Iron and Steel

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DESPITE the 34-day steel strike which started on July 1, domestic production of pig iron and of steel (75.0 and 115.2 million short tons, respectively) was only 1.8 million short tons less for each than in the record year 1955. Except for the months affected by the strike, blast and steel furnaces operated at over 95 percent of capacity—both exceeded 100 percent for 3 months. Record monthly outputs were established in October for steel and in December for pig iron.

There were significant developments in steel research and plant expansion. A large, modern research center at Monroeville, Pa., was completed by United States Steel Corp., and research laboratories were being planned or built by several other steel companies. The steel industry added 5 million tons to its steelmaking capacity and 1.3 million tons to its blast-furnace capacity during 1956 and established new record capacities of 133.5 and 86.8 million tons, respectively. Weirton Steel Co. lit its 600-ton open hearth, the world's largest, and electric-furnace plants were built at Flowood, Miss., and Roanoke, Va. In addition, a number of new furnaces were built or under construction, and others being enlarged at various locations. Following the United States pattern, many foreign countries completed, had under construction, or planned facilities to greatly increase iron and steel output.

Domestic shipments of steel, including exports, in 1956 totaled 83,251,168 short tons, a decrease of 1.5 million from the 1955 total of 84,717,444.

Although the automotive industry was again steel's largest consumer, the quantity of steel was 4.6 million tons less than in 1955. Automotive units produced in 1956 and 1955 were 6.9 and 9.2 million, respectively. All other steel-consuming industries showed a slight increase in receipts except agricultural and ordnance and other direct military applications. Exports of steel totaled 3,622,427 tons—slightly higher than 1955.

Average weekly hours worked per employee in the steel industry during 1956 was 40.4, compared with 40.6 in 1955. The average number of employees for the year was 534,000, compared with 545,000 in 1955, and the average hourly wage was $2.52 in 1956, compared with $2.38 for the previous year. The average value, f. o. b. mill, of all steel products, computed from figures supplied by the Bureau of the Census, United States Department of Commerce, was 7.731 cents per pound in 1956, compared with 7.099 cents per pound in 1955.

[1] Commodity specialist.

TABLE 1.—Salient statistics of iron and steel in the United States, 1947–51 (average) and 1952–56, in short tons

	1947–51 (average)	1952	1953	1954	1955	1956
Pig iron:						
Production	61,300,287	61,308,424	74,853,319	57,947,551	76,848,509	75,030,249
Shipments	61,242,881	61,234,790	74,162,829	57,782,686	77,300,681	75,109,714
Imports	444,598	380,200	589,825	290,716	283,559	326,700
Exports	22,530	14,085	18,837	10,247	34,989	267,175
Steel:[1]						
Production of ingots and castings:						
Open-hearth:						
Basic	80,543,066	82,143,400	99,827,729	80,019,628	104,804,570	102,167,989
Acid	635,290	703,039	646,094	307,866	554,847	672,596
Bessemer	4,369,575	3,523,677	3,855,705	2,548,104	3,319,517	3,227,997
Electric[2]	5,161,797	6,797,923	7,280,191	5,436,054	8,357,151	9,147,567
Total	90,709,728	93,168,039	111,609,719	88,311,652	117,036,085	115,216,149
Capacity, annual, as of Jan. 1	97,043,618	108,587,670	117,547,470	124,330,410	125,828,310	128,363,090
Percent of capacity	93.5	85.8	94.9	71.0	93.0	89.8
Production of alloy steel:						
Stainless	673,316	935,012	1,054,113	852,021	1,222,316	1,255,725
Other	7,427,005	8,199,739	9,274,081	6,340,842	9,437,775	9,072,343
Total	8,100,321	9,134,751	10,328,194	7,192,863	10,660,091	10,328,068
Shipments of steel products:						
For domestic consumption	64,399,021	64,732,412	77,472,162	60,618,843	81,134,367	79,628,741
For export	3,260,087	3,271,200	2,679,731	2,533,883	3,583,077	3,622,427
Total	67,659,108	68,003,612	80,151,893	63,152,726	84,717,444	83,251,168

[1] American Iron and Steel Institute.
[2] Includes a very small quantity of crucible steel and oxygen converter steel for 1954–56.

The average composite price of finished steel, as published by the Iron Age, was 5.358 cents per pound, compared with 4.977 cents in 1955.

PRODUCTION AND SHIPMENTS OF PIG IRON

Domestic production of pig iron, exclusive of ferroalloys, in 1956 was 75.0 million short tons, a 2.4-percent decrease from 1955. Blast furnaces operated at well above 95 percent of capacity, except for the months affected by the steel strike, and exceeded 100-percent capacity for the last 3 months of the year. New monthly records exceeding the 7-million-ton mark were established for pig-iron production in March, October, and December, with an alltime record of 7.25 million tons in December. Despite the steel strike, production exceeded 1955 in California, Utah, Illinois, Michigan, Tennessee, and West Virginia. Pennsylvania and Ohio again ranked first and second in pig-iron production, supplying 27 and 20 percent, respectively, of the total—the same as 1955.

Expansion during the year included a new blast furnace for Granite City Steel and enlargement of two furnaces by Armco Steel Corp. Expansion plans were announced for at least nine other blast-furnace plants, which included construction of new furnaces and the enlargement and modernization of existing furnaces. The Nation's pig-iron output will also increase through the use of more sinter and higher grade foreign iron ores in blast furnaces. In 1956 blast furnaces consumed 752 pounds of sinter and 464 pounds of foreign iron ore per ton

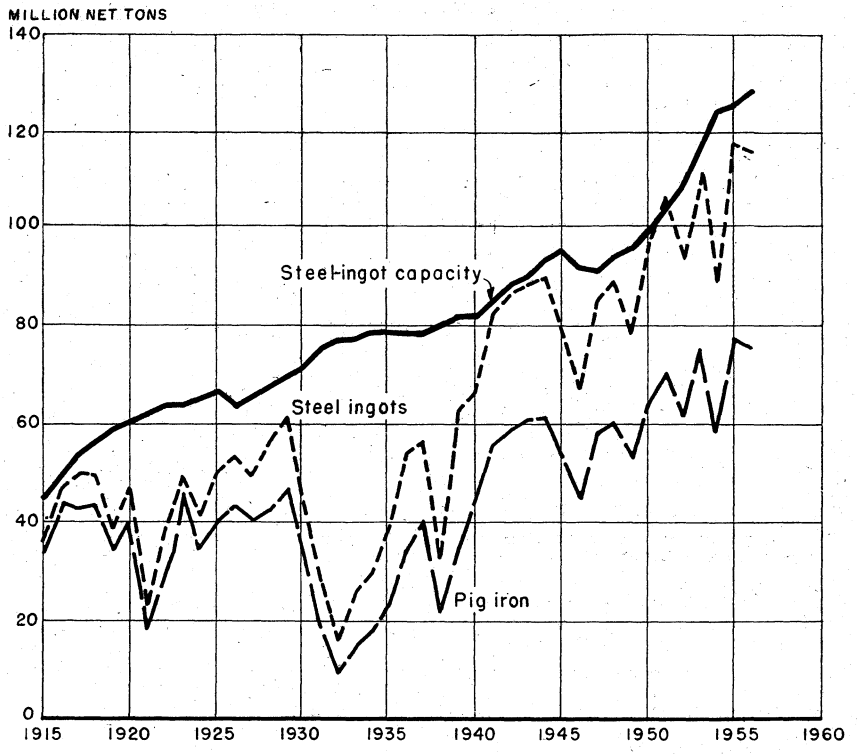

FIGURE 1.—Production of pig iron and steel ingots and steel ingot capacity in United States, 1915–56.

of pig iron, compared with 708 and 421 pounds, respectively, in 1955. Our sintering capacity increased and is expected to reach 63 million tons by the end of 1957—a rise of 66 percent since 1955. Pig-iron production in 1956 required 83,749,365 short tons of domestic iron and manganiferous ores and 17,405,794 tons of foreign ores. Canada, Venezuela, and Peru supplied 47, 37, and 9 percent, respectively, of imports.

Shipments of pig iron decreased 3 percent in quantity, while value increased 3 percent compared with 1955. Data on total shipments, consisting predominantly of molten pig iron transferred to steel furnaces on the site, are given in table 4. Values for merchant pig iron are included; however, the average value per ton of pig iron was lower than market prices published in trade journals because handling charges, selling commissions, freight costs, and other related items were excluded. The term "shipped" as distinguished from "production" refers (as in the case of on-site transfers) to departmental transfers, upon which value was placed for bookkeeping purposes, rather than to actual sales (as in the case of merchant pig iron).

Metalliferous Materials Used.—The production of pig iron in 1956 required 129.3 million short tons of iron ore, sinter, and manganiferous ore; 4.0 million tons of mill cinder and roll scale; 5.7 million tons of open-hearth and Bessemer slags; 3.4 million tons of scrap (purchased

TABLE 2.—Pig iron produced and shipped in the United States, 1955–56, by States

State	Produced		Shipped from furnaces			
			1955		1956	
	1955 (short tons)	1956 (short tons)	Short tons	Value	Short tons	Value
Alabama	4,923,552	4,166,593	4,930,579	$236,105,703	4,326,511	$217,314,687
California	1,122,091	1,409,105	1,111,279		1,393,875	
Colorado						
Texas	3,150,534	3,098,865	3,171,015	220,873,220	3,049,036	223,637,070
Utah						
Illinois	6,489,015	6,515,852	6,466,534	331,126,618	6,537,451	356,432,770
Indiana	8,716,885	8,245,756	8,734,168	443,621,548	8,203,198	435,543,342
Kentucky	817,115	669,483	817,115	(1)	669,483	(1)
Maryland	4,043,401	3,865,214	4,055,413	(1)	3,852,552	(1)
Massachusetts	136,586	64,159	146,690	(1)	89,697	(1)
Michigan	3,294,823	3,352,790	3,345,538	(1)	3,367,323	(1)
Minnesota	708,738	645,730	752,393	(1)	636,758	(1)
New York	5,038,451	4,832,293	5,128,759	264,338,459	4,817,934	262,782,283
Ohio	15,372,349	15,127,518	15,444,439	762,162,095	15,086,354	790,897,903
Pennsylvania	20,788,373	20,618,260	20,949,219	1,074,680,915	20,651,381	1,135,945,127
Tennessee	2,246,596	2,418,631	2,247,540	(1)	2,428,161	(1)
West Virginia						
Undistributed [1]				584,427,329		602,124,174
Total	76,848,509	75,030,249	77,300,681	3,917,335,887	75,109,714	4,024,677,356

[1] Concealed to avoid disclosing individual company operations.

TABLE 3.—Foreign iron ore and manganiferous iron ore consumed in manufacturing pig iron in the United States, 1955–56, by sources of ore, in short tons

Source	1955	1956	Source	1955	1956
Africa	156,911	137,699	Peru	2,009,280	1,548,032
Brazil	58,288	17,583	Sweden	577,056	290,200
Canada	6,755,035	8,196,055	Venezuela	5,640,683	6,482,917
Chile	686,381	188,423	Unclassified	98,984	346,403
Cuba	7,227	74,691			
India	3,573	1,954	Total	16,198,015	17,405,794
Mexico	204,597	121,837			

and home, excluding blast-furnace home scrap), the total scrap charge consisted of 2,212,142 short tons of purchased scrap and 2,090,259 tons of home scrap; and 32,078 tons of other materials—an average of 1.900 tons of metalliferous materials (exclusive of 68,043 tons of flue dust charged directly to blast furnaces) per ton of pig iron. However, 8,183,024 tons of flue dust was used in making sinter. Sinter is utilized in both blast and steelmaking furnaces.

Alabama furnaces consumed hematite from the Birmingham district and Missouri, brown ores from Alabama and Georgia, and byproduct ore from Tennessee; imported iron ores from Brazil, Labrador, Peru, Sweden, and Venezuela; and a small quantity of foreign manganese-bearing ores from Brazil and India.

Blast furnaces at Fontana, Calif., were supplied with iron ore from the Eagle Mountain mine, Riverside County, Calif.

Pueblo, Colo., furnaces (Colorado Fuel & Iron Corp.) used iron ores from Wyoming and Utah.

All iron ores consumed at Sparrows Point, Md., were of foreign origin—from Labrador, Venezuela, Chile, Peru, and Sweden. The manganiferous ore came from Labrador and Egypt.

TABLE 4.—Pig iron shipped from blast furnaces in the United States, 1955–56, by grades [1]

Grade	1955			1956		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Foundry	3,268,468	$159,611,970	$48.83	2,502,265	$129,841,696	$51.89
Basic	64,268,630	3,260,139,719	50.73	62,012,160	3,325,547,674	53.63
Bessemer	5,693,360	288,786,970	50.72	6,625,236	358,447,652	54.10
Low-Phosphorus	280,971	15,657,626	55.73	346,924	20,603,109	59.39
Malleable	3,623,386	184,286,212	50.86	3,471,100	182,801,123	52.66
All other (not ferroalloys)	165,866	8,853,390	53.38	152,029	7,436,102	48.91
Total	77,300,681	3,917,335,887	50.68	75,109,714	4,024,677,356	53.58

[1] Includes pig iron transferred directly to steel furnaces at same site.

The Lake Superior region was the primary source of iron ores for Pennsylvania blast furnaces. The major foreign sources were Venezuela, Peru, Canada, and Sweden; manganiferous ores came from Labrador and Africa.

Blast furnaces in Illinois, Indiana, Ohio, and West Virginia were supplied with iron and manganiferous ores from the Lake Superior region of the United States and Canada. Canadian ore and a small quantity of ore from South America were also used.

The Everett, Mass., blast furnace used iron ore from Newfoundland, Peru, Sweden, and Venezuela and iron and manganiferous ores from Labrador. Less than 10 percent of the iron ore used was of domestic origin.

In New York blast furnaces in the Buffalo district used magnetite from the Mineville area, hematite from Canadian and domestic mines in the Lake Superior region, and iron and manganiferous ores from

TABLE 5.—Number of blast furnaces (including ferroalloy blast furnaces) in the United States, December 31, 1955–56

[American Iron and Steel Institute]

State	Dec. 31, 1955			Dec. 31, 1956		
	In blast	Out of blast	Total	In blast	Out of blast	Total
Alabama	20	1	21	17	4	21
California	3		3	3		3
Colorado	4		4	4		4
Illinois	21	1	22	22		22
Indiana	22	1	23	23		23
Kentucky	3		3	3		3
Maryland	9		9	9		9
Massachusetts		1	1	1		1
Michigan	8		8	8		8
Minnesota	3		3	3		3
New York	16	1	17	16	1	17
Ohio	48	5	53	49	4	53
Pennsylvania	74	4	78	75	3	78
Tennessee	3		3	3		3
Texas	2		2	2		2
Utah	5		5	5		5
Virginia	1		1	1	1	2
West Virginia	5		5	5		5
Total	247	14	261	249	13	262

TABLE 6.—Iron ore and other metallic materials, coke, and fluxes consumed and pig iron produced in the United States, 1955–56, by States, in short tons

State	Metalliferous materials consumed						Net coke	Fluxes	Pig iron produced	Metalliferous materials consumed per ton of pig iron made					Coke and fluxes consumed per ton of pig iron	
	Iron and manganiferous ores		Sinter [1]	Net scrap [2]	Miscellaneous [3]	Total				Ores	Sinter [1]	Net scrap [2]	Miscellaneous [3]	Total	Coke	Fluxes
	Domestic	Foreign														
1955																
Alabama	6,969,971	1,888,279	1,966,917	211,006	61,925	11,098,098	4,828,558	1,734,142	4,923,552	1.799	0.399	0.043	0.013	2.254	0.981	0.352
Illinois	10,505,762	159,332	1,048,087	345,129	912,469	12,970,779	5,637,406	2,366,665	6,489,015	1.644	.161	.053	.141	1.999	.869	.365
Indiana	13,348,592	556,587	2,123,546	99,346	1,336,585	17,464,656	7,424,267	3,116,035	8,716,885	1.595	.244	.011	.153	2.003	.852	.357
Ohio	18,154,115	3,361,585	4,651,900	919,055	2,015,202	29,101,857	13,554,053	6,258,245	15,372,349	1.400	.302	.060	.131	1.893	.882	.407
Pennsylvania	21,458,320	4,086,975	8,993,763	1,187,847	3,131,274	38,858,179	17,710,743	8,496,209	20,788,373	1.229	.433	.057	.150	1.869	.852	.409
California, Colorado, Utah	3,534,887	2,641	2,652,881	65,078	206,631	6,462,118	2,724,984	1,105,955	3,560,789	.993	.745	.018	.058	1.814	.765	.311
Kentucky, Tennessee, Texas	2,018,307	449,763	339,950	164,266	239,496	3,211,782	1,495,188	770,650	1,724,872	1.431	.197	.095	.139	1.862	.867	.447
Maryland, West Virginia	3,075,717	5,241,333	1,816,521	117,957	691,524	10,943,052	5,017,319	1,966,016	6,094,076	1,365	.298	.019	.114	1.796	.823	.323
Michigan, Minnesota	5,828,785	7,862	1,223,687	340,236	262,617	7,663,187	3,480,606	1,727,381	4,003,561	1.458	.306	.085	.065	1.914	.869	.431
New York, Massachusetts	5,096,391	443,658	2,373,022	362,880	768,507	9,044,458	4,364,127	2,000,148	5,175,037	1.071	.459	.070	.148	1.748	.843	.386
Total	89,990,847	16,198,015	27,190,274	3,812,800	9,626,230	146,818,166	66,237,251	29,541,446	76,848,509	1.382	.354	.049	.125	1.910	.862	.384
1956																
Alabama	5,576,001	1,737,475	1,587,088	209,451	95,674	9,205,689	4,017,769	1,354,483	4,166,593	1.755	.381	.050	.023	2.209	.964	.325
Illinois	10,476,328	43,695	1,072,769	342,215	1,239,443	13,174,450	5,463,493	2,090,416	6,515,852	1.615	.165	.052	.190	2.022	.839	.321
Indiana	12,062,650	562,333	2,117,134	141,918	1,282,186	16,166,221	6,982,306	2,864,803	8,245,756	1.531	.257	.017	.156	1.961	.847	.347
Ohio	16,557,639	4,352,219	4,568,354	790,730	1,974,032	28,242,974	13,107,138	5,728,531	15,127,518	1.382	.302	.052	.131	1.867	.866	.379
Pennsylvania	19,886,545	4,834,121	9,014,233	1,221,819	3,250,308	38,207,026	17,027,748	8,006,628	20,618,260	1.199	.437	.059	.158	1.853	.826	.388
California, Colorado, Utah	3,890,869	6,694	2,886,940	74,364	184,503	7,043,370	2,973,585	1,143,112	3,869,003	1.007	.746	.019	.048	1.820	.769	.295
Kentucky, Tennessee, Texas	1,792,590	289,114	349,882	122,222	202,512	2,756,320	1,323,013	653,882	1,505,111	1.383	.232	.081	.135	1.831	.879	.434
Maryland, West Virginia	2,033,815	4,833,797	2,882,752	101,374	705,236	10,556,974	4,716,103	1,867,778	6,087,184	1.128	.473	.017	.116	1.734	.775	.307
Michigan, Minnesota	6,025,652	238,134	1,262,273	197,732	334,135	8,057,926	3,630,196	1,664,135	3,998,520	1.566	.316	.049	.084	2.015	.908	.416
New York, Massachusetts	5,447,276	508,212	2,444,528	229,915	512,894	9,142,825	4,148,579	1,755,794	4,896,452	1.216	.499	.047	.105	1.867	.847	.359
Total	83,749,365	17,405,794	28,185,953	3,431,740	9,780,923	142,553,775	63,389,930	27,131,562	75,030,249	1.348	.376	.046	.130	1.900	.845	.362

[1] Includes sintered flue dust.
[2] Excludes home scrap produced at blast furnaces.
[3] Does not include recycled material.

Labrador. The Troy, N. Y., furnace consumed iron ore from eastern New York and manganiferous ore from Labrador, Africa, and India.

Texas furnaces used brown ores from east Texas and iron and manganiferous ores from Mexico.

Utah furnaces used iron ore from Iron County, Utah, and manganiferous ore from Mexico.

PRODUCTION AND SHIPMENTS OF STEEL

Steel production in 1956 in the United States was 115.2 million short tons, or 89.8 percent of capacity, with an AISI index of 137.2 (1947–49=100). The corresponding figures for 1955 were 117, 93, and 139.7, respectively. Except for the summer months, monthly steel production exceeded the 10-million-ton mark, and a new record of 11 million tons was established in October. Of the total tonnage of steel ingots produced in the United States in 1956, 89 percent was made in open-hearth furnaces, compared with 90 percent in 1955 and 91 percent in 1954; 8 percent in the electric furnace, compared with 7 percent in 1955 and 6 percent in 1954; and 3 percent in the Bessemer converter, the same as in 1955 and 1954. Electric-furnace output established a new record of 9.1 million tons.

In 1956, 35 percent of domestic steel was produced in the Pittsburgh-Youngstown district, 22 percent in the Chicago district, 22 percent in the Eastern district, 10 percent in the Cleveland-Detroit district, 6 percent in the Western district, and 5 percent in the Southern district, compared with 35, 23, 21, 10, 6 and 5 percent, respectively, in 1955. The above districts are those designated by AISI.

During the year open-hearth capacity increased 4,595,370 short tons to 116,912,410 tons and electric-furnace capacity, 782,690 to 12,041,-700; Bessemer capacity decreased 282,000 tons to 4,505,000. The figure for electric-furnace capacity includes 540,000 short tons of oxygen-converter capacity.

Steelmaking-capacity figures represent net-steel capacity after the producers deducted an average of 8.8 percent for operating time lost for rebuilding, relining, repairs, and holiday shutdowns (AISI). The output from steel foundries that did not produce steel ingots was not included in the production data.

During the year between 15 and 20 million tons of additional ingot capacity at a cost of about $2.5 to $3.0 billion was planned, completed, or under construction at 45 steel plants. Some of the major expansions were as follows: Bethlehem planned to add 3 million tons, of which 2 million will be at Sparrows Point, Md.; United States Steel was to add 2 million; Republic had plans for 1.7 million; Armco, Inland, National Steel and Youngstown Sheet & Tube each planned 1-million-ton increases, part of which was completed in 1956; and Acme, Jones & Laughlin, Kaiser, and Phoenix Iron and Steel planned to add oxygen converters totaling 2 million tons.

Domestic shipments of steel in 1956 totaled 79,628,741 short tons. The automotive industry was again the largest steel consumer, receiving 14,141,887 short tons or 17.8 percent of total domestic shipments, compared with 18,721, 880 or 23.1 percent in 1955.

The construction and container industries ranked second and third as consumers, receiving 10,441,126 and 6,818,361 short tons, respec-

tively. The 1956 percentages of domestic shipments were 13.1 and 8.6, compared with 11.9 and 8.3 in 1955.

Rail transportation and ordnance and other direct military uses showed little change in the percentage of shipments received.

Alloy Steel.[2]—The 1956 domestic steel production included 10,328,068 short tons of alloy steel, a decrease of 3 percent from 1955; it was 9 percent of the total steel output, compared with 9 percent in 1955 and 8 percent in 1954.

Stainless-steel ingot production (12 percent of the 1956 alloy-steel output) was 1,248,289 short tons. The output for the year was 2.5 percent higher than in 1955 and 19 percent greater than in the previous record million-ton year—1953. The production of austenitic stainless steel AISI 300 (nickel-bearing) and 200 series (manganese-nickel-bearing), representing 61 percent of the total stainless-steel production, increased 15 percent over 1955; and the ferritic and martensitic, straight chromium types, AISI 400 series, decreased 13 percent. Production of the AISI 200 series, reported for the first time in 1955, increased from 1,914 tons in 1955 to 19,454 in 1956. The AISI 200 series, grades 201 and 202, are used as substitutes for the higher nickel 300 series. The output of type 501, 502, and other high-chromium, heat-resisting steels included in the stainless-steel-production figure increased 3 percent over 1955. Production of all grades of alloy steel, other than stainless, decreased 4 percent. High-strength steel, silicon sheets, manganese-molybdenum and chromium-molybdenum increased. All others decreased, with carbon-boron steel showing the greatest decline (43 percent). The percentages of alloy steel produced in the basic open-hearth, acid open-hearth, and electric furnaces were 61, 2, and 37 percent, respectively, compared with 63, 2, and 35 percent, respectively, in 1955.

TABLE 7.—Steel capacity, production, and percentage of operations, in the United States, 1947–51 (average) and 1952–56, in short tons [1]

[American Iron and Steel Institute]

Year	Annual capacity as of Jan. 1	Production				
		Open hearth	Bessemer	Electric [2]	Total	Percent of capacity
1947–51 (average)	97,043 618	81 178,356	4,369,575	5,161,797	90,709,728	93.5
1952	108,587,670	82,846,439	3,523,677	6,797,923	93,168,039	85.8
1953	117,547,470	100,473,823	3,855,705	7,280,191	111,609,719	94.9
1954	124,330,410	80,327,494	2,548,104	5,436,054	88,311,652	71.0
1955	125,828,310	105,359,417	3,319,517	8,357,151	117,036,085	93.0
1956	128,363,090	102,840,585	3,227,997	9,147,567	115,216,149	89.8

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. Omitted portion is about 2 percent of total steel production.
[2] Includes a very small quantity of crucible steel and oxygen converter steel for 1954–56.

[2] The Bureau of Mines uses the American Iron and Steel Institute specifications for alloy steels which include stainless and any other steel containing one or more of the following elements in the designated amounts: Manganese in excess of 1.65 percent, silicon in excess of 0.60 percent, and copper in excess of 0.60 percent. It also includes steel containing the following elements in any amount specified or known to have been added to obtain a desired alloying effect: Aluminum, boron, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, and other alloying elements.

TABLE 8.—Open-hearth steel ingots and castings manufactured in the United States, 1947–51 (average) and 1952–56, by States, in short tons [1]

[American Iron and Steel Institute]

States	1947–51 (average)	1952	1953	1954	1955	1956
Mass., R. I., Conn	456,992	436,993	489,967	327,108	468,893	378,626
New York	4,368,159	4,521,685	5,771,684	4,596,359	6,304,168	6,045,209
Pennsylvania	23,581,628	24,224,361	28,805,249	20,549,346	29,357,878	29,218,214
N. J., Del., Md	4,837,613	4,621,306	5,687,465	5,582,382	6,350,784	5,986,771
West Virginia, Kentucky	3,116,534	3,303,510	3,648,235	3,069,339	3,810,285	3,935,260
Georgia, Alabama	3,658,729	3,493,922	4,321,489	3,451,696	4,265,487	3,439,887
Ohio	14,466,234	14,759,616	17,570,814	13,661,994	18,446,670	18,240,360
Indiana	10,525,177	10,414,109	13,818,187	12,330,815	15,032,809	14,323,470
Illinois	6,493,105	6,508,525	7,735,397	5,963,127	8,025,030	8,065,262
Michigan, Minnesota	3,932,706	4,270,019	4,979,415	4,247,700	5,463,778	5,318,570
Mo., Okla., Colo., Texas	2,366,202	2,390,214	3,088,318	2,868,874	3,480,238	3,250,580
Utah, Wash., Calif	3,375,277	3,902,179	4,557,603	3,678,754	4,353,397	4,638,376
Total	81,178,356	82,846,439	100,473,823	80,327,494	105,359,417	102,840,585

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. Omitted portion is about 2 percent of total steel production.

TABLE 9.—Bessemer-steel ingots and castings manufactured in the United States, 1947–51 (average) and 1952–56, by States, in short tons [1]

[American Iron and Steel Institute]

State	1947–51 (average)	1952	1953	1954	1955	1956
Ohio	1,977,411	1,922,776	2,326,983	1,658,176	2,268,715	2,210,386
Pennsylvania	1,303,051	751,297	689,814	451,845	589,249	593,208
Other States	1,089,113	849,604	838,908	438,083	461,553	424,403
Total	4,369,575	3,523,677	3,855,705	2,548,104	3,319,517	3,227,997

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. See table 7.

TABLE 10.—Steel electrically manufactured in the United States, 1947–51 (average) and 1952–56, in short tons [1]

[American Iron and Steel Institute]

Year	Ingots	Castings	Total [2]	Year	Ingots	Castings	Total [2]
1947–51 (average)	5,062,416	99,381	5,161,797	1954	5,381,762	54,292	5,436,054
1952	6,703,734	94,189	6,797,923	1955	8,307,138	50,013	8,357,151
1953	7,229,340	50,851	7,280,191	1956	9,090,264	57,303	9,147,567

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. See table 7.

[2] Includes a very small quantity of crucible steel and oxygen converter steel for 1954–56.

TABLE 11.—Alloy-steel ingots and castings manufactured in the United States, 1947–51 (average) and 1952–56, by processes, in short tons [1]

[American Iron and Steel Institute]

Process	1947–51 (average)	1952	1953	1954	1955	1956
Open hearth:						
Basic	5,664,328	5,807,191	6,599,038	4,528,336	6,735,450	6,288,648
Acid	144,901	218,867	185,341	130,559	185,473	201,377
Electric [2]	2,291,092	3,108,693	3,543,815	2,533,968	3,739,168	3,838,043
Total	8,100,321	9,134,751	10,328,194	7,192,863	10,660,091	10,328,068

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots. See table 7.
[2] Includes a very small quantity of crucible steel and oxygen converter steel for 1954–56.

Metalliferous Materials Used in Steelmaking.—The data in table 12 include pig iron and scrap for all steelmaking furnaces in the United States. The combined consumption of these 2 commodities in 1956 was 128.7 million short tons. According to the American Iron and Steel Institute's consumption figures, which exclude independent steel foundries, the combined total was 124.6 million short tons. Percentages of pig iron and scrap charged were 52 and 48, respectively, compared with 53 and 47, respectively, for the institute. Record scrap consumption in steelmaking furnaces in 1956 was due to expanded electric-furnace production and decrease in open-hearth and Bessemer output.

For the third consecutive year the consumption of foreign iron ore in steelmaking furnaces exceeded that from domestic sources. The percentages of foreign ore consumed, by countries, were as follows: Brazil, 25 percent; Chile, 18 percent; Liberia, Venezuela, and Sweden, each 15 percent; and Peru, 4 percent. The remaining 8 percent came from Canada, Africa, Santo Domingo, Cuba, Mexico, and India. Iron ore consumed in steelmaking furnaces by plants that do not have blast furnaces were not included in these figures.

CONSUMPTION OF PIG IRON

In 1956, 89 percent of the total pig iron consumed (74,995,479 short tons) was used in steelmaking furnaces (open-hearth, Bessemer, and electric), 4 percent for direct castings, and 7 percent in ironmaking furnaces. Although plants in all 48 States and the District of Columbia used some pig iron, consumption was concentrated largely in the steelmaking centers of the East North Central, Middle Atlantic, South Atlantic, and East South Central States. These areas in 1956 consumed 93 percent of the pig iron. Pennsylvania (the leading consumer) used 27 percent of the total and Ohio (second largest) 20 percent—the same as 1955.

TABLE 12.—Metalliferous materials consumed in steel furnaces in the United States, 1947–51 (average) and 1952–56, in short tons

Year	Iron ore		Sinter	Pig iron	Ferro-alloys [1]	Iron and steel scrap
	Domestic	Foreign				
1947–51 (average)	3,605,494	1,429,917	1,262,439	53,375,532	1,260,000	48,194,518
1952	3,511,221	2,275,868	1,614,512	53,491,734	1,460,000	52,217,060
1953	4,178,398	3,459,075	1,817,722	65,839,018	1,650,000	59,100,900
1954	2,619,871	3,640,771	1.143,160	51.658,482	1,270,000	46,064,651
1955	3,352,182	4,615,966	1,751,663	67,957,207	1,620,000	61,774,897
1956	3,398,359	4,741,062	1,516,936	66,437,573	[2] 1,630,000	62,276,019

[1] Includes ferromanganese, speigeleisen, silicomanganese, manganese briquets, ferrosilicon, and ferrochromium alloys.
[2] Preliminary figure.

TABLE 13.—Consumption of pig iron in the United States, 1953–56, by type of furnace

Type of furnace or equipment	1953		1954		1955		1956	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Open hearth	61,306,565	82.1	48,632,261	82.9	63,750,490	82.6	62.165,807	82.9
Bessemer	4,351,117	5.8	2,848,691	4.9	3,932,920	5.1	4,038,845	5.4
Electric	181,336	.3	177,530	.3	273,797	.3	232,921	.3
Cupola	5,549,522	7.4	4,896,703	8.3	5,961,861	7.7	5,349,402	7.1
Air	313,054	.4	232,422	.4	295,209	.4	292,717	.4
Crucible	268	(1)	42	(1)	38	(1)	36	(1)
Direct castings	3,005,882	4.0	1,874,400	3.2	3,002,020	3.9	2,915,751	3.9
Total	74,707,744	100.0	58,662,049	100.0	77,216,335	100.0	74,995,479	100.0

[1] Less than 0.05 percent.

TABLE 14.—Consumption of pig iron in the United States, 1952–56, by States and districts, in short tons

District and State	1952	1953	1954	1955	1956
New England:					
Connecticut	60,598	63,436	48,981	50,126	54,104
Maine	4,072	5,928	3,057	3,357	4,556
Massachusetts	165,324	174,513	140,194	160,664	170,658
New Hampshire	4,607	3,503	3,731	3,731	4,059
Rhode Island	46,842	49,432	38,583	53,316	52,875
Vermont	14,643	8,974	9,033	10,626	13,053
Total	296,086	305,786	243,579	281,820	299,305
Middle Atlantic:					
New Jersey [1]	244,320	200,572	207,610	234,153	245,524
New York	3,128,013	3,689,763	2,984,809	3,891,870	3,710,751
Pennsylvania [1]	17,026,406	20,608,854	14,601,423	20,600,273	20,450,118
Total	20,398,739	24,499,189	17,793,842	24,726,296	24,406,393
East North Central:					
Illinois [1]	4,893,725	6,055,031	4,320,164	5,877,830	5,942,389
Indiana [1]	7,044,738	8,928,835	7,713,815	9,411,067	9,015,531
Michigan	3,294,753	3,811,411	3,140,805	4,642,449	4,401,778
Ohio [1]	11,650,525	14,641,399	11,117,854	15,203,917	14,818,433
Wisconsin	278,670	258,786	206,221	259,552	275,984
Total	27,162,411	33,695,462	26,498,859	35,394,815	34,454,115

See footnotes at end of table.

TABLE 14.—Consumption of pig iron in the United States, 1952–56, by States and districts, in short tons—Continued

District and State	1952	1953	1954	1955	1956
West North Central:					
Iowa	101,833	89,467	71,868	88,072	73,814
Kansas, Nebraska	6,682	12,378	6,559	7,322	5,769
Minnesota, North Dakota, South Dakota	506,084	518,930	486,718	601,199	532,391
Missouri	80,995	77,075	36,002	51,864	45,722
Total	695,594	697,850	601,147	748,457	657,696
South Atlantic:					
Delaware, District of Columbia, Maryland	3,144,907	3,919,420	3,877,686	4,260,786	4,050,142
Florida, Georgia	60,528	65,111	24,600	45,371	23,245
North Carolina	27,194	22,644	17,886	23,456	22,109
South Carolina	12,911	10,501	13,107	14,165	13,777
Virginia, West Virginia	1,862,646	1,933,541	1,706,519	2,006,306	2,098,515
Total	5,108,186	5,951,217	5,639,798	6,350,084	6,207,788
East South Central:					
Alabama	3,527,809	4,163,931	3,554,765	4,319,869	3,674,477
Kentucky [1], Mississippi, Tennessee	845,718	1,055,604	764,232	1,137,360	958,142
Total	4,373,527	5,219,535	4,318,997	5,457,229	4,632,619
West South Central:					
Arkansas, Louisiana, Oklahoma	11,961	12,464	8,673	10,229	9,132
Texas	418,964	568,161	661,821	749,298	675,432
Total	430,925	580,625	670,494	759,527	684,564
Mountain:					
Arizona, Nevada, New Mexico	144	195	266	82	184
Utah and Colorado	1,776,397	2,506,885	1,889,089	2,259,694	2,199,915
Montana, Idaho, Wyoming	685	478	324	180	318
Total	1,777,226	2,507,558	1,889,679	2,259,956	2,200,417
Pacific:					
California [1]	1,288,561	1,233,898	1,000,576	1,223,264	1,430,737
Oregon, Washington	19,706	15,357	5,078	14,887	21,845
Total	1,308,267	1,249,255	1,005,654	1,238,151	1,452,582
Undistributed [1]	----------	1,267	----------	----------	----------
Total United States	61,550,961	74,707,744	58,662,049	77,216,335	74,995,479

[1] Small tonnages of pig iron, not separable, shown as "Undistributed."

PRICES

The average value of all grades of pig iron, f. o. b. blast furnaces, was $53.58 in 1956, compared with $50.68 in 1955.

The weighted averages, f. o. b. value of all grades of steel, given in table 17, were computed from statistics supplied by the Bureau of the Census.

The 1956 average composite price of finished steel (published by Iron Age) was 5.358 cents per pound, compared with 4.977 cents per pound in 1955. Prices increased from 5.179 cents per pound in July to 5.560 in August and 5.622 in September.

TABLE 15.—Average value of pig iron at blast furnaces in the United States, 1947–51 (average) and 1952–56, by States, per short ton

State	1947–51 (average)	1952	1953	1954	1955	1956
Alabama, California, Colorado, Utah	$36.88	$45.10	$46.63	$46.97	$47.89	$50.23
Illinois	42.04	50.83	51.14	51.08	53.82	50.67
Indiana	39.79	48.31	49.85	50.09	51.21	54.52
New York	40.04	48.16	49.29	50.16	50.79	53.09
Ohio	39.32	49.31	50.46	50.60	51.54	54.54
Pennsylvania	39.67	47.65	49.44	48.92	49.35	52.42
Other States [1]	40.16	49.16	50.69	50.52	51.30	55.01
Average	42.28	48.70	49.66	50.61	50.78	54.19
	40.11	48.43	49.83	49.93	50.68	53.58

[1] Comprises Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Tennessee, Texas, Virginia, and West Virginia.

TABLE 16.—Average monthly prices per short ton of chief grades of pig iron, 1955–56

Month	Foundry pig iron at Birmingham furnaces		Foundry pig iron at Valley furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1955	1956	1955	1956	1955	1956	1955	1956
January, February, March, April, May, June	$47.22	$49.11	$50.45	$52.94	$50.89	$53.38	$50.00	$52.49
January, February				$52.68		$53.13		$52.23
March, April, May, June				54.02		54.46		53.57
July	48.66	52.51	52.12		52.56		51.67	
August, September, October, November, December	49.11	52.68	52.68	56.25	53.13	56.70	52.23	55.80
Average	48.13	50.88	51.52	54.63	51.96	55.08	51.07	54.19

TABLE 17.—F. o. b. value of steel-mill products in the United States, 1955–56, in cents per pound [1]

Product	1955				1956			
	Carbon	Alloy	Stainless	Average	Carbon	Alloy	Stainless	Average
Ingots	3.308	9.382	25.366	4.431	4.307	8.361	31.559	5.398
Semifinished shapes and forms	4.668	7.575	[2] 23.056	5.272	5.081	8.446	29.487	5.846
Plates	5.135	13.424	55.044	5.475	5.717	9.471	54.791	6.241
Sheets and strips	5.992	[2] 12.394	46.874	[2] 6.834	6.474	13.252	50.991	7.413
Tin-mill products	[2] 7.831			[2] 7.831	8.449			8.449
Structural shapes and piling	[2] 5.120	7.250		[2] 5.151	5.540	6.986		5.551
Bars	6.188	[2] 11.273	51.515	[2] 7.521	6.642	12.848	55.923	8.158
Rails and railway-track material	5.848			5.848	6.328			6.328
Pipes and tubes	8.472	14.858	162.519	9.243	9.099	16.614	142.899	10.071
Wire and wire products	10.077	29.124	66.312	10.810	10.938	34.396	75.215	11.909
Other rolled and drawn products	8.521	25.439	51.728	11.503	7.882	32.343	60.530	11.081
Average total steel	6.391	11.581	[2] 46.909	7.099	6.915	12.770	53.587	7.731

[1] Computed from figures supplied by the U. S. Department of Commerce, Bureau of the Census.
[2] Revised.

FOREIGN TRADE [3]

Pig-iron imports (326,700 short tons) were the highest since 1953, and exports of this commodity were almost 8 times the 1955 figure of 34,989 short tons. Canada supplied 93 percent of the pig iron imported. Exports of pig iron totaled 267,175 short tons, of which Japan received 93 and Canada 4 percent. Eight countries received the remaining 3 percent.

Exports of iron and steel products totaled 4.7 million short tons, an increase of 7 percent over 1955. Imports and exports of semi-finished iron and steel products both decreased, while imports and exports of finished iron and steel products both increased.

TABLE 18.—Pig iron imported for consumption in the United States, 1947–51 (average) and 1952–56, by countries, in net tons

[Bureau of the Census]

Country	1947–51 (average)	1952	1953	1954	1955	1956
North America:						
Canada	87,129	288,722	305,256	203,303	260,741	303,121
Mexico	201					
Total	87,330	288,722	305,256	203,303	260,741	303,121
South America:						
Argentina	(1)					
Brazil	6,897					19,621
Chile	12,965	2,577				
Total	19,862	2,577				19,621
Europe:						
Austria	32,767	11,071				
Belgium-Luxembourg	14,705	3,045				
Finland			168			
France	18,636	343				
Germany	116,664	[2] 16,203	[2] 3,539	[2] 31,854		
Italy	1,025	1				
Netherlands	82,176	12,735	18,475	7,914	1,232	112
Norway	10,853	6,369	2,692	3,482	224	339
Poland-Danzig	1,493					
Spain	6,810	25,224	4,665	11,704	3,000	
Sweden	12,071	2,096	56,633	1,203	2,466	1,852
U. S. S. R.	271					
United Kingdom	3,108					
Total	300,579	77,087	86,172	56,157	6,922	2,303
Asia:						
India	16,101		12,659	7,470	11,217	336
Turkey	7,318	622				
Total	23,419	622	12,659	7,470	11,217	336
Africa:						
Rhodesia and Nyasaland, Federation of			[3] 6,606	[4] 1,944	241	
Union of South Africa	4,108			5,517	1,425	128
Total	4,108		6,606	7,461	1,666	128
Oceania: Australia	9,300	11,192	179,132	16,325	3,013	1,191
Grand total: Net tons	444,598	380,200	589,825	290,716	283,559	326,700
Value	$18,709,753	$19,846,695	$25,967,435	$13,315,255	$14,563,612	$17,842,357

[1] Less than 1 ton.
[2] West Germany.
[3] Southern Rhodesia.
[4] Southern Rhodesia not separately classified after July 1, 1954; 1,562 net tons January–June.

[3] Figures on imports and exports compiled by Mae B. Price and Elsie D. Page, Division of Foreign Activities, Bureau of Mines, from records of the Bureau of the Census.

TABLE 19.—Major iron and steel products imported for consumption in the United States, 1954–56

[Bureau of the Census]

Products	1954		1955		1956	
	Net tons	Value	Net tons	Value	Net tons	Value
Semimanufactures:						
Steel bars:						
Concrete reinforcement bars	164,289	[1] $11,689,830	158,973	[1] $13,559,126	173,302	[1] $17,314,051
Solid and hollow, n. e. s.	40,873	[1] 3,858,537	[2] 33,225	[2] 3,664,784	47,372	[1] 5,794,523
Hollow and hollow drill steel	378	144,307	592	[1] 183,256	954	251,145
Bar iron, iron slabs, blooms, or other forms	219	49,554	79	17,909	93	[1] 21,842
Wire rods, nail rods, and flat rods up to 6 inches in width	39,848	4,047,003	47,761	[1] 5,699,167	64,193	7,823,521
Boiler and other plate iron and steel, n. e. s.	2,242	240,682	[2] 3,964	[2] 469,571	62,494	8,414,026
Steel ingots, blooms, and slabs; billets, solid or hollow	8,783	[1] 1,216,009	146,103	[1] 10,635,444	26,142	3,069,702
Die blocks or blanks, shafting, etc	310	[1] 80,743	285	46,464	487	143,478
Circular saw plates	13	[1] 21,904	24	18,688	41	34,125
Sheets of iron or steel, common or black and boiler or other plate iron or steel	789	107,121	[2] 2,571	[2] 348,957	6,812	[1] 870,834
Sheets and plates and steel, n. s. p. f.	197	262,272	298	[2] 90,287	223	119,018
Tinplate, terneplate, and taggers' tin	143	[1] 31,305	44	16,826	656	[1] 148,235
Total semimanufactures	258,084	[1] 21,749,267	[2] 393,919	[1 2] 34,750,479	382,769	[1] 44,004,500
Manufactures:						
Structural iron and steel	276,828	[1] 28,000,467	266,161	[1] 28,963,223	614,781	[1] 76,819,259
Rails for railways	3,511	191,847	6,278	362,469	7,437	662,853
Rail braces, bars, fishplates, or splice bars and tie plates	267	25,029	772	[1] 36,323	112	[1] 13,709
Pipes and tubes:						
Cast-iron pipe and fittings	6,868	[1] 876,427	9,219	[1] 1,383,590	10,750	2,114,747
Other pipes and tubes	66,250	[1] 10,810,489	[2] 77,105	[1 2] 10,990,257	140,365	[1] 22,486,171
Wire:						
Barbed	52,948	[1] 6,079,100	60,084	7,695,229	62,296	[1] 8,416,191
Round wire, n. e. s.	40,794	[1] 4,771,604	40,495	[1] 5,627,152	49,921	[1] 7,790,678
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	422	[1] 295,870	635	[1] 582,963	1,747	[1] 1,378,254
Flat wire and iron and steel strips	17,438	[1] 4,894,711	[2] 24,765	[1 2] 7,043,253	18,394	[1] 8,035,028
Rope and strand	3,939	[1] 1,619,444	5,537	[1 2] 933,517	9,662	[1] 5,445,568
Galvanized fencing wire and wire fencing	10,435	[1] 1,191,220	13,460	[1] 1,709,300	21,988	[1] 2,922,962
Iron and steel used in card clothing	(3)	308,945	(3)	409,196	(3)	[1] 609,678
Hoop and band iron and steel, for baling	17,500	1,819,972	6,261	726,812	13,595	1,876,792
Hoop, band and strips, or scroll iron or steel, n. s. p. f.	20,995	1,669,642	[2] 24,549	[2] 2,243,672	20,263	2,434,121
Nails	92,829	[1] 11,559,148	132,838	[1] 18,093,133	113,480	[1] 16,860,733
Castings and forgings, n. e. s.	5,459	1,855,545	[2] 8,011	[1] 2,242,451	10,005	[1] 3,221,773
Total manufactures	616,483	[1] 75,969,460	[2] 676,170	[1 2] 91,042,540	1,094,796	[1] 161,088,517
Advanced manufactures:						
Bolts, nuts, and rivets	15,568	[1] 3,964,850	21,643	[1] 5,402,242	23,102	[1] 7,072,721
Chains and parts	1,139	[1] 754,590	1,556	[1] 974,561	3,201	[1] 1,816,388
Hardware, builders'	-------	[1] 249,626	-------	[1] 341,011	-------	[1] 578,734
Hinges and hinge blanks	-------	[1] 1,328,068	-------	[1] 1,363,490	-------	[1] 1,495,571
Screws (wholly or chiefly of iron or steel)	-------	[1] 708,291	-------	[1] 1,328,502	-------	[1] 1,507,455
Tools	-------	5,255,219	-------	[1] 8,198,468	-------	[1] 8,887,020
Other advanced manufactures	-------	27,297	-------	[1] 25,672	-------	[1] 83,558
Total advanced manufactures	-------	[1] 12,287,941	-------	[1] 17,633,946	-------	[1] 21,441,447
Grand total	-------	[1] 110,006,668	-------	[1 2] 143,426,965	-------	[1] 226,534,464

[1] Owing to changes in tabulating procedures by the Bureau of the Census data known to be not comparable with years before 1954.
[2] Revised figure.
[3] Weight not recorded.

TABLE 20.—Major iron and steel products exported from the United States, 1954–56

[Bureau of the Census]

Products	1954		1955		1956	
	Net tons	Value	Net tons	Value	Net tons	Value
Semimanufactures:						
Steel ingots, blooms, billets, slabs, and sheet bars	29,465	$2,619,317	[1] 621,333	[1] $51,350,303	362,724	$35,719,065
Iron and steel bars and rods:						
Iron bars	1,142	333,021	408	89,559	1,151	204,186
Concrete reinforcement bars	29,856	3,078,997	73,969	8,018,949	97,301	11,927,535
Other steel bars	59,895	10,434,982	131,276	21,424,479	199,599	34,287,859
Wire rods	9,025	946,232	30,930	3,227,968	17,514	2,056,656
Iron and steel plates, sheets, skelp, and strips:						
Plates, including boiler plate, not fabricated	154,149	19,548,635	215,391	28,803,072	298,664	46,369,238
Skelp iron and steel	56,793	5,214,634	88,329	8,455,238	148,520	15,704,087
Iron and steel sheets, galvanized	142,945	25,444,070	157,036	28,102,680	154,598	30,187,805
Steel sheets, black, ungalvanized	616,266	97,976,710	1,067,085	164,614,295	929,507	158,029,529
Strip, hoop, band, and scroll iron and steel:						
Cold-rolled	31,042	11,264,852	54,149	19,063,245	49,921	20,676,172
Hot-rolled	25,355	4,148,970	38,373	7,022,547	40,733	7,002,004
Tin plate and terneplate	712,284	122,895,046	[1] 837,404	[1] 143,195,161	725,725	134,379,955
Total semimanufactures	1,868,217	303,905,466	[1] 3,315,683	[1] 483,367,496	3,025,957	496,544,091
Manufactures—steel-mill products:						
Structural iron and steel:						
Water, oil, gas, and other storage tanks complete and knocked-down material	60,773	14,389,849	41,781	11,294,219	75,453	19,482,217
Structural shapes:						
Not fabricated	267,259	28,452,461	[1] 279,487	[1] 32,198,998	363,400	46,954,245
Fabricated	48,054	15,440,392	[1] 87,619	22,080,038	84,315	26,206,978
Plates, sheets, fabricated, punched, or shaped	14,023	4,040,272	[1] 16,653	[1] 4,209,725	21,158	4,773,832
Metal lath	2,759	810,947	2,452	829,066	2,689	875,109
Frames, sashes, and sheet piling	23,013	3,444,699	11,035	2,116,256	11,013	2,294,154
Railway-track material:						
Rails for railways	96,914	9,778,837	[1] 57,825	[1] 4,579,185	68,319	7,559,764
Rail joints, splice bars, fishplates, and tieplates	18,006	3,194,633	11,279	2,316,702	17,549	3,557,549
Switches, frogs, and crossings	2,704	939,349	3,000	932,772	6,104	1,921,048
Railroad spikes	2,414	395,871	1,930	369,962	2,850	559,894
Railroad bolts, nuts, washers, and nut locks	917	342,513	818	317,480	1,081	480,344
Tubular products:						
Boiler tubes	19,899	7,364,461	[1] 26,683	[1] 7,679,501	26,375	9,739,104
Casing and line pipe	306,152	54,738,453	216,049	[1] 44,613,066	602,888	115,995,848
Seamless black and galvanized pipe and tubes, except casing, line and boiler, and other pipes and tubes	32,007	6,291,517	22,140	4,977,734	45,658	10,308,943
Welded black pipe	56,232	8,254,480	27,929	5,351,135	30,770	6,554,216
Welded galvanized pipe	11,273	2,252,681	12,125	2,449,004	11,254	2,548,844
Malleable-iron screwed pipe fittings	2,013	1,685,040	1,857	1,652,137	1,983	1,849,679
Cast-iron pressure pipe and fittings	21,489	3,360,190	21,021	3,077,033	27,345	4,661,595
Cast-iron soil pipe and fittings	10,770	1,830,344	9,243	1,695,536	9,329	1,907,159
Iron and steel pipe, fittings, and tubing, n. e. c.	43,582	23,374,691	48,928	27,422,795	71,102	42,107,628
Wire and manufactures:						
Barbed wire	3,695	630,744	1,641	285,576	1,085	216,188
Galvanized wire	5,056	1,343,608	10,668	2,175,877	10,677	2,448,957
Iron and steel wire, uncoated	23,441	4,757,463	23,299	5,670,926	30,551	7,531,831
Spring wire	4,242	2,088,331	4,696	2,444,793	4,714	2,577,276
Wire rope and strand	13,228	6,755,653	14,166	7,263,801	18,350	9,748,332
Woven-wire fencing and screen cloth	3,244	[2] 1,831,168	4,174	[2] 2,265,921	3,905	[2] 2,274,819
All other	26,700	8,977,445	30,576	10,816,808	34,328	13,385,891

See footnotes at end of table.

TABLE 20.—Major iron and steel products exported from the United States, 1954–56—Continued

[Bureau of the Census]

Products	1954		1955		1956	
	Net tons	Value	Net tons	Value	Net tons	Value
Manufactures—steel-mill products—Continued						
Nails and bolts, iron and steel, n. e. c.:						
Wire nails, staples, and spikes	3,235	$1,705,901	3,090	$2,022,481	3,273	$2,347,621
All other nails, staples, spikes, and tacks	2,489	1,277,073	2,733	1,401,259	2,208	1,232,351
Bolts, screws, nuts, rivets, and washers, n. e. c	13,752	11,254,985	[1] 19,868	[1] 15,445,666	21,751	17,462,012
Castings and forgings: Iron and steel, including car wheels, tires, and axles	66,121	16,650,107	109,534	25,323,043	109,745	25,858,696
Total manufactures	1,205,456	247,654,158	[1] 1,124,299	[1] 255,278,495	1,721,222	395,422,124
Advanced manufactures:						
Buildings (prefabricated and knockdown)		4,998,798		[1] 7,083,068		11,118,784
Chains and parts	9,505	7,693,658	[1] 8,206	[1] 7,936,142	11,211	10,480,268
Construction material	6,762	4,000,865	8,012	4,727,559	10,648	5,958,982
Hardware and parts		14,342,712		17,123,664		20,533,440
House-heating boilers and radiators		6,644,674		7,896,943		9,491,538
Oil burners and parts		8,244,712		10,134,831		11,030,717
Plumbing fixtures and fittings		6,203,291		7,407,358		6,917,669
Tools		43,238,299		48,183,073		54,161,771
Utensils and parts (cooking, kitchen, and hospital)	1,272	3,783,383	1,531	4,569,769	1,540	4,687,746
Other advanced manufactures		23,595,543		[1] 29,410,460		32,622,941
Total advanced manufactures		122,745,935		[1] 144,472,867		167,003,856
Grand total		674,305,559		883,118,858		1,058,970,071

[1] Revised figure.
[2] Includes wire cloth as follows—1954: $952,431 (5,529,215 square feet); 1955: $1,163,185 (6,950,825 square feet); 1956: $1,104,737 (6,713,660 square feet).

TECHNOLOGY

The year 1956 was highlighted by a number of important developments in iron- and steel-making. There was sustained interest in achieving greater output from the installed blast furnaces through increased use of sinter, other agglomerates, and higher grade foreign iron ores. Limited application in the use of oxygen-enriched air, humidity control of the air blast, and high-top pressures continued to be interesting developments. The oxygen converter became more widely accepted as a tool for the United States steelmaker. There was increased emphasis on high-vacuum techniques in steelmaking, both in melting the steel and pouring the ingots. The use of basic refractories in open hearths increased. The portable gas-fired scrap preheater, developed by the Bureau, was adopted by industry. Considerable interest was shown in the American H-Iron process, the German Rotor furnace, and the British Cyclosteel process. Finally, more oxygen was used at iron and steel plants. The iron and steel industry consumed 23.9 billion cu. ft. of the reported United States production of 49.3 billion cu. ft. of oxygen during 1956. More than 200 cu. ft. per ton of ingots was consumed, compared with 175 in 1955, 105 in 1945, and 38 in 1935.

In addition to new construction, additional steel capacity was realized by improved techniques in iron- and steel-making. Changes in blast-furnace techniques or operations included: Better preparation of ore charges; increased use of higher iron content ores from foreign sources, increased use of concentrates, agglomerates, and oxygen; and use of high-top pressure and humidity control. One company that was increasing its steelmaking capacity 1 million tons planned on a 25-percent increase in pig-iron output by using a blast-furnace burden consisting of 50 percent sinter.[4] It was anticipated that, by the end of 1957, sintering capacity would be 63 million tons, representing a 25-million-ton increase in 2 years. Increased output of pig iron through the use of oxygen-enriched air was noted in the 1955 chapter.

Advances in steelmaking and rolling mills continued. These included the following: (1) Improved layout, (2) use of richer fuels and oxygen, (3) mechanization, (4) better methods for handling materials and refractories, (5) faster rebuilding of units, (6) rapid charging and heating, (7) automatic controls and instrumentation, (8) better refractories, and (9) scheduled maintenance of equipment. The use of hot metal in electric arc furnaces was given further attention during 1956. At least 1 company used a charge composed of 50 percent hot metal. An interesting item in vacuum melting was the use of the continuous mass spectrometer to aid in controlling the process. A record of gases drawn off during melting and refining tells the operator when the process has reached the desired end point. A number of steel companies were expanding their facilities for producing vacuum melting and vacuum casting of steel ingots. The pilot plant of one company could vacuum-melt heats up to about 6,000 pounds. Another company had a vacuum casting unit for large forgings which is essentially a 17-foot-diameter cylinder 31 feet high.

The H-Iron process under development by the Hydrocarbon Research, Inc., Trenton, N. J., offered possibilities as a new source of iron units for the American iron and steel industry. This process employs the fluidized-bed technique, using hydrogen as the reducing agent. The reduced iron is formed into shapes, with ordinary steel-plant rolls, which are used as melting stock for open-hearth and electric furnaces. H-Iron with only 75 percent of the oxygen removed was used experimentally in open-hearth furnaces to replace charge ore as well as to substitute for scrap. Cost of operation per unit of metal was reported to compare favorably with the cost of iron and steel scrap.[5]

The portable, gas-fired scrap preheater developed by the Bureau of Mines to preheat scrap for top-charged electric furnaces was adopted by one steel plant. This innovation for reducing the energy cost and heat time for electric-furnace steelmaking was described at the 1956 AIME Electric Furnace Steel Conference.

An experimental development in German steelmaking was the rotating furnace, known as the "Rotor," developed at the Oberhausen works. In this cylindrical furnace, which rotates on its horizontal axis, high- or low-phosphorus molten pig iron is converted directly

[4] Madsen I. E., Developments in the Iron and Steel Industry During 1956: Iron and Steel Eng., January 1957, pp. 119–170.

[5] Unterweiser, P. M., H-Iron: Competition for the Blast Furnace: Iron Age, vol. 178, No. 2, July 12, 1956, pp. 71–74.

into steel. Refining and the necessary heat are accomplished with oxygen, which is introduced through two separate, controlled jets. One is introduced beneath the surface of the molten metal and the other into the furnace atmosphere. A furnace with a heat capacity of 60 tons was operated, and a 100-ton furnace was under construction.[6]

During the year a new process for making steel directly from iron ore in a cyclone, called the Cyclosteel process, was announced by the British Iron and Steel Research Association. The process employs a preheater and a cyclone reactor. Powdered iron ore and powdered coal are fed into a fluidized-bed preheater, and the iron ore is partly reduced by the exhaust gases from the reactor. The mixture then passes through jet nozzles into the cyclone reactor and spirals downward through the reduction and burning zones. Oxygen is introduced to remove carbon and phosphorus and convert the carburized iron to steel. A pilot plant was being erected in England to further investigate this process.[7] Substitutes for the nickel-bearing AISI 200 and 300 series received further attention during the year. The United States Steel Corp. announced a nickel-free stainless called "Tenelon," with the following typical analysis in percent: Manganese 14.50, chromium 17.00, and nitrogen 0.40. The new steel is completely austenitic, and its physical properties (tensile and yield strength) are higher at both room and elevated temperatures than the conventional nickel-bearing austenitic grades. Its corrosion resistance is comparable to that of types 301 and 302 in mild acids. Magnetic permeability of "Tenelon" is equivalent to that of AISI 302. It can be readily spot-welded or welded by the shielded metal-arc process.[8]

The use of clad steel, conserving nickel and other critical metals, was manufactured by a number of steel companies in the United States. Consumption was estimated to have increased some 30 to 40 times since its inception during the late 1930's. A stainless-steel-clad plate is made of an ordinary carbon steel to one or both sides of which a veneer or cladding is uniformly and permanently bonded. This clad material may be substituted for a 100-percent stainless plate. It is less expensive and offers the same corrosion resistance as the steel or alloy for which it is substituted. Thickness of cladding generally ranges from 5 to 20 percent of the total thickness. In addition to cladding with stainless steel, high-purity nickel, aluminum, copper, and other metals may be used. During 1956 a number of methods were described for making metal claddings.[9] Clad steel was widely used for restaurant equipment, cooking utensils,[10] and construction. The 250,000-gallon water tank and tower at the General Motors Technical Center near Detroit, Mich., was made of type 304 stainless clad on Grade A283 carbon steel.[11]

A new process of tinplating only the narrow margins of steel sheets that make up the soldered side-seams of tin cans was announced by the American Can Co. during the year. It was estimated that 5 million pounds of tin could be saved annually.[12]

[6] Iron and Coal Trades Review, Technical Developments in the German Iron and Steel Industry: Nov. 23, 1956, pp. 1267–1268.
[7] American Metal Market, vol. 63, No. 169, Sept. 1, 1956, p. 1. No. 170, Sept. 5, 1956, p. 13.
[8] United States Steel Corp., Data on USS Tenelon (undated pamphlet).
[9] Durst, George, A New Development in Metal Cladding: Jour. Metals, March 1956, pp. 328–333.
[10] Watson, T. T., The Manufacture and Properties of Clad Steel Plate: Blast Furnace and Steel Plant, March 1953, pp. 318–355.
[11] Engineering News-Record, Mar. 10, 1955, p. 33.
[12] Daily Metal Reporter, vol. 56, No. 91, May 12, 1956, pp. 1, 6.

Designers were looking to special steels as the only materials that will retain their strength at temperatures of more than 600° C. for use in skins and frames of supersonic aircraft.[13]

West Germany was building a ship that might be the first ever constructed of oxygen-jet converter steel. The Austrian steel firm, VOEST, supplied the steel and funds for this ship. Oxygen-converter steel has been recommended for sheets, strip, and wire because of its superior deep-drawing qualities, whereas ship steel is usually higher in carbon and less ductile. At least one Austrian producer stated that the higher carbon grade can be made by the oxygen-jet steel process.

Additional information on foreign technical developments is given for Sweden and the European Coal and Steel Community in the World Review section.

WORLD REVIEW

World production of pig iron, including ferroalloys, and steel in 1956 reached a new high of 222.3 and 312.7 million short tons, respectively, a 5-percent increase in both pig iron and steel. The United States, the European Coal and Steel Community, and the Soviet Union ranked first, second, and third in both pig-iron and steel production. The United States produced 35 percent of world pig iron and 37 percent of world steel, compared with 37 and 39 percent, respectively, in 1955.

NORTH AMERICA

Canada.—Canada expanded its steelmaking and rolling-mill capacities at a number of locations. The Steel Co. of Canada began a $100 million expansion program to include a new slabbing mill and a second electrolytic tinning line. The Dominion Foundries & Steel, Ltd., of Hamilton began to operate a new 2,000-ton-per-day blast furnace and a new oxygen-steelmaking converter in November. This company was also constructing a new roughing mill. At Welland, Ontario, a pipe mill that will produce 20- to 36-inch-diameter welded pipe was scheduled to start operations at the end of 1956. During the latter part of the year Algoma Steel Corp. announced an oxygen-steelmaking installation that will boost ingot capacity to 1.6 million tons. A new blooming and plate mill was also planned. Operations of the new facilities were scheduled for early 1959. Western Canada Steel, Ltd., announced a $2 million project at Vancouver. Future plans included a $5 million electric smelting operation, which might be the first western Canadian steel plant to utilize west coast ores. On October 20, 1956, a new pipe mill called the Alberta Phoenix Tube & Pipe, Ltd., was dedicated at Edmonton, Alberta, Canada. The reported annual capacity of this mill was 100,000 tons.[14]

Cuba.—Cuba was installing an open hearth that will raise output to 112,000 tons per year.[15]

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[13] American Metal Market, vol. 63, No. 181, Sept. 21, 1956, pp. 1, 2.

[14] Madsen, I. E., Developments in the Iron and Steel Industry During 1956: Iron and Steel Eng., January 1957, p. 127.
U. S. Consulate General, Toronto, Canada, State Department Dispatch 138: Feb. 8, 1957.

[15] Madsen, I. E., Developments in the Iron and Steel Industry During 1956: Iron and Steel Eng., January 1957, p. 127.

TABLE 21.—World production of pig iron (including ferroalloys), by countries,[1] 1947–51 (average) and 1952–56, in thousand short tons [2]

[Compiled by Pearl J. Thompson and Berenice B. Mitchell]

Country	1947–51 (average)	1952	1953	1954	1955	1956
North America:						
Canada	2,444	2,914	3,166	2,327	3,380	3,810
Mexico [3]	245	340	271	297	356	455
United States	63,163	63,391	77,201	59,752	79,263	77,667
Total	65,852	66,645	80,638	62,376	82,999	81,932
South America:						
Argentina	[4] 22	30	39	30	40	31
Brazil	667	906	985	1,222	1,198	1,291
Chile	87	298	315	336	282	386
Colombia				97	109	[4] 120
Total	776	1,234	1,339	1,685	1,629	1,828
Europe:						
Austria	808	1,295	1,456	1,493	1,660	1,915
Belgium	4,202	5,280	4,641	5,098	5,941	6,350
Bulgaria		12	28	44	50	55
Czechoslovakia	[4] 1,990	2,540	3,065	3,070	3,287	3,618
Denmark	39	40	40	44	60	62
Finland	94	119	88	83	127	114
France	8,073	10,894	9,678	9,868	12,220	12,833
Germany:						
East	323	728	1,188	1,453	1,672	1,735
West	7,603	14,194	12,846	13,792	18,168	19,375
Hungary	452	638	777	904	942	820
Italy	689	1,425	1,536	1,484	1,911	2,200
Luxembourg	2,749	3,391	3,000	3,086	3,401	3,652
Netherlands	473	594	654	672	739	730
Norway	239	301	305	271	387	496
Poland	1,444	2,028	2,600	2,935	3,430	3,865
Rumania [4]	270	430	500	480	630	650
Saar	1,637	2,811	2,626	2,752	3,174	3,341
Spain	671	868	911	1,004	1,093	1,100
Sweden	911	1,228	1,165	1,103	1,375	1,552
Switzerland	34	44	45	39	60	45
U. S. S. R. [5]	18,166	27,700	30,200	33,100	36,700	39,500
United Kingdom	10,288	12,015	12,516	13,309	13,966	14,750
Yugoslavia	230	317	310	406	585	713
Total [5]	61,385	88,892	90,175	96,490	111,578	119,471
Asia:						
China	[4] 640	[4] 2,200	[4] 3,300	3,340	4,057	5,616
India	1,813	2,076	1,990	2,197	2,122	2,194
Japan	1,836	3,952	5,129	5,237	5,960	6,905
Korea, North [4]	32	22	55	55	125	200
Taiwan (Formosa)	4	7	8	10	11	18
Thailand	[6] 10	[4] 2	6	2	2	4
Turkey	132	216	239	216	223	243
Total [5]	4,467	8,475	10,727	11,057	12,500	15,180
Africa:						
Rhodesia and Nyasaland, Federation of: Southern Rhodesia	[7] 31	43	40	41	63	29
Union of South Africa	777	1,245	1,348	1,319	1,433	1,495
Total	808	1,288	1,388	1,360	1,496	1,524
Oceania: Australia	1,333	1,735	2,064	2,079	2,010	2,321
World total (estimate)	134,600	168,300	186,300	175,000	212,200	222,300

[1] Pig iron is also produced in Belgian Congo and Indonesia, but quantity produced is believed insufficient to affect estimate of world total.
[2] This table incorporates a number of revisions of data published in previous Iron and Steel chapters. Data do not add to totals shown owing to rounding where estimated figures are included in the detail.
[3] Excluding ferroalloy production, for which data are not yet available, but estimate has been included in total.
[4] Estimate.
[5] U. S. S. R. in Asia, included with U. S. S. R. in Europe.
[6] Average for 1950–51.
[7] Average for 1948–51.

TABLE 22.—World production of steel ingots and castings, by countries, 1947–51 (average) and 1952–56, in thousand short tons [1]

[Compiled by Pearl J. Thompson and Berenice B. Mitchell]

Country	1947–51 (average)	1952	1953	1954	1955	1956
North America:						
Canada	3,258	3,703	4,116	3,195	4,529	5,306
Mexico	397	595	579	686	838	992
United States [2]	90,710	93,168	111,610	88,312	117,036	115,216
Total	94,365	97,466	116,305	92,193	122,403	121,514
South America:						
Argentina [3]	183	140	220	185	230	310
Brazil	687	984	1,120	1,265	1,380	1,626
Chile	72	268	345	354	320	408
Colombia	[3] 10	[3] 11			85	100
Total	952	1,403	1,685	1,804	2,015	2,444
Europe:						
Austria	841	1,166	1,415	1,822	2,010	2,291
Belgium	4,295	5,585	4,957	5,482	6,504	7,043
Bulgaria			14	68	82	143
Czechoslovakia	[3] 3,175	4,139	4,813	4,819	4,932	5,381
Denmark	108	194	198	219	261	265
Finland	118	162	162	195	206	217
France	8,946	11,947	10,951	11,627	13,880	14,770
Germany:						
East	862	2,087	2,400	2,569	2,765	3,020
West	9,569	17,423	16,998	19,218	23,519	25,561
Greece	[3] 25	[3] 35	[3] 45	62	73	83
Hungary	999	1,608	1,701	1,644	1,796	1,571
Ireland [3]	17	22	22	33	33	33
Italy	2,490	3,897	3,858	4,637	5,947	6,512
Luxembourg	2,638	3,309	2,931	3,117	3,555	3,810
Netherlands	441	755	948	1,023	1,074	1,149
Norway	85	108	122	133	183	316
Poland	2,457	3,509	3,973	4,353	4,879	5,527
Rumania	[3] 485	[3] 770	[3] 790	691	844	862
Saar	1,807	3,112	2,959	3,092	3,483	3,719
Spain	782	1,111	1,063	1,296	1,427	1,365
Sweden	1,490	1,836	1,939	2,028	2,345	2,650
Switzerland [4]	134	172	173	165	183	188
U. S. S. R. [5]	25,375	38,000	42,000	45,600	50,000	53,600
United Kingdom	16,891	18,389	19,723	20,742	22,165	23,137
Yugoslavia	433	499	580	692	903	993
Total [5]	[3] 84,500	119,835	124,735	135,327	153,049	164,206
Asia:						
China	[3] 365	1,490	1,955	2,500	3,210	5,025
India	1,519	1,768	1,688	1,887	1,909	1,947
Japan	3,773	7,703	8,446	8,543	10,371	12,242
Korea:						
North [3]	47	11	11	60	150	210
Republic of		1	1	1	(6)	(6)
Taiwan (Formosa)	9	17	22	28	44	68
Thailand	[7] 10	[3] 4	1	2	4	4
Turkey	116	179	187	187	217	212
Total [5]	5,839	11,173	12,311	13,208	15,905	19,708
Africa:						
Belgian Congo	(6)	1	4	3	2	[3] 2
Egypt [3]	11	11	22	78	95	88
Rhodesia and Nyasaland, Federation of: Southern Rhodesia	19	40	28	36	55	64
Union of South Africa	778	1,326	1,368	1,577	1,742	1,769
Total	808	1,378	1,422	1,694	1,894	1,923
Oceania: Australia	1,491	1,839	2,288	2,476	2,460	2,915
World total (estimate)	188,000	233,100	258,700	246,700	297,700	312,700

[1] This table incorporates a number of revisions of data published in previous Iron and Steel chapters. Data do not add to totals shown owing to rounding where estimated figures are included in the detail.
[2] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.
[3] Estimate. [4] Including secondary. [5] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[6] Less than 500 tons. [7] Average for 1950–51.

Mexico.—Mexico was building two integrated steel plants on the west coast, in addition to other expansion in ingot and rolling-mill capacity at various locations. During the year La Consolidada initiated production of its new 135-ton-per-day capacity furnace at Piedras Negras, thus becoming the third basic iron producer in the country.[16] Cia Fundidora de Fierro y Acero de Monterrey, S. A., obtained a $26 million loan from the Import-Export Bank, which will be used to help finance a modern open-hearth plant with 250-ton furnaces, plus heating and rolling facilities, for the production of flat-rolled products. Mexico also was building a 900-ton-per-day sintering plant.[17]

SOUTH AMERICA

Argentina.—Steelmaking capacity in Argentina will be increased from 260,000 tons to 1,250,000 by 1960. Two 500,000-ton blast furnaces,[18] coke plant, steelmaking facilities, blooming and billet mills, and plate, strip, sheet, and tinplate mills were planned, at an estimated cost of $258 million. This will include approximately $100 million for United States equipment. Credit of $60 million has been given Argentina by the Import-Export Bank to help finance the program.

Brazil.—Brazil's largest steel company, Volta Redonda, will increase its steelmaking capacity from 700,000 to 1 million tons by 1960.

Venezuela.—In Venezuela 2 Italian firms were to build an integrated steel plant at Puerto Ordaz with a capacity of 421,000 tons.[19]

EUROPE

Sweden.—The year 1956 was one of continued progress for the Swedish iron and steel industry. Improvements in productive facilities and the modernization and expansion program begun at the end of World War II enabled the industry to achieve a new alltime record in both crude- and finished-steel production—2.6 and 1.8 million short tons, respectively. It was announced during the year that a new steel plant and rolling mill would be constructed by Trafik AB Grängesberg-Oxelösund (TGO) at Oxelösund, a Baltic seaport open to navigation throughout the year. The new plant will have an annual production capacity of 475,000 short tons of ingot steel. The rolling mill was to be equipped for an annual capacity of 330,000 tons of rolled products, primarily ship's plate and heavy plate for other special requirements.

This project was scheduled for completion in 1961 at an estimated cost of 465.6 million kronor (1 krona equals US$0.193). Of this amount, 169 million is for the rolling mill and 93.5 million for the steel plant. The balance is to be expended as follows: The existing coke plant is to be expanded from 27 coke ovens to 72; an iron-ore-sintering plant, with an annual capacity of 660,000 short tons, will be constructed; a new blast furnace of 330,000 tons annual capacity will

[16] Bureau of Mines, Mineral Trade Notes: Vol. 45, No. 2, August 1957, pp. 10–11.
[17] Madsen, I. E., Developments in the Iron and Steel Industry During 1956: Iron and Steel Eng., January 1957, p. 127.
[18] Bureau of Mines, Mineral Trade Notes: Vol. 44, No. 6, June 1957, pp. 14–15.
[19] Madsen, I. E., Developments in the Iron and Steel Industry During 1956: Iron and Steel Eng., January 1957, p. 127.

be installed; several limestone and dolomite kilns will be added; and facilities for generating and distributing electric power and gas and other auxiliary installations will be provided.[20]

At the Domnarfvet works a new type of rotating converter designed to overcome the difficulties experienced when the Austrian Linz-Donawitz process is applied to high-phosphorus pig iron was used experimentally. A symmetrical, pear-shaped vessel is mounted on trunnions similar to the ordinary converter, but can also be revolved about its longitudinal axis at up to 30 r. p. m. Oxygen is injected into the mouth of the vessel when it is some 20° from the horizontal position and is rotating at 30 r. p. m. It is claimed that a 2-percent-phosphorus pig iron can be dephosphorized and converted to low-nitrogen steel without the difficulties of "slopping," foaming, and fume that have proved very cumbersome heretofore.

The Kalling process developed in Sweden for removing sulfur from high-sulfur pig iron is effective and inexpensive and was adopted by steel plants in various parts of Europe.[21] The process consists of agitating molten pig iron with 1 to 2 percent of powder lime in a revolving drum.

U. S. S. R.—Soviet Russia's Sixth Five-Year Plan (1956–60) stressed expansion, technologic developments, and automation. The plan calls for increasing pig-iron output from 37 million short tons in 1956 to 58 million tons by 1960, and steel production from 53.6 million tons to 75 million.

There were about 130 blast furnaces in Russia, and it was reported that 85 percent operate with automatic humidity control (moisture equals 2.5 percent of air blast by volume). Self-fluxing sinter was widely used, and its proportion will increase from 54 percent of the iron-bearing burden in 1955 to 80 percent in 1960.

In steelmaking open-hearth capacity increased 25 percent by employing oxygen. Most of the plants used mixtures of blast-furnace gas and coke-oven gas for open-hearth fuel. The Russians favor open hearths of 300 tons or over, and some 500-ton furnaces are being built.[22]

The European Coal and Steel Community.—Pig-iron and steel production in the European Coal and Steel Community established a new record in 1956, with 48.5 million short tons of pig iron and 62.6 million tons of steel. Pig-iron and steel production was 6.4 and 7.9 percent, respectively, above 1955.

As in the rest of the world, the Community was expanding its ore-dressing, pig-iron, steelmaking, and rolling-mill facilities. Actual production for 1952 and 1956 and production potential or capacities for 1956 and 1960 are given in table 23.

As noted in this table, the increased use of sinter in the Community parallels the trend in the United States. Sintering capacity in 1960 indicated by investments may double what it was in 1956. Counting the sinter produced at mines, approximately one-third of the blast-

[20] Bureau of Mines, Mineral Trade Notes: Vol. 44, No. 2, February 1957, pp. 10–12.
[21] Brandt, D. J. O., Technical Developments in the Steel Industry: Iron and Coal Trades Rev., vol. 174, No. 4627, Jan. 25, 1957, pp. 197–200.
[22] Metal Bulletin (London), Challenge to West by U. S. S. R.: No. 4062, Jan. 20, 1956, pp. 9–10.
Voice, E. W., and Klemantaski, S., Ironmaking in the U. S. S. R.: Jour. Metals, vol. 9, No. 4, April 1957, pp. 592–596.
Iron and Coal Trades Review, Plant and Equipment at Two Russian Steel Centres: Vol. 174, No. 4626, Jan. 18, 1957, pp. 151–152.
Wilson, Lee, Russian Log: Iron and Steel Eng., vol. 33, No. 10, October 1956, pp. 150–162.

TABLE 23.—European Coal and Steel Community production and capacity for sintered ore, pig iron, and steel 1952, 1956, and 1960, in short tons

	Actual production			Capacity as indicated by investments started or approved at the end of 1956		
	1952	1956	Change from 1952 (percent)	1956	1960	Change from 1956 (percent)
Sintered ore [1]	16.1	20.1	+25	22.0	44	+100
Pig iron	38.4	48.1	+26	50.2	64	+28
Steel	46.2	62.6	+36	64.5	83	+28
Finished rolled products	32.3	43.7	+36	45.2	58	+30

[1] Sintered ore and other elements in the ferrous charge, at iron and steel works only.

furnace metallic charge will be sinter by 1960. Pig-iron output will be increased through improved blast-furnace burdens and new construction. As a result of the scrap shortage, the emphasis in steel expansion will be in processes that utilize high percentages of pig iron. All existing processes will be expanded plus a predicted combined capacity of 3 million short tons for the Linz-Donawitz process and the German "Rotor" process. As a result of the uncoordinated investments in preceding years, the pig iron-to-steel ratio will drop from the 1956 level of 1,540 pounds per short ton to 1,490 during 1957–58 and back to 1,540 by 1960.

In increasing the proportion of pig iron in steelmaking charges, two lines of action will be considered.

(a) The pig-iron input in open-hearth and electric furnaces may be increased considerably. Since the proportion of pig iron to scrap used in European open hearths is much below that in the United States, there is room for increasing the use of pig iron in this field. In the electric furnace the quantity of pig iron used may be increased by the use of the duplex process. Also, consideration will be given to Krupp-Renn balls, which may be employed as a substitute for scrap.

(b) Pig-iron input may also be increased by employing new techniques and new processes by which steel may be made to compare in quality with open-hearth and electric-furnace grades. These include: (1) The use of oxygen-enriched air in converters, which reduces the nitrogen and phosphorus content; (2) the use of mixtures of oxygen and steam or oxygen and carbon dioxide, which gives still better qualities of steel for certain purposes; (3) the Linz-Donawitz process, in which pure oxygen is surface-blown at high velocities onto the molten-metal bath and which enables hematitic and low-phosphorus pig iron to be refined at comparatively small capital expenditure; (4) the Perrin process, which produces higher quality steels by stirring in specially prepared slag melted in the electric furnace; and (5) conversion of basic Bessemer pig with oxygen in the rotary furnace. This process will be given a particularly attentive study.

In regard to research on steel in the Community, the High Authority set aside $1 million to make comparative tests in 1956 with different grades of coke in blast furnaces. $200,000 has been set aside to pinpoint the irregularities in steel rolling that affect the finished product

and to establish the factors governing the formation and adhesion of scale. In addition, the High Authority alloted $383,000 for studies in improving the quality of refractory materials and studies on flame radiation. A grant of $850,000 was made to the international research program, covering the low-shaft blast furnace at Liége, Belgium. A credit of $650,000 was allotted the various technical research centers that are making tests leading to the reduction of furnace inputs and improve efficiency. All of the assistance granted by the High Authority on steel totals $3,830,000.[23]

ASIA

China.—The Chinese Communist Party Congress in Peking approved a Second Five-Year Plan during the year, for increasing steel production from the 1957 objective of 6.0 million short tons to 13.2 million tons by 1962. The program covered items other than steel, such as aluminum and electrical energy. Emphasis was placed on the use of atomic energy and automation in fulfilling the plan. Chinese pig-iron and steel production in 1956 was 5.6 million and 5.0 million short tons, respectively.[24]

India.—Production of steel in 1956 was about the same as in 1955. However, imports doubled, totaling about 2 million tons compared with 1 million in 1955. Three new steel plants, having a combined annual capacity of 2.5 million tons of finished steel, were being constructed at Rourkela, Bhilai, and Durgapur. The Rourkela and Bhilai plants were scheduled to go into production in late 1958 and the Durgapur in June 1959. The three existing plants, Tata Iron & Steel Co., Indian Iron & Steel Co., and Mysore Iron & Steel Works, were being expanded to about 2.7 million tons annual capacity by 1960. The total projected output for the country of 5.2 million tons of steel by 1960 should relieve India of its past practice of importing approximately half of the steel requirements.[25]

Japan.—New records were established for pig iron, crude steel, and ordinary rolled steel. Tonnages and percentages of increase over 1955 were 6.9, 12.2, and 9.0 million short tons and 16, 18, and 20 percent, respectively. Although heavy industry, machinery, shipbuilding, and construction consumed record tonnages of steel, shortages occurred in the small consumer groups, chiefly light industry and building trades. Also, the shortage of pig iron resulted in increased dependence upon imported ferrous scrap to meet metallic requirements for the iron and steel industry. To cope with this situation, the Japanese steel industry revised its 5-year construction plan for blast furnaces to provide an increased capacity of 50 percent above the 1956 level. The revised plan included construction of additional oxygen-steel converters that will reduce the quantity of scrap needed for steel production. Planned converter production in 1960 will be 3.7 million short tons, compared with 0.5 million tons in 1956.

The price of steelmaking pig iron increased from ¥22,700 [26] per short ton in January to ¥27,200 in December. Because of speculative buying the price of 19-mm. bars rose to ¥88,000 in September,

[23] European Iron and Steel Community, Fifth General Report on the Activities of the Community: Pub. Dept., Apr. 13, 1957, 358 pp.
[24] Metal Bulletin (London), No. 4132, Oct. 2, 1956, p. 12.
[25] Bureau of Mines, Mineral Trade Notes: Vol. 44, No. 5, May 1957, pp. 9–15.
[26] US$1=360 yen.

which prompted announcement of an allocation arrangement for certain steel products by the Government. As the result of this announcement, speculators were discouraged, and the price of these bars dropped to ¥60,800 in December. During the same period the mill price for this product increased from ¥41,700 to ¥44,500. The average wage of steelworkers per day was $2.78.[27]

Taiwan (Formosa).—A preliminary agreement between the Chinese Nationalist Government and the Aetna-Standard Engineering Co. of Pittsburgh, Pa., to establish an iron and steel plant in Formosa was announced. This plant, with an output of 200,000 tons annually and costing between $55 and $60 million, will use local coal and Philippine iron ore. Formosa has consumed about 180,000 tons of steel yearly, of which about 110,000 tons has been imported in semi-finished form for use in making plates, rails, structural steel, galvanized sheets, tinplate, and bars.[28]

OCEANIA

Australia.—Australia's steel production continued to be about three-fourths million short tons below consumption. Pig-iron and steel production for 1956 was 2.3 and 2.9 million tons, respectively. To meet the shortage of steelmaking and finishing capacity, the Broken Hill Proprietary Co., Ltd., and its subsidiary, Australian Iron & Steel, Ltd., Australia's sole producers, have been expanding their plants. A new 1-million-ton-per-year hot-strip mill, the first wide hot-strip mill in Australia, was completed at Port Kembla in August 1955 at a cost of A30 million.

Also at Port Kembla 2 new 300-short ton open hearths were completed, increasing Australian steelmaking capacity by 400,000 tons. Several rolling mills were under construction or had recently been built at other locations. A tinplate mill with an annual capacity of 75,000 tons was scheduled for completion at Port Kembla in late 1957. An ore screening and sintering plant valued at A4.7 million was completed at Port Kembla. Blast-furnace output was expected to increase through improving blast-furnace feed.[29]

[27] U. S. Embassy, Tokyo, Japan, State Department Dispatch 1039: Apr. 2, 1957.
[28] Metal Bulletin (London), No. 4151, Dec. 7, 1956, p. 25.
[29] U. S. Consulate General, Sydney, Australia, State Department Dispatch 110: Jan. 22, 1957.
Mining Journal (London), Steel Expansion: Vol. 245, No. 6264, Sept. 9, 1955, p. 288.
Chemical Engineering and Mining Review, vol. 49, No. 4, Jan. 15, 1957, p. 111.