Mines Holdings Ltd. completed the sale of its 20% interest in Goldsworthy Mining to Renison Gold Fields Ltd., one of its partners in the venture. As a result of this sale, ownership will be shared between Renison Gold Fields (58.3%) and BHP (41.7%). Goldsworthy Mining operates

the Shay Gap and Sunrise Hill iron mines in the Pilbara region of Western Australia. The company recently installed a pilot beneficiation plant at its Mount Goldsworthy Mine, where mining was suspended in December 1982, to test the feasibility of upgrading 100 million tons of marginal reserves containing 58.0% to 60.7% iron that occur at five deposits in the area.

In December, BHP Minerals Ltd. acquired the 25% and 30% interests in the Mount Newman Joint Venture held, respectively, by AMAX Iron Ore Corp. and Pilbara Iron Ltd. The two acquisitions raised BHP's equity in the venture from 30% to 85%. The joint venture mines the 1.1-billion-ton Mount Whaleback ore body and the 153-million-ton Marra Mamba No. 29 ore body in the southeastern corner of Western Australia's Hamersley Iron Province. AMAX will no longer act as sales agent outside Australia for Mount Newman and has agreed to transfer this function to BHP as well, effectively withdrawing from the world iron ore market. Earlier in the year, BHP shut down its mine on Cockatoo Island in Yampi Sound, northeast of the Pilbara coast. The mine, which shipped 31 million tons of ore during its 33-year life, will continue to ship stockpiled material over the next 2 years.

**Bahrain.**—The pelletizing plant of Arab Iron & Steel Co. (AISCO) shipped about 700,000 tons of pellets during its first year of operation. The Bahraini facility is the world's first merchant pelletizing plant to be based wholly on imported iron ore. The \$310 million plant, commissioned in November 1984, has a production capacity of 4 million tons of pellets per year and uses a grate-kiln pelletizing system fueled by natural gas from local oilfields. It is a joint venture of Arab organizations and the public sectors of Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates, and was built to produce pellets for DR plants along the Persian Gulf and in Southeast Asia. Difficulty in finding buyers for AISCO's product has forced management to adopt a 30-day-up and 30-day-down production schedule. Saudi Iron & Steel Co. has reportedly placed an order for 60,000 tons to be delivered in 1986 to its DR plant at Jubail. However, the ongoing war between Iran and Iraq has completely disrupted markets in the rest of the region, forcing AISCO to seek out customers in the EC, Turkey, and northern Africa.

**Brazil.**—Shipments of iron ore for export

and domestic consumption rose to record-high levels for the second year in a row. Exports totaled about 91 million tons, 4% more than those of 1984, while net shipments for domestic consumption increased more than 55% to 34 million tons. Exports included about 45 million tons to Europe and 27 million tons to Japan. Total shipments of pellets were estimated at about 20 million tons.

CVRD produced 73.7 million tons of iron ore products and exported 50.6 million tons. CVRD also exported 18.9 million tons for other companies, including about 8.7 million tons of pellets for its joint ventures at Tubarão with Japanese, Italian, and Spanish companies, 7.4 million tons of ore products for Ferteco Mineração S.A., and 2.8 million tons for S.A. Mineração da Trindade (SAMITRI). Most of CVRD's production came from the Caue and Conceição Mines near Itabira. Minas da Serra Geral S.A., owned 51% by CVRD, sold about 10.3 million tons of ore from the Capanema Mine for beneficiation at the Timbopeba plant and shipment to the Tubarão steelworks.

CVRD's huge \$5 billion Carajás project in the State of Pará was more than 80% completed by yearend.<sup>3</sup> The N4E Mine began shipping trial amounts of ore in mid-year, and was scheduled to reach full production capacity of 35 million tons per year, averaging 66.13% iron, in July 1987. About 12 million tons of overburden already had been removed at the N4E project site. The \$1.3 billion, 550-mile-long railroad between the mine and São Luis on the coast of Maranhão was inaugurated on February 28, 1985, with the first cargoes of iron and manganese ores being transshipped to the old port of Itaqui. A total of 539,000 tons of iron ore was exported through Itaqui during the year. The new marine terminal at nearby Ponta da Madeira was almost completed and was scheduled to open in January 1986. The terminal will be able to accommodate vessels with a carrying capacity of 280,000 tons.

MBR, Brazil's second largest producer, shipped 15.1 million tons of ore in 1985, including 13.1 million tons for export. Most of the ore was produced at the Aguas Claras Mine, southeast of Belo Horizonte in the Minas Gerais Iron Ore Quadrangle. Empreendimentos Brasileiros de Mineração S.A. owns 51% of MBR, while Hanna has an indirect interest of 34% through the St. John d'el Rey Mining Co. PLC. Another 5% is indirectly held by Bethlehem Steel.

Ore shipments by other producers, in million tons, follow: Ferteeco (sales), 8.6; SAMITRI, 8.9; Samarco Mineração S.A., 6.7; Cia. Siderúrgica Nacional, 4.8 (estimated); William H. Mueller S.A., 1.1; and Empresa de Mineração Esperança S.A., 0.2.

**Canada.**—Shipments of iron ore products totaled 40.2 million tons, compared with 40.7 million tons in 1984. Exports totaled about 24.7 million tons, of which 57% was destined for EC countries and 29% was destined for the United States. Domestic consumption was estimated at 14.8 million tons.

Shipments of ore by individual producers, in million tons, follow: Iron Ore Co. of Canada, 14.9 including 8.3 of pellets, 4.8 of concentrates, and 1.8 of direct-shipping ore; Quebec Cartier Mining Co., 15.6, including 8.9 of concentrates and 6.7 of pellets; Pickands Mather, 6.0 of pellets including 5.5 from Wabush Mines; Cliffs of Canada Ltd. (for Dofasco Inc.), 2.1 of pellets from the Adams and Sherman Mines; and Inco Ltd., 0.09 of pellets from stockpile. The Algoma Steel Corp. Ltd. shipped 1.4 million tons of superfluxed sinter from Wawa, Ontario, to its steelworks at Sault Ste. Marie. Feed to the sinter plant included 1.6 million tons of siderite ore produced at the MacLeod underground mine.

Stelco Inc. took steps to permanently close its Griffith Mine and pelletizing plant near Red Lake, Ontario. The mine produced only 475,000 tons of pellets, 50% of capacity in 1985 and is operated for Stelco by Pickands Mather.

**China.**—China was expanding the iron and steel complexes at Panzhihua near Dukou in Sichuan Province, Maanshan in Anhui Province, and Handan in Hebei Province as part of its seventh 5-year plan (1986-90). Construction of new steelmaking facilities and modernization of existing plants was in progress at each of three sites and was expected to be completed by 1995. Panzhihua and Maanshan both have their own titaniferous magnetite mines and are major producers of vanadiferous slags that average 17% vanadium pentoxide. The Panzhihua blast furnace operations also produce a titaniferous slag containing 12% to 14% titanium dioxide. This second type of slag is used as feed for the Zunyi titanium sponge plant in Guizhou.

The Panzhihua complex would have an annual production capacity of 2.8 million tons of pig iron when the new 1,350-cubic-meter blast furnace is completed. The pres-

ent plant reportedly was producing 1.5 million tons of pig iron annually with its three existing blast furnaces. The project would include the construction of a new sinter plant, a hot rolling mill, and two coke oven batteries. According to Xinhua, an official Chinese news agency, the Panzhihua deposit contains more than 10 billion tons of iron ore and accounts for 93% of the country's titanium reserves and 87% of its vanadium reserves. An earlier report stated that the iron mine had only 1.03 billion tons of ore grading 33.2% iron, 11.6% titanium dioxide, and 0.3% vanadium pentoxide. The 10-year expansion program was expected to raise raw steel production capacity from 1.75 million metric tons per year to 2.5 million tons per year, making Panzhihua the largest iron and steel center in southwestern China.

A new 2,500-cubic-meter blast furnace and a new sinter plant would also be installed at Maanshan. Existing plans called for the 30% to 50% iron ore at Maanshan to be blended with Australian ore as feed for the new sinter plant. The existing open hearth furnaces were to be replaced by either oxygen converters or electric arc furnaces. One of the first improvements would be the construction of a new oxygen plant for the steel mill. Maanshan has an annual raw steel capacity of 1 million tons and employs 60,000 workers.

**Guinea.**—A recently completed, \$500,000 study to examine the most economical means of developing the Mifergui-Nimba Co. iron deposit found that the deposit would require a \$267 million investment for a 10-million-ton-per-year operation. An 11-mile rail line would be built to haul the ore from its location on the Liberian border to the existing railway of the LAMCO Joint Venture Operating Co. (LJV) inside Liberia. The Guinean ore could then be processed along with LJV's ore and shipped an additional 167 miles to the Liberian Port of Buchanan for export. The port facilities can currently handle vessels with a carrying capacity of 80,000 tons. The results of the study were being reviewed by both the Government of Guinea and the Mifergui-Nimba shareholders. The study was funded by the International Bank for Reconstruction and Development (World Bank) and carried out by Granges International Mining and U.S. Steel. According to the World Bank, a follow-on study was being undertaken to assess the economic viability of the project and the marketability of the ore.

Development of the deposit could extend the life of LJV's Nimba Mine by permitting the company to mix its diminishing, lower grade Liberian ore with the richer Guinean ore. Furthermore, Nigeria, an investor in Mifergui-Nimba, could benefit from access to West African ore that might be more economic because of lower ocean shipping costs.

**Hungary.**—The Ministry of Industry announced that the Rudabanya Mine, near Miskolc in Borsod-Abaúj-Zemplén County, would be closed on January 22, 1986. Production at the country's only active iron mine declined from 434,000 tons in 1983 to 306,000 tons in 1985. The grade of the Rudabanya ore traditionally has been low and reportedly has fallen to a point where beneficiation is no longer economical. The mine has been able to satisfy only a minor part of Hungarian demand.

**India.**—Production, exports, and consumption of iron ore increased in 1985 compared with 1984 levels. Exports totaled 28.4 million tons and domestic consumption was estimated at 13.5 million tons. Exports included 19.2 million tons to Japan, 2.9 million tons to the Republic of Korea, and 2.5 million tons to Romania. Shipments from Goa totaled 13.7 million tons, and shipments from east coast ports by the National Mineral Development Corp. totaled 7.5 million tons.

The 3-million-ton pelletizing plant of Kudremukh Iron Ore Co. Ltd. (KIOC) at the Port of Mangalore was completed in June and was undergoing testing. The plant will receive concentrates through a 42-mile pipeline from the Kudremukh Mines in the Western Ghats. Commissioning was delayed by a miners' strike that lasted from September 3 to November 2. The opening ceremony has been rescheduled for April 1, 1986. The first pellets are to be shipped to Malaysia for feed in DR plants. KIOC shipped about 1.6 million tons of pellet feed in 1985, most of which went to Japan. The company has signed a contract with AISCO to supply 6.5 to 8.3 million tons of concentrates to Bahrain between April 1985 and March 1989.

Minerals and Metals Trading Corp. of India was seeking financial assistance for a \$90 million port expansion and channel dredging project at Paradip. The port would be able to accommodate ships up to 200,000 deadweight tons, compared with the existing limit of 60,000 tons. The project would also increase iron ore handling capacity from the present 2 million tons per year to 6

million tons per year.

**Japan.**—Imports of iron ore decreased to 122.5 million tons from 123.4 million tons in 1984. Production of pig iron, in contrast, rose slightly from 79.1 to 79.3 million tons. The principal suppliers continued to be Australia, Brazil, and India. Consumption of ore was estimated at 130 million tons.

**Liberia.**—Exports of iron ore products totaled 16.1 million tons, of which 81% was destined for the EC and 13% was destined for the United States. Exports included 11.9 million tons of sinter fines, 3.2 million tons of pellets, and 1.0 million tons of lump ore. All of the pellets and slightly more than one-third of the sinter fines were shipped by Bong Mining Co.

Shipments by LJV totaled 8.4 million tons, about 7% less than in 1984. The company planned to resume production near Tokadeh and was seeking loans for the purchase of mining equipment. The main ore body at the Nimba Mine could be exhausted as early as 1989. However, the western concession areas, which include the Tokadeh, Gangra, and Yuelliton ore bodies, have a total reserve of 400 million tons of crude ore, averaging 50.8% iron. Bethlehem Steel sold its 25% interest in LJV to the Government of Liberia in January 1984 and agreed to purchase 2 million tons of ore annually for a period of 3 years.

The National Iron Ore Co. (NIOC) produced only about 211,000 tons of ore products in 1985. The company has had increasing difficulty finding buyers for its ore in recent years. The financial condition of NIOC has continued to deteriorate despite a loan from the World Bank. On April 1, 1985, NIOC closed its mine near the border with Sierra Leone and began winding down operations. Only limited amounts of siliceous fines have been produced since April.

**Malaysia.**—The DR plant of Sabah Gas Industries Sdn. Bhd. (SGI) on Labuan Island was completed in early 1984, but did not go into production until the end of the year because of technical problems in the briquetting plant. Since then, SGI has shipped a total of 30,000 tons of hot-briquetted iron to 30 Indian minimills for evaluation. The SGI operation is somewhat unique because it is the first plant to use a modified version of the Midrex process that permits the hot DRI to be discharged directly into the briquetting machines. At Trengganu, the new DR plant of Perwaja Trengganu Sdn. Bhd. reached full-scale production in March. The company initially was using Brazilian and

Swedish pellets along with high-grade Brazilian lump ore as feed. Designed production capacity of each plant is about 650,000 tons of DRI per year.

**Mauritania.**—Exports of iron ore totaled 9.2 million tons, about 2% less than those of 1984. As in the past 2 years, more than 90% of shipments was destined for EC countries.

The first stage of the Guelbs project was inaugurated in July 1984 and scheduled to reach a production rate of 6 million tons per year by the end of 1987. Mechanical difficulties with a conveyor belt and other ore handling equipment at the mine temporarily delayed the first shipments. Magnetic concentrates were being produced from crude ore mined at El Rhein, about 15 miles north of the Kedia d'Idjil hematite mines. Owing to scarcity of water, the ore was being beneficiated in the dry state, using semiautogenous mills and low-intensity magnetic separators.

**New Zealand.**—New Zealand Steel Mining Ltd. produced 1.9 million dry tons of titaniferous magnetite concentrates at its beach sand operations on the North Island. Shipments of the concentrates, loosely referred to as "iron sand," included exports of about 1.8 million tons to Japan and 201,000 tons to the Woolf Fisher steelworks of the parent company in South Auckland. New Zealand is currently the sole supplier of iron sand to the Japanese steel industry, where it is added to the blast furnace feed to extend the life of the refractories. Three specially equipped Japanese carriers—the *Taharoa Maru* (126,604 deadweight tons), the *Slurry Express* (122,042 deadweight tons), and the *Taharoa Venture* (124,589 deadweight tons)—haul the iron sand to Japan.

**Peru.**—Exports of iron ore by Empresa Minera del Hierro del Perú in 1985 totaled 5.2 million dry tons, of which 44% consisted of sinter fines, 37% consisted of pellets, and the remainder was pellet feed. About 2.0 million tons of products was shipped to the Republic of Korea, and 1.4 million tons was shipped to Japan. All of the material passed through the Port of San Nicolás. An additional 345,000 tons of mostly pellets went to the Chimbote steel mill operated by Empresa Siderúrgica del Perú.

**South Africa, Republic of.**—Production and exports of iron declined slightly from 1984 levels. Production totaled 24.0 million tons, compared with 24.3 million tons in 1984. Exports totaled 10.0 million tons, mostly to Japan and the EC. Domestic sales

were 10.4 million tons, as production of pig iron increased 21% and output of DRI jumped to 405,000 tons. All four of the new Lurgi DR rotary kilns at the Vanderbijlpark steelworks of South African Iron and Steel Industrial Corp. Ltd. (Isacor) were in operation at the beginning of 1985. The units have a total design capacity of 709,000 tons of DRI.

Isacor was supplied with 8.4 million tons of ore products from the Sishen Mine and 2.3 million tons from the Thabazimbi Mine. An additional 8.71 million tons was exported from the Sishen Mine through Saldanha Bay. Increased freight charges on the railway from Sishen to Saldanha Bay, reduced ore prices, and nonrenewal of several sales contracts in Western Europe had made exports of ore products increasingly unprofitable. However, the decline of the rand against the dollar and the adoption of certain rationalization measures by Isacor improved the company's position. On September 7, the company exported its 100 millionth ton of ore from Saldanha Bay. At the Sishen Mine, the South Plant, which accounts for one-third of the mine's production capacity of 27 million tons per year, was reopened in the second quarter at a reduced rate. At midyear, the North Plant was operating at full capacity. The life of the Thabazimbi Mine has been extended by the discovery of a minable ore body west of the Donkerpoort open pit. At Isacor's Pretoria Works, workers began constructing the foundations for a 300,000-ton-per-year iron-making plant. The new plant will utilize the KR—Kohle reduktion (coal reduction)—process developed by Korf Engineering GmbH in Austria and the Federal Republic of Germany.

**Spain.**—Production of iron ore products in 1985 included a record high 3.7 million tons by Cía. Andaluza de Minas S.A. (CAM); 1.3 million tons by the Agruminsa subsidiary of Altos Hornos de Vizcaya S.A. (AHV); and 1.2 million tons by Cía. Minera de Sierra Menera S.A. CAM's production, consisting of sinter fines, came from the Marquesado Mine at Alquife. Agruminsa's production included siderite concentrates from ore mined underground at Bodovalle as well as oxide ores from four other locations in Spain. In September, Agruminsa closed its Gallarta Mine near Bodovalle for at least 6 months to reduce stocks of sinter feed from 1.1 million tons to 400,000 tons. The Gal-

larta ores traditionally have been shipped to AHV's sinter plant at Sestao. However, renovation of the No. 2A blast furnace at the Sestao steelworks temporarily reduced demand for the mine's product.

Spanish exports of iron ore totaled 2.0 million tons, of which CAM shipped 1.8 million tons from the Port of Almeria; most of the remainder was shipped from Sagunto by the Sierra Menera company. Imports totaled 4.9 million tons, of which 60% came from Brazil.

**Sweden.**—Production and exports of iron ore products increased by 28% and 5%, respectively, from 1984 levels. Exports totaled 18.4 million tons including 5.5 million tons of pellets. About 3.8 million tons was shipped for domestic consumption. Stocks of iron ore were reduced by 0.9 million tons, to 3.6 million tons at yearend.

Luossavaara-Kiirunavaara AB (LKAB) produced 17.6 million tons including 8.6 million tons of pellets. Of the company's output, 52% was produced at Kiruna, 34% was produced at Malmberget, and the rest was produced at the Svappavaara pelletizing plant, which resumed production in November 1984. Shipments totaled 18.6 million tons, mostly for export. LKAB increased the capacity of its pelletizing plant at Kiruna to 4 million tons per year, and a steel-belt pelletizing plant began production at Malmberget in late 1985.

Svenskt Stål AB produced 1.9 million tons of concentrates at Grangesberg, including 1 million tons of granulated sinter feed, and produced 500,000 tons of ore products at the Dannemora Mine. These production levels were almost identical to those of 1984. Combined shipments totaled 3.1 million tons including 1.9 million tons for export.

**U.S.S.R.**—Soviet exports were estimated at 45.0 million tons. According to the Association of Iron Ore Exporting Countries, exports in 1984 totaled 45.2 million tons, of which 10.5 million tons were pellets and 34.7 million tons were lump ore and other products. The material in the latter category included 10.9 million tons to Poland, 9.4 million tons to Czechoslovakia, 4.3 million tons to Romania, and 3.9 million tons to Hungary.

On June 16, the Soviet Premier and the President of Finland formally inaugurated the third stage of the Kostamush project near Lake Kujto in the Karelia A.S.S.R. The mining complex, begun in late 1977, is designed to produce 9 million tons of nonfluxed pellets per year from 24 million

tons of ferruginous quartzite ores. The project began production in 1982 when the first of three pelletizing plants, each with a capacity of 2.9 million tons per year of pellets, was completed. All three plants were in operation at mid-1985. The bulk of the pellets reportedly were being railed to the new, 5,600-cubic-meter blast furnace of the Cherepovets Iron and Steel Works, while most of the remainder was being exported to the Raahé Steel Works of Rautaruukki Oy in Finland.

The main processing facilities of Kostamush were designed by the Mekhanobr Institute of Leningrad, with supervision from the Giproruda Planning Institute of the Soviet Ministry of Ferrous Metallurgy. Much of the construction and civil engineering work was carried out by a consortium of 15 Finnish companies led by Finn-Stroi Ltd. The ore body, which was discovered in 1945, contains some 2 billion tons of magnetite ore averaging 31% iron. Beneficiation is complicated by the presence of 0.1% to 3% pyrrhotite and other sulfides in the ore. The finished pellets contain 65.6% iron and less than 0.05% sulfur.<sup>4</sup>

In the fall, the second of four Midrex DR modules was commissioned at the Stary Oskol Iron and Steel Works near Kursk. The third module was already under construction and was expected to be operational by mid-1987. When completed, the DR complex, which is operated by Oskolskiy Electro-Metallurgicheskiy Kombinat (OEMK) will have a capacity of 1.7 million tons of DRI. OEMK produced 420,000 tons of DRI in 1985, primarily with the No. 1 module, and now has an existing capacity of 830,000 tons. OEMK also has its own pelletizing plant, which receives concentrates through a 16-mile-long slurry pipeline from the Gubkin Mine and beneficiation plant in the Kursk Magnetic Anomaly. The Gubkin Mine produced 40 million tons of Lake Superior-type ore, averaging 33% iron, in 1984 and has reserves in excess of 35 billion tons.

**Venezuela.**—Shipments of iron ore products by the state-owned CVG Ferrominera Orinoco C.A. totaled 14.5 million tons and included about 8.9 million tons for export. Domestic consumption was estimated at 4.8 million tons.

Ferrominera began production in September at its Cerro San Isidro Mine near Cerro Bolivar. The new mine is linked by an 11-mile railway to the main line between

Cerro Bolivar and the docks at Puerto Ordaz. Ore from the open pit operation, which had a capacity of 5 million tons per year, was scheduled to replace about 45% of the production from the Cerro Bolivar Mine in 1986. To accomplish this, San Isidro's output would be raised to 9 million tons per year. Shipments for the first year totaled about 1.4 million tons. A primary objective of the \$20 million development was to improve the average grade of ore marketed by the company, creating savings in beneficiating costs. San Isidro ore contains about 0.06% phosphorus, compared with 0.11% at Cerro Bolivar, and the iron content of San Isidro ore is reportedly higher than that at Cerro Bolivar. El Pao, Ferrominera's third mine, shipped about 3 million tons in 1985, but its reserves could be exhausted as early as 1991.

Production of DRI in 1985 was 2.6 million tons, of which about 52% was produced by the Midrex process, 38% was produced by the HYL process, and the rest was produced by Fior de Venezuela S.A. Under contract with Ferrominera, Midrex Corp. was study-

ing the feasibility of modifying the high-iron briquet (HIB) reduction plant at Puerto Ordaz to use the Midrex process. The HIB plant, closed since 1982, would primarily use screened lump ore from San Isidro as feed material. The plant belongs to Minerale Ordaz C.A., a subsidiary of Ferrominera.

**Yugoslavia.**—Rudarsko Metalurški Kombinat Zenica commissioned its \$12 million Omarska Mine on November 1. The mine, near Prijedor in Bosnia-Herzegovina, had been under development for 10 years and will permit Yugoslavia to reduce drastically its dependency on imported ore. In recent years, the country has imported from 1.0 to 1.5 million tons of ore and concentrate per year, mainly from Brazil, India, Peru, and the U.S.S.R. Omarska has an initial production goal of only 400,000 tons of concentrates per year containing 53% iron, but is designed to produce 1.7 million tons per year, which will more than compensate for the exhaustion of several smaller operations.

## TECHNOLOGY

Intense competition in iron ore and steel markets and the need to reduce costs continued to stimulate technological improvements in iron ore production and use.

In December, Michigan Technological University (MTU) received a \$5.75 million appropriation from the State of Michigan for construction of a demonstration plant that would test a novel ironmaking operation.<sup>5</sup> The ironmaking operation would integrate two patented technologies. The MTU-PELLETECH or cold-bond agglomeration process first would be used to form pellets from a mixture of iron ore fines, carbon fines, and burnt lime. The carbon-bearing pellets would then be reduced in a hot blast cupola to produce molten iron, using a process developed by Pellet Technology Corp. (PTC). PTC, a partnership between MTU and a Pennsylvania entrepreneur, would be responsible for operating both the 80,000-ton-per-year demonstration MTU-PELLETECH pelletizing plant and the 1-1/2-ton-per-hour PTC hot metal pilot plant. Construction of the new facility, which would cost \$16 to \$20 million in State and private funds, was scheduled to begin in July 1986 at Eagle Mills on the Marquette Range.

The cold-bond agglomeration process has

been under development at MTU since the 1960's. The carbon-bearing pellets made by this process can be used either in a blast furnace to produce conventional pig iron, or in a cupola furnace to produce a variety of reduced iron products. The PTC hot metal process should cut pellet reduction time and furnace fuel costs as well as eliminate the enormous costs of building and maintaining a blast furnace. Relatively small amounts of hot metal could be produced profitably in a scaled-down cupola, an impossibility with a conventional blast furnace. The pellets can be used successfully in the cupola because the carbon fines and burnt lime incorporated into the pellet accelerate the rate of reduction. The carbon fines act as a reducing agent, while the burnt lime serves as a bonding agent. Hot metal costs are reported to be as low as \$100 to \$110 per ton in the PTC process compared with the current \$160 to \$170 per ton for the blast furnace. The MTU pellets can also be fed into rotary kilns to produce DRI. A large variety of iron oxides of varying quality can be utilized for pellet feed, including iron ore concentrates, steel dust from basic oxygen furnaces, mill scale, and blast furnace sludge. Carbon sources can include coke breeze, anthracite, and coal char. Pellet production costs were



expected to be less than those for conventional processes because the pellets are indurated at a lower temperature in less time than in existing pelletizing facilities (i.e., a PTC autoclave would be operated at approximately 390° F compared with 2,400° F for a conventional kiln). Because of the lower temperature of the autoclaving process, the MTU pellets are in the form of magnetite, instead of hematite. This phase phenomenon creates a pellet that has more iron per unit volume and that requires less energy to reduce.

Oxide Recycle Corp. has been designated PTC's exclusive licensee for the North American iron and steel industry. In late 1985, Oxide Recycle began building a PTC hot metal facility in Gary, IN, that would produce iron from steel-plant wastes. This second facility, scheduled for completion by the end of 1987, will have a design capacity of 1.5 million tons per year of molten iron. Production costs would be partially offset by earnings from the waste collection part of the operation. Disposal charges for mill scale, dust, and slag have been running as high as \$150 per ton of waste.

The State of Minnesota, U.S. Steel, and Korf Engineering have applied for nearly \$100 million in Federal grants and loans to demonstrate new ironmaking technology that could make domestic steel more competitive with imports. The funds would be used to finance a plant in northern Minnesota that would produce 360,000 tons of iron per year with less pollution and possibly at lower cost than iron produced by the con-

ventional coke oven and blast furnace process. The plant would be the first in North America to produce iron commercially through the method developed by Korf Engineering. The KR process eliminates the blast furnace in pig iron production by using coal instead of coke, thus avoiding the costs and environmental problems of coke production. The reactions in the process are similar to those in the conventional blast furnace, but they take place in two separate chambers. One contains a fluidized bed where coal is gasified and prereduced iron is melted. The second chamber is a vertical shaft furnace where ore is reduced by gas from the fluidized bed. Korf Engineering, U.S. Steel, and the State of Minnesota submitted the \$94.8 million proposal in February to the U.S. Department of Energy.

Weirton Steel Corp. has also applied to Energy for a \$65 million grant to cover about one-half the cost of building and operating, for 1 year, a similar KR plant. Funds for the other half of the project would be provided by the State of West Virginia and West Virginia coal producers.

<sup>1</sup>Physical scientist, Division of Ferrous Metals. The author was assisted in preparation of this chapter by F. L. Klinger, physical scientist, Division of Ferrous Metals (retired), and William I. Spinrad, Jr., physical scientist, Division of Ferrous Metals (now with the National Park Service, Atlanta, GA).

<sup>2</sup>Unless otherwise specified, the unit of weight used in this chapter is the long ton of 2,240 pounds.

<sup>3</sup>Engineering and Mining Journal. Carajas Iron Ore. V. 136, No. 11, Nov. 1985, pp. 34-42.

<sup>4</sup>Mining Magazine. The Kostomuksha Project. V. 153, No. 3, Sept. 1985, pp. 193-197.

<sup>5</sup>Skullings' Mining Review. Pellet Technology Corp. To Demonstrate New Ironmaking Process at Eagle Mills, MI. V. 75, No. 15, Apr. 12, 1986, pp. 4-6.

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 1985, by district and State

District and State	Average number of employees	Worker hours (thousands)	Production (thousand long tons)		Iron content (natural) percent	Average per worker hour (long tons)	
			Crude ore	Usable ore		Crude ore	Usable ore
Lake Superior:							
Michigan	2,083	3,427	39,656	12,479	64.5	11.28	3.64
Minnesota	5,780	10,020	106,394	34,910	64.2	10.82	3.48
Total or average <sup>1</sup>	7,863	13,447	147,050	47,388	64.3	10.94	3.52
Other States <sup>2</sup>	315	595	2,162	1,363	61.2	3.63	2.29
Grand total or average <sup>2</sup>	8,178	14,042	149,212	48,751	64.2	10.63	3.47

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

<sup>2</sup>Includes California, Colorado, Missouri, Montana, Nevada, and Texas.

**Table 3.—Crude iron ore<sup>1</sup> mined in the United States in 1985,  
by district, State, and mining method**

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

District and State	Number of mines	Open pit	Under- ground	Total quantity
<b>Lake Superior:</b>				
Michigan -----	2	38,656	--	38,656
Minnesota -----	11	108,394	--	108,394
<b>Total</b> -----	<b>13</b>	<b>147,050</b>	<b>--</b>	<b>147,050</b>
<b>Other States:</b>				
Missouri -----	1	--	1,675	1,675
Other <sup>2</sup> -----	6	486	--	486
<b>Total</b> -----	<b>7</b>	<b>486</b>	<b>1,675</b>	<b>2,162</b>
<b>Grand total</b> -----	<b>20</b>	<b>147,536</b>	<b>1,675</b>	<b>149,212</b>

<sup>1</sup>Excludes byproduct ore.<sup>2</sup>Includes California, Colorado, Montana, Nevada, and Texas.<sup>3</sup>Data do not add to total shown because of independent rounding.**Table 4.—Usable iron ore produced in the United States in 1985,  
by district, State, and type of product**

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

District and State	Direct- shipping ore	Concen- trates	Agglomer- ates	Total quantity <sup>1</sup>
<b>Lake Superior:</b>				
Michigan -----	--	--	12,479	12,479
Minnesota -----	--	1,462	33,448	34,910
<b>Total<sup>1</sup></b> -----	<b>--</b>	<b>1,462</b>	<b>45,927</b>	<b>47,388</b>
<b>Other States:</b>				
Missouri -----	--	56	1,044	1,099
Other <sup>2</sup> -----	58	206	--	263
<b>Total<sup>1</sup></b> -----	<b>58</b>	<b>261</b>	<b>1,044</b>	<b>1,363</b>
<b>Grand total<sup>1</sup></b> -----	<b>58</b>	<b>1,723</b>	<b>46,970</b>	<b>48,751</b>

<sup>1</sup>Data may not add to totals shown because of independent rounding.<sup>2</sup>Includes California, Colorado, Montana, Nevada, and Texas.

**Table 5.—Shipments of usable iron ore<sup>1</sup> from mines in the United States in 1985**

(Exclusive of ore containing 5% or more manganese)

District and State	Gross weight of ore shipped (thousand long tons)				Average iron content (natural) percent	Total value (thousand dollars)
	Direct-shipping ore	Concentrates	Agglomerates	Total quantity		
<b>Lake Superior:</b>						
Michigan -----	--	--	12,629	12,629	64.2	W
Minnesota -----	--	1,458	33,519	34,977	63.7	1,430,353
Total reportable -----	--	1,458	46,148	47,606	63.9	1,430,353
<b>Other States:</b>						
Missouri -----	--	56	1,054	1,110	65.9	W
Other <sup>2</sup> -----	60	634	( <sup>3</sup> )	694	55.1	12,997
Total reportable -----	60	690	1,054	1,804	61.8	12,997
Total withheld -----	--	--	--	--	--	633,381
Grand total <sup>4</sup> -----	60	2,148	47,203	49,411	63.8	2,076,730

W Withheld to avoid disclosing company proprietary data; included in "Total withheld."

<sup>1</sup>Includes byproduct ore.<sup>2</sup>Includes California, Colorado, Montana, Nevada, New Mexico, New York, and Texas.<sup>3</sup>Included in concentrates.<sup>4</sup>Data may not add to totals shown because of independent rounding.**Table 6.—Usable iron ore produced in the U.S. Lake Superior district, by range**

(Thousand long tons and exclusive after 1905 of ore containing 5% or more manganese)

Year	Marquette	Menominee	Gogebic	Vermillion	Mesabi	Cuyuna	Spring Valley	Black River Falls	Total <sup>1</sup>
1854-1978 -----	478,058	325,267	320,334	103,528	3,182,512	70,336	8,149	7,221	4,495,401
1979 -----	15,100	2,032	--	--	59,320	--	--	698	77,151
1980 -----	14,450	1,970	--	--	45,162	--	--	699	62,282
1981 -----	15,508	75	--	--	51,025	--	--	854	67,462
1982 -----	6,874	--	--	--	23,898	--	--	241	31,013
1983 -----	9,339	--	--	--	26,255	--	--	--	35,594
1984 -----	12,982	--	--	--	36,697	--	--	--	49,679
1985 -----	12,479	--	--	--	34,910	--	--	--	47,388
Total -----	564,790	329,344	320,334	103,528	3,459,779	70,336	8,149	9,713	4,865,970

<sup>1</sup>Data may not add to totals shown because of independent rounding.**Table 7.—Average analyses of total tonnage<sup>1</sup> of all grades of iron ore shipped from the U.S. Lake Superior district**

Year	Quantity (thousand long tons)	Content (percent) <sup>2</sup>					
		Iron	Phosphorus	Silica	Manganese	Alumina	Moisture
1981 -----	64,925	63.13	0.020	5.70	0.17	0.30	2.59
1982 -----	32,173	63.50	.018	5.40	.13	.31	2.60
1983 -----	42,418	63.32	.018	5.35	.12	.29	2.64
1984 -----	48,613	63.48	.018	5.28	.14	.32	2.66
1985 -----	46,916	63.64	.016	5.17	.11	.29	2.63

<sup>1</sup>Railroad weight—gross tons.<sup>2</sup>Iron and moisture on natural basis; phosphorus, silica, manganese, and alumina on dried basis.

Source: American Iron Ore Association.

**Table 8.—U.S. consumption of iron ore and agglomerates in 1985, by State**  
(Thousand long tons and exclusive of ore containing 5% or more manganese)

State	Iron ore and concentrates <sup>1</sup>		Agglomerates <sup>2</sup>		Miscellaneous <sup>3</sup>	Total reportable
	Blast furnaces	Steel furnaces	Blast furnaces	Steel furnaces		
Alabama, Kentucky, Texas, Utah -----	W	W	7,606	W	W	7,606
Illinois, Indiana, Michigan -----	W	W	31,972	W	W	31,972
Maryland and Pennsylvania -----	995	W	11,885	W	W	12,880
Ohio and West Virginia -----	1,236	W	15,072	W	W	16,308
Undistributed -----	292	119	--	268	1,129	1,808
<b>Total<sup>4</sup> -----</b>	<b>2,524</b>	<b>119</b>	<b>66,535</b>	<b>5268</b>	<b>1,129</b>	<b>70,575</b>

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

<sup>1</sup>Excludes pellets or other agglomerated products.

<sup>2</sup>Includes approximately 42,878 units of pellets produced at U.S. mines and 7,117 units of foreign pellets and other agglomerates.

<sup>3</sup>Includes iron ore consumed in production of cement and iron ore shipped for use in manufacturing paint, ferrites, heavy media, cattle feed, refractory and weighting materials, and for use in lead smelting.

<sup>4</sup>Data may not add to totals shown because of independent rounding.

<sup>5</sup>Includes an estimated 220 units of ore and agglomerates used for production of direct-reduced iron for steelmaking.

**Table 9.—Iron ore consumed in production of sinter at iron and steel plants in the United States in 1985, by State**  
(Thousand long tons)

State	Iron ore consumed <sup>1</sup>	Sinter produced
Indiana, Kentucky, Michigan, and Utah -----	3,779	7,968
Maryland and Pennsylvania -----	3,382	6,333
Ohio and West Virginia -----	1,359	2,236
<b>Total -----</b>	<b>8,520</b>	<b>16,557</b>

<sup>1</sup>Includes domestic and foreign ores.

**Table 10.—U.S. production of iron ore agglomerates,<sup>1</sup> by type**  
(Thousand long tons)

Type	1984	1985
Sinter -----	<sup>2</sup> 16,926	<sup>3</sup> 16,557
Pellets -----	50,083	46,970
<b>Total -----</b>	<b>67,009</b>	<b>63,527</b>

<sup>1</sup>Production at mines and consuming plants.

<sup>2</sup>Includes 7,983 units of self-fluxing sinter.

<sup>3</sup>Includes 7,256 units of self-fluxing sinter.

**Table 11.—U.S. exports of iron ore, by country**  
(Thousand long tons and thousand dollars)

Country	1983		1984		1985	
	Quantity	Value	Quantity	Value	Quantity	Value
Canada -----	3,780	182,490	4,988	238,856	5,033	240,435
India -----	( <sup>1</sup> )	12	( <sup>1</sup> )	2	---	---
Iraq -----	( <sup>1</sup> )	76	---	---	---	---
Mexico -----	( <sup>1</sup> )	4	( <sup>1</sup> )	24	( <sup>1</sup> )	10
Netherlands -----	---	---	3	262	---	---
Saudi Arabia -----	( <sup>1</sup> )	34	---	---	---	---
United Kingdom -----	( <sup>1</sup> )	5	( <sup>1</sup> )	32	---	---
Venezuela -----	( <sup>1</sup> )	10	( <sup>1</sup> )	15	( <sup>1</sup> )	22
Other -----	1	113	1	66	( <sup>1</sup> )	87
<b>Total<sup>2</sup></b> -----	<b>3,781</b>	<b>182,744</b>	<b>4,993</b>	<b>239,257</b>	<b>5,033</b>	<b>240,557</b>

<sup>1</sup>Less than 1/2 unit.

<sup>2</sup>Data may not add to totals shown because of independent rounding.

**Table 12.—U.S. imports for consumption of iron ore, by country**  
(Thousand long tons and thousand dollars)

Country	1983		1984		1985	
	Quantity	Value	Quantity	Value	Quantity	Value
Brazil -----	1,276	30,192	2,533	55,132	2,540	49,322
Canada -----	8,832	339,472	11,190	413,473	8,557	325,245
Chile -----	---	---	---	---	164	2,320
Liberia -----	1,732	31,487	1,745	25,270	2,206	30,987
Peru -----	( <sup>1</sup> )	5	7	76	121	2,722
Sweden -----	68	1,540	84	1,659	65	1,503
Venezuela -----	<sup>2</sup> 1,333	<sup>2</sup> 42,934	<sup>3</sup> 1,524	<sup>3</sup> 31,377	<sup>4</sup> 2,068	<sup>4</sup> 39,369
Other -----	5	102	104	2,078	50	769
<b>Total</b> -----	<b>13,246</b>	<b><sup>5</sup>445,731</b>	<b>17,187</b>	<b>529,065</b>	<b>15,771</b>	<b>452,240</b>

<sup>1</sup>Less than 1/2 unit.

<sup>2</sup>Excludes approximately 82,000 long tons of sponge iron valued at \$6,516,000, originally reported as iron ore.

<sup>3</sup>Excludes approximately 64,000 long tons of sponge iron valued at \$5,016,000, originally reported as iron ore.

<sup>4</sup>Excludes approximately 214,000 long tons of sponge iron valued at \$15,635,828, originally reported as iron ore.

<sup>5</sup>Data do not add to total shown because of independent rounding.

**Table 13.—U.S. imports for consumption of iron ore, by customs district**  
(Thousand long tons and thousand dollars)

Customs district	1983		1984		1985	
	Quantity	Value	Quantity	Value	Quantity	Value
Baltimore -----	3,062	63,216	4,668	133,448	3,673	71,336
Buffalo -----	195	8,862	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	5
Chicago -----	1,625	52,357	2,574	59,705	2,594	58,712
Cleveland -----	4,491	179,771	3,859	136,654	1,646	59,853
Detroit -----	182	4,490	393	12,927	542	19,107
Houston -----	37	1,169	133	2,758	165	2,541
Houston -----	525	25,778	1,548	68,283	2,600	111,772
Mobile -----	573	12,369	643	12,315	878	16,266
New Orleans -----	2,463	93,963	3,250	98,777	3,408	107,029
Philadelphia -----	91	3,768	119	4,198	266	5,620
Other -----	---	---	---	---	---	---
<b>Total<sup>2</sup></b> -----	<b>13,246</b>	<b>445,731</b>	<b>17,187</b>	<b>529,065</b>	<b>15,771</b>	<b>452,240</b>

<sup>1</sup>Less than 1/2 unit.

<sup>2</sup>Data may not add to totals shown because of independent rounding.

Table 14.—Iron ore, iron ore concentrates, and iron ore agglomerates:  
World production, by country<sup>1</sup>  
(Thousand long tons)

Country <sup>2</sup>	Gross weight <sup>3</sup>					Metal content <sup>4</sup>				
	1981	1982	1983	1984 <sup>p</sup>	1985 <sup>e</sup>	1981	1982	1983	1984 <sup>p</sup>	1985 <sup>e</sup>
Albania <sup>e 5</sup>	591	7690	7840	61,063	1,100	197	230	280	7350	370
Algeria	78,426	73,831	3,626	3,606	3,600	1,788	1,915	1,813	1,839	1,840
Argentina	392	578	618	618	620	245	383	384	400	400
Australia	83,324	86,397	69,316	87,564	98,500	52,516	54,688	44,587	55,920	62,500
Austria	3,062	3,277	3,484	3,543	3,520	933	1,028	1,090	1,120	1,020
Brazil	97,928	791,887	87,315	110,287	118,100	68,654	60,070	57,064	71,650	80,300
Bulgaria	1,126	1,327	1,775	2,080	2,070	529	467	545	612	615
Canada <sup>7</sup>	51,164	35,030	32,966	40,416	39,250	32,126	22,279	20,964	25,664	24,730
Chile	78,380	6,368	5,880	7,004	6,407	5,108	3,813	3,545	4,183	6,882
China <sup>e</sup>	65,000	66,000	70,000	74,000	79,000	32,500	34,000	35,000	37,000	39,000
Colombia	426	463	449	434	490	192	209	202	195	220
Czechoslovakia	1,904	1,832	1,873	1,839	1,870	494	475	482	473	480
Denmark	8	8	8	8	8	3	3	3	3	3
Egypt	1,912	2,106	2,188	2,461	2,460	956	1,053	1,094	1,230	1,230
Finland <sup>8</sup>	1,211	1,218	1,257	1,212	1,180	777	774	809	776	740
France	21,257	19,085	15,878	14,605	14,744	6,693	6,088	4,981	4,606	4,580
German Democratic Republic <sup>9</sup>	39	39	39	39	39	20	20	20	20	20
Germany, Federal Republic of <sup>9</sup>	1,547	1,298	961	962	61,018	468	380	275	288	304
Greece <sup>5</sup>	1,252	508	1,322	1,899	1,870	538	218	563	797	790
Hungary	415	460	434	377	310	99	110	104	91	74
India	40,698	40,256	39,187	40,378	43,842	25,479	25,201	23,905	25,276	27,446
Indonesia	86	142	131	82	120	49	82	76	47	40
Iran <sup>e 10</sup>	590	740	840	840	840	360	380	440	440	440
Italy <sup>11</sup>	121	3	3	3	3	1	1	1	1	1
Japan	435	356	293	319	335	270	221	182	199	209
Kenya <sup>12</sup>	4	4	4	4	4	2	2	2	2	2
Korea, North <sup>e</sup>	7,900	7,900	7,900	7,900	7,900	3,200	3,200	3,200	3,200	3,200
Korea, Republic of	585	610	645	615	580	328	342	361	344	280
Liberia	19,393	17,878	14,701	14,862	15,100	12,000	11,062	9,114	9,212	9,330
Luxembourg	422	422	422	422	422	148	148	148	148	148
Malaysia	524	386	112	191	230	320	205	69	117	139
Mauritania <sup>13</sup>	8,567	8,125	7,268	9,377	9,800	5,160	4,675	4,183	5,663	4,900
Mexico <sup>14</sup>	78,573	8,026	7,913	8,186	7,700	5,658	5,297	5,222	5,402	5,087
Morocco	72	220	170	188	188	44	137	104	96	116
New Zealand <sup>15</sup>	3,202	2,747	2,168	2,376	2,400	1,825	1,566	1,298	1,354	1,402
Norway	3,469	3,469	3,469	3,469	3,469	2,643	2,688	2,688	2,688	2,688
Peru	4,973	5,683	4,289	4,012	5,023	3,944	3,151	2,824	2,676	3,360
Philippines	6	6	6	6	6	3	3	3	3	3

See footnotes at end of table.

Table 14.—Iron ore, iron ore concentrates, and iron ore agglomerates:  
World production, by country<sup>1</sup>—Continued

Country <sup>2</sup>	Gross weight <sup>3</sup> (Thousand long tons)						Metal content <sup>4</sup>								
	1981	1982	1983	1984 <sup>P</sup>	1985 <sup>5</sup>	1981	1982	1983	1984 <sup>P</sup>	1985 <sup>5</sup>	1981	1982	1983	1984 <sup>P</sup>	1985 <sup>5</sup>
Poland	103	48	10	11	11	11	29	14			14				63
Portugal <sup>17</sup>	26	27	35		35	36	591	551			551				522
Romania	2,268	2,112	1,956	1,968	2,070	2,070	591	40			40				185
Sierra Leone		165	386	549	295	295	17,837	15,467			15,467				15,941
South Africa, Republic of <sup>18</sup>	27,672	24,166	16,343	24,258	24,008	24,008	4,151	4,065			4,065				3,139
Spain <sup>19</sup>	8,430	8,231	7,331	7,535	6,350	6,350	14,855	10,524			10,524				13,065
Sweden	22,858	15,888	13,003	17,537	20,131	20,131	33	15			15				32
Thailand	61	27	39	60	80	80	209	146			146				163
Tunisia	390	1,271	311	303	304	304	1,562	1,628			1,628				1,638
Turkey	2,889	3,007	3,573	3,985	3,940	3,940	129,001	129,001			129,001				133,160
U.S.S.R.	238,589	240,551	241,328	243,201	244,100	244,100	158	101			101				72
United Kingdom		719	378	397	340	340	46,539	22,542			22,542				31,296
United States <sup>19</sup>	73,174	35,433	37,562	51,269	48,751	48,751	9,477	6,834			6,834				9,450
Venezuela	15,286	11,023	9,562	12,548	15,240	15,240	1,486	1,653			1,653				1,770
Yugoslavia	4,718	5,025	4,939	5,237	5,391	5,391	1,486	1,505			1,505				1,673
Zimbabwe	1,079	824	911	912	915	915	650	492			492				625
Total	844,606	768,011	726,399	817,428	845,251	845,251	487,850	440,581			440,581				492,276

<sup>6</sup>Estimated. <sup>P</sup>Preliminary. <sup>R</sup>Revised.

<sup>7</sup>Table includes data available through Sept. 5, 1986.

<sup>8</sup>In addition to the countries listed, Cuba and Vietnam may produce iron ore, but definitive information on output levels, if any, is not available.

<sup>9</sup>Insofar as availability of sources permits, gross weight data in this table represent the nonmultiplicative sum of marketable direct-shipping iron ores, iron ore concentrates, and iron ore agglomerates produced by each of the listed countries. Concentrates and 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.

<sup>10</sup>Data represent actual reported weight of contained metal or are calculated from reported metal content. Estimated figures are based on latest available iron ore content reported, except for the following countries for which grades are Bureau of Mines estimates: Albania, China, Denmark, Hungary, and North Korea.

<sup>11</sup>Nickeliferous iron ore.

<sup>12</sup>Reported figure.

<sup>13</sup>Series represent gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

<sup>14</sup>Includes magnetite concentrate, pelletized iron oxide (from roasted pyrite), and roasted pyrite (purple ore).

<sup>15</sup>Includes "roasted ore," presumably from pyrite, not separable from available sources.

<sup>16</sup>Year beginning Mar. 21 of that stated.

<sup>17</sup>Excludes iron oxide pellets produced from roasted pyrite.

<sup>18</sup>For cement manufacture.

<sup>19</sup>Gross weight is exported iron ore (Mauritania exports all of its iron ore).

<sup>20</sup>Gross weight calculated from reported iron content based on grade of 66% Fe.

<sup>21</sup>Concentrates from titaniferous magnetite beach sands.

<sup>22</sup>Revised to zero.

<sup>23</sup>Includes manganese iron ore.

<sup>24</sup>Includes magnetite ore as follows, in thousand long tons: 1981—4,175; 1982—4,253; 1983—3,414; 1984—3,780 (revised); and 1985—3,550.

<sup>25</sup>Includes byproduct ore.