MANGANESE.

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INTRODUCTION.

Manganese is an essential element in the steel industry. Prior to 1870 the iron used was largely in the form of cast and wrought iron and crucible steel, to which no manganese is added. The develop-

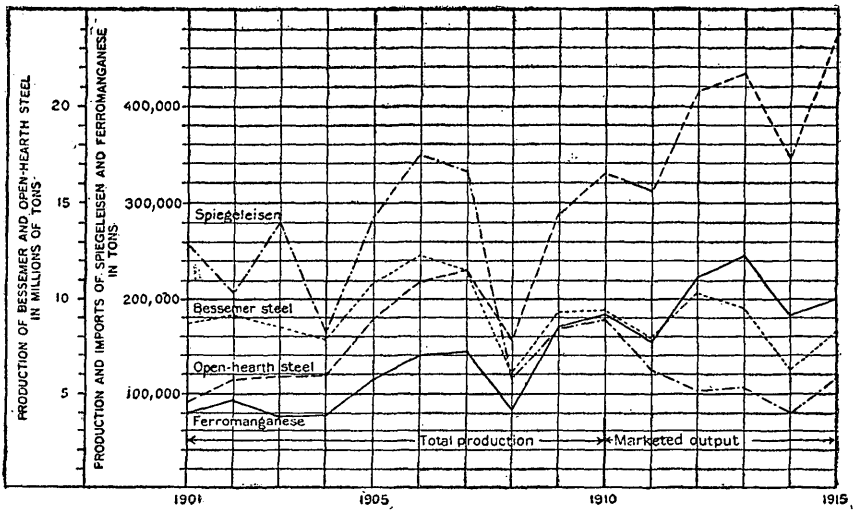

FIGURE 1.—Diagram showing the production of Bessemer and open-hearth stee and the combined production and imports of spiegeleisen and ferromanganese, 1901–1915.

ment of the Bessemer and open-hearth processes of making steel about 1870 created a demand for manganese alloys, and during recent years about 14 pounds of manganese in the form of ferromanganese or spiegeleisen is added to every ton of steel produced by these processes. Ferromanganese contains from 77 to 80 per cent of manganese and is largely used in making open-hearth steel. Spiegeleisen contains 12 to 33 per cent of manganese and is largely used in making Bessemer steel. Manganese also forms a large part of certain alloys that are almost essential to modern industry and are used especially in the manufacture of grinding and crushing machinery.

In addition, certain grades of manganese ore are needed for the manufacture of dry batteries.

As most of the manganese in Bessemer steel is added in the form of the low-grade manganese alloy spiegeleisen, and as the higher-grade ferromanganese is used in making open-hearth steel, it should be expected that the sum of the production and imports of these alloys should show a close relation to the production of Bessemer and open-hearth steels, respectively. This relation is shown in figure 1, which shows also the general decline in the production of Bessemer steel in the United States during recent years and the great advance in the production of open-hearth steel. The extent to which this displacement of one variety of steel by the other is due to factors of cost, on the one hand, and qualities of product, on the other, is probably a matter concerning which only steel metallurgists are competent judges. The same may be said concerning the possibility of using spiegeleisen instead of ferromanganese in the open-hearth process. There can be no doubt, however, that if imports of ferromanganese, as well as of the high-grade ores needed to make it, were shut off, considerable readjustment in either practice or plants would be necessary to maintain the present rate of production.

At present most ferromanganese is made by smelting in the common type of iron blast furnace a mixture of high-grade manganese ore with enough iron ore to make a product containing about 80 per cent of manganese and 15 per cent of iron. Recently a small tonnage of ferromanganese has been made in the electric furnace, but information at present available indicates that the electric process can compete with the blast-furnace process only where there are exceptionally favorable local conditions, such as the proximity of sources of ore to sources of cheap electric power. In both processes the losses of manganese in slag and flue dust and by volatilization are large. For both processes ore containing at least 40 per cent of manganese, less than 8 per cent of silica, and less than 0.2 per cent of phosphorus is desired.

Spiegeleisen is made in the blast furnace, and at present more than half of the amount produced is obtained by smelting manganiferous zinc residuum, which contains about 40 per cent of iron and 14 per cent of manganese. Spiegeleisen may be made from mixtures of high-grade manganese ore and iron ore, from manganiferous iron ore, and from manganiferous silver ore.

GENERAL CONDITIONS.

MANGANESE AND MANGANIFEROUS ORES.

For convenience in presenting statistics the United States Geological Survey recognizes four classes of materials that contain manganese. (1) Manganese ore, most of which contains more than 40

per cent of manganese, is used in making ferromanganese and dry batteries. (2) Manganiferous iron ore, most of which contains from 12 to 25 per cent of manganese, is largely used in making spiegeleisen, but some is mixed with high-grade imported manganese ore to make low-grade ferromanganese and some is used to make high-manganese pig iron. (3) Manganiferous silver ore, whose composition closely resembles that of manganiferous iron ore, is largely used as a flux by lead smelters, but from time to time large quantities are smelted to spiegeleisen. (4) Manganiferous zinc residuum is similar in composition to manganiferous iron ore and is smelted to spiegeleisen.

The following table shows the number of operators of manganese mines that reported to the Survey for 1912 to 1915 and the number that shipped ore during those years:

Operators of manganese mines in the United States, 1912–1915.

	1912		1913		1914		1915	
	Reported.	Shipped.	Reported.	Shipped.	Reported.	Shipped.	Reported.	Shipped
Alabama	1	0	1	0	1	0	3	1
Arizona	1	0	1	0	1	0	3	1
Arkansas	3	0	3	0	3	0	10	7
California	8	2	8	0	22	2	26	6
Colorado					1	0	7	1
Georgia	5	0	5	0	5	0	8	4
Maine	1	0	1	0	1	0	1	0
Maryland					1	0	1	0
Montana	1	0	1	0	1	0	2	0
New Mexico					1	0	1	0
Oklahoma							1	0
Oregon							1	0
South Carolina	1	1	1	0	1	1	1	0
Tennessee	4	0	3	0	4	0	7	1
Texas	2	0	1	0	1	0	1	1
Utah	2	0	2	0	2	0	6	2
Virginia	31	5	27	4	28	7	36	7
Washington			1	0	1	0	6	0
West Virginia					1	0		
	60	8	55	4	75	10	121	31
Ore shipped, long tons		1,664		4,048		2,635		9,709

The largest domestic production of manganese ore for a single year was but 34,524 tons in 1887, and since that year, except for several brief periods, the domestic production has declined rather steadily.

The average annual production from 1880 to 1915 was 10,645 tons. Although one mine is reported to have produced about 250,000 tons most of the product has come from many small mines worked intermittently. Information concerning many of the deposits indicates that they were formed by the accumulation near the surface of manganese originally disseminated in minute quantities through the adjacent rocks. In order to obtain a marketable product from most of these mines, the raw ore must be washed and concentrated. On account of the nature of the deposits and conditions in the industry, little ore is developed in advance of mining, so that the extent of the individual deposits is not accurately known.

In contrast with the domestic production, the imports of manganese ore, largely from India, Brazil, and Russia, have rather steadily risen in proportion to the production of steel. The extensive deposits of these countries are rich enough to permit the shipment of large quantities of ore without concentration. The subjoined table shows the relation of the production and imports of manganese ores and alloys to the production of steel in the United States. The table also shows that whereas Russia, India, and Brazil commonly contribute to the imports into the United States, each country in turn has supplied the largest quantity for short periods.

Manganese alloys and ore produced in the United States and imported from important foreign sources, 1890–1916, in long tons.

Year.	Steel.	Ferromanganese.		Spiegeleisen.		Manganese ore.				
	Production.	Production.	Imports.	Production.	Imports.	Production.	Total imports.	Imports from—		
								Russia.	India.	Brazil.
1890	4,277,071	.....	.....	.....	.....	19,287	34,154	.....	.....	.....
1891	3,904,240	.....	.....	.....	.....	22,452	28,825	.....	.....	.....
1892	4,927,581	.....	.....	.....	.....	13,613	58,572	.....	.....	.....
1893	4,019,995	.....	.....	.....	.....	7,718	68,113	[a] 36,070	[b]	.....
1894	4,412,032	.....	.....	.....	.....	6,308	44,655	[a] 28,300	.....	[c]
1895	6,114,834	.....	.....	.....	.....	9,547	86,111	[a] 55,987	.....	.....
1896	5,281,689	.....	.....	.....	.....	10,088	31,489	[a] 3,600	.....	.....
1897	7,156,957	.....	.....	.....	.....	11,108	119,961	38,910	17,400	12,083
1898	8,932,857	.....	.....	.....	.....	15,957	114,885	46,396	5,944	17,031
1899	10,639,857	.....	.....	.....	.....	9,935	188,349	73,397	17,950	28,115
1900	10,188,329	[d]	[e]	[d]	[e]	11,771	256,252	132,121	10,650	54,451
1901	13,473,595	59,639	20,750	231,822	26,827	11,995	165,722	32,600	11,000	48,029
1902	14,947,250	44,526	50,388	138,408	68,813	7,477	235,576	3,338	64,170	102,550
1903	14,534,978	35,961	41,519	156,700	122,015	2,825	146,056	5,576	35,960	76,910
1904	13,859,887	57,076	21,813	162,370	4,623	3,146	108,519	11,959	10,200	66,875
1905	20,023,947	62,186	52,841	227,797	55,457	4,118	257,033	24,650	101,030	114,670
1906	23,398,136	55,520	84,359	244,980	103,268	6,921	221,260	13,805	154,180	30,260
1907	23,362,594	55,918	87,400	283,430	48,994	5,604	209,021	1,000	95,300	52,922
1908	14,023,247	40,642	44,624	111,376	4,579	6,144	178,203	250	143,813	17,150
1909	23,955,021	82,209	88,934	142,831	16,921	1,544	212,765	14,486	145,140	35,600
1910	26,094,919	71,376	114,228	153,055	25,383	[f] 2,258	242,348	33,120	140,965	53,750
1911	23,676,106	[f] 74,602	80,263	[f] 104,013	20,970	[f] 2,457	176,852	19,103	103,580	41,600
1912	31,251,303	[f] 125,378	99,137	[f] 102,561	1,015	[f] 1,664	300,661	83,334	128,645	81,580
1913	31,300,874	[f] 119,495	128,070	[f] 106,980	77	[f] 4,048	345,090	124,337	141,587	70,200
1914	23,513,030	[f] 100,731	82,997	[f] 76,625	2,870	[f] 2,635	283,294	52,681	103,583	113,924
1915	32,151,036	[f] 144,260	55,263	[f] 114,556	200	[f] 9,709	313,985	.....	36,450	268,786
1916	[g]	[h] 221,532	90,928	[h] 194,002	.....	[i] 33,000	576,321	.....	51,960	471,837

[a] Drake, Frank, The manganese ore industry of the Caucasus: Am. Inst. Min. Eng. Trans., vol. 28, p. 191, 1898.
[b] First shipment made from India.
[c] First shipments made from Brazil.
[d] Figures for ferromanganese and spiegeleisen combined prior to 1901.
[e] Figures for fiscal years only available prior to 1901.
[f] Marketed production.
[g] Figures not yet available.
[h] American Iron and Steel Institute.
[i] Estimated.

Deposits of manganiferous iron ores have been worked in several States. With the exception of those in the Lake Superior region, the ores from most of which contain less than 5 per cent of manganese and are therefore smelted to pig iron, most deposits of manganiferous iron ore in the United States have a geographic distribution similar to those of manganese ore. Many deposits yield material of both

classes. The following table shows the number of operators of manganiferous iron and silver mines that reported to the Survey for 1912 to 1915 and the number that shipped ore during those years. The operators of those deposits in Marquette County, Mich., and Iron County, Wis., whose product is smelted to pig iron are not included in the table:

Operators of manganiferous iron and silver mines in the United States, 1912–1915.

	1912		1913		1914		1915	
	Reported.	Shipped.	Reported.	Shipped.	Reported.	Shipped.	Reported.	Shipped.
Arizona [a]							1	1
Arkansas	2	1	3	2	2	2	3	2
Colorado [a]	20	20	24	24	23	23	52	52
Georgia							1	1
Minnesota	0	0	2	1	3	2	10	3
Nevada [a]							1	1
Vermont	1	0	1	0	1	0	1	0
Virginia	2	2	3	0	4	4	6	6
	25	23	33	27	33	31	75	66
Ore shipped, long tons		51,517		85,603		98,265		185,238

[a] Manganiferous silver ore.

Manganiferous silver ore is derived largely from the Leadville district, Colo., where the weathered parts of lead-silver deposits contain sufficient manganese, iron, and silver to warrant shipment to lead smelters for use in fluxing. From time to time the Colorado Fuel & Iron Co. manufactures spiegeleisen from these ores. The manganiferous silver ore may be regarded as a by-product of the mining of the lead-silver ore of the district, for if the mines were not operated for that purpose it would not pay to extract the manganiferous ore.

Manganiferous zinc residuum is a by-product of the smelting of manganiferous zinc ore from mines near Franklin Furnace, N. J. After the zinc is extracted the residue is smelted to spiegeleisen. As zinc is the most valuable product, the output of the mines varies with the demand for zinc and zinc oxide.

As the approximate composition of each of these varieties of ore has been submitted by the shippers, it is possible to calculate approximately the amounts of metallic manganese which they contained. The sum of these amounts, which are shown in the table below, less the losses in reduction, which range from 15 to 50 per cent, gives a figure that represents approximately the amount of metallic manganese which would have been available if all the current domestic supply of ore had been converted to manganese alloys. Most of the Colorado and Nevada manganiferous silver ore was not smelted to manganese alloys, however, but was used as flux in smelting lead ore.

A part of the manganese ore and manganiferous iron ore was used directly to make dry batteries and other articles.

On the last line of the table are given the percentages of the total manganese needed by the domestic steel industry as alloys that could have been supplied by domestic deposits if all the ore had been reduced. According to this calculation, domestic deposits could have supplied during 1915 at most only one-fifth of the demand for manganese in alloys.

Manganese recoverable from ore produced in the United States, 1912–1915, in long tons.

Source.	1912		1913		1914		1915	
	Ore.	Manganese.	Ore.	Manganese.	Ore.	Manganese.	Ore.	Manganese
Manganese ore	1,664	799	4,048	1,943	2,635	1,265	9,709	4,660
Manganiferous iron ores [a]	2,899	580	35,850	6,646	58,384	10,732	48,193	9,040
Manganiferous silver ores	48,618	7,293	49,753	5,970	39,881	6,780	137,045	17,504
Manganiferous zinc residuum	104,670	13,701	102,239	13,996	100,198	14,438	159,318	23,053
		22,373		28,555		33,215		54,257
Manganese recoverable as alloys		15,023		19,096		22,312		36,792
Percentage of total manganese needed		7.5		8.8		13.8		21.0

[a] Exclusive of Marquette County, Mich., and Iron County, Minn.

FERROMANGANESE AND SPIEGELEISEN.

The ferromanganese needed for the American steel industry has been supplied in part by imports of the alloy itself and in part by domestic manufacture from imported ore. It is evident that the domestic manganese ore is the source of little ferromanganese. The available data for spiegeleisen, however, show that prior to 1914 about half of the domestic product was made from domestic ore. During recent years the imports of spiegeleisen have been negligible. The available supply of these manganese alloys for 1912 to 1915 and the approximate content in manganese is shown in the table on page 7. From these results, it has been calculated that for the four-year period an average of 14 pounds of manganese has been consumed for each ton of steel produced.

The number of makers of ferromanganese increased from 2 in 1912 to 5 at the end of 1914, and of spiegeleisen from 3 to 6.

Makers of manganese alloys, 1912–1915.

	1912	1913	1914	1915
Ferromanganese	2	2	5	8
Spiegeleisen	3	4	6	7

Available supply of manganese alloys in the United States, 1912–1915, in long tons.

	1912		1913		1914		1915	
	Quantity.	Manganese content.	Quantity.	Manganese content.	Quantity.	Manganese content.	Quantity.	Manganese content.
Imports:								
Ferromanganese	99,137	[a] 79,310	128,070	[a] 102,456	82,997	[a] 66,398	55,263	[a] 42,210
Spiegeleisen	1,015	[a] 183	77	[a] 14	2,870	[a] 417	200	[a] 36
Domestic production:								
Ferromanganese	125,378	[b] 98,430	119,495	[b] 94,342	100,731	[b] 79,408	144,260	[b] 110,134
Spiegeleisen	102,561	[b] 19,618	106,980	[b] 20,790	76,625	[b] 15,288	114,556	[b] 22,808
	.....	197,541	.....	217,602	.....	161,511	.....	175,189

[a] Percentage of manganese estimated. [b] Percentages of manganese submitted by makers.

PRICES.

The market price of ferromanganese in the United States appears to depend upon several factors. As about half of our supply of this alloy is imported from England, where it is made from imported ore, and as most of the remainder is made in the United States from imported ore, the price of ferromanganese depends in part on economic conditions in the countries which are the sources of ore and in England and on the demands of the steel industry in the United States.

Figure 2 shows the range in price per unit of 49 per cent manganese ore and of standard ferromanganese (75 to 80 per cent manganese) for prompt delivery from 1910 to 1917. Such a diagram can not show accurately the prices at which these materials are sold, because there is no established market for them, as there is for several other metals. The diagram shows that the price offered for 49 per cent ore from 1910 to 1914 ranged from 26 to 23 cents a unit, and for ferromanganese from $40 to $70 a ton.

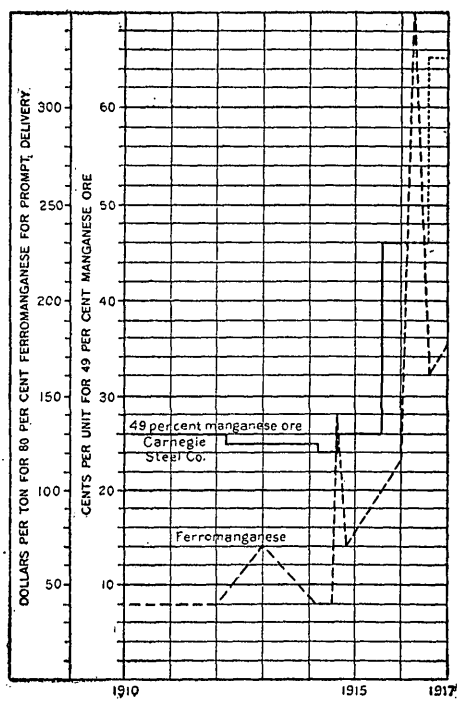

FIGURE 2.—Diagram showing prices of ferromanganese and manganese ore, 1910–1917.

CONDITIONS SINCE 1914.

MANGANESE AND MANGANIFEROUS ORES.

The first effect of the war in Europe was to reduce imports of ore from Russia and India. This reduction continued through 1915, but although Russian ore is no longer obtainable, imports from India were much larger in 1916 than in 1915.

In the United States the shortage of manganese ore did not greatly stimulate mining until 1915. For that year the number of shippers and the marketed production were three times those of 1914. At present there is a likelihood that the number of shippers and the marketed production for 1916 will be about three times those of 1915. Most of the increase in production for both these years was derived from deposits previously known. Recently discovered deposits in Arizona, California, Colorado, Nevada, Utah, Virginia, and Washington have been sources of production since 1914, but several of these deposits would probably have been exploited even had the war not developed a shortage. Little is known concerning most of the new deposits, except that several have shipped considerable ore. Many other discoveries are reported, but as the superficial exposures of manganese deposits are likely to be deceptive to casual observers, it would not be advisable to assume without further investigation that these new deposits will become sources of production. No manganese ore has been received from Russia since 1914, and imports from India are considerably below the normal. On the other hand, imports from Brazil and Cuba have greatly increased and more than make up for the loss of supplies from Russia and India.

The number of shippers of manganiferous iron ores was also greater in 1915 than in 1914, but the marketed production decreased. It is a coincidence that war should have come in Europe and a shortage of manganese ores have developed at a time when attempts were being made to exploit the manganiferous iron ores of the Cuyuna range, Minn. If the manganiferous zinc residuum of New Jersey is omitted, the shipments of these ores in 1914 contained more metallic manganese than all other shipments in the United States. As a result of the operations of a number of mines, large amounts of ore carrying from 10 to 20 per cent of manganese have been proved as reserves. This activity is obviously due to the high prices offered for manganese alloys and may cease if prices drop, but there is good reason for believing that sufficient ore from which spiegeleisen and low-grade ferromanganese can be made is available in case of need.

The shipments of manganiferous residuum during 1915 increased greatly over the average of previous recent years. The production

of this material is dependent upon the output of zinc ore, and the reserves may not be readily available.

One direct result of the shortage of manganese ore has been the stimulus to miners of manganiferous silver ores to select portions of the ore rich enough in manganese to be more valuable for this metal than for their small gold and silver content. Thus, one mine in the Tombstone district, Ariz., is treating a fairly large quantity of the raw ore in mills and producing a concentrate rich enough in manganese to be used in making dry batteries and ferromanganese, while the tailing is shipped to smelters as a flux. In the Philipsburg district, Mont., high-grade manganese ore is being mined and shipped from the oxidized zones of gold and silver bearing veins that have never before been sources of manganese ore. In addition to the Leadville district, Colo., the Pioche district, Nev., has recently been the source of large shipments of manganiferous silver ore, which is largely used as a flux by lead smelters. There is little doubt that if the price of spiegeleisen were double that now offered a large part of the product of both districts would be used to make this alloy.

FERROMANGANESE AND SPIEGELEISEN.

As the war has made heavy demands on the steel industry of England, it is natural that her exports of products like ferromanganese should be curtailed. In fact, from November, 1914, to March, 1915, there was an embargo on the shipment of ferromanganese from England. The resulting shortage in the United States has been met by an increase in domestic production. So far as information is available, it appears that the increase has been accomplished by the entrance of new makers into the field, rather than by increase in the output of those already in it. The number of makers of ferromanganese in 1915 was eight, and there were several additional in 1916. The production of spiegeleisen has increased slightly, and several new makers entered the field in 1916.

PRICES.

The prevailing price of manganese ore has steadily risen since 1914, but the increases have lagged behind those in ferromanganese. For 15 years prior to 1914 the price per unit of 49 per cent ore in the United States ranged from 23 to 30 cents, but during 1916 it rose first to 45 cents and later to 65 cents. The price of 65 cents was maintained through the early months of 1917.

Soon after the war broke out the price of ferromanganese rose suddenly from $40 to $120 a ton for a brief period, then ranged from $70 to $115 for more than a year. During 1916 prices ranged from $115 to $175 a ton, except for a short time in April, when $400 a ton was

recorded. This great rise was probably caused by Germany's declaration of a blockade of England. In February, 1917, the price reached $250 a ton.

The price offered for standard 18 to 22 per cent spiegeleisen has also increased from about $25 a ton in 1914 to $50 in 1916 and $65 in 1917.

SUMMARY.

The preceding review of the trend of production, imports, and prices of manganese ore and alloys during the last three years of extraordinary demands, when several regular sources have been largely eliminated, leads to several conclusions. First, it is reassuring to know that even if Russian and Indian ores are largely eliminated, Brazil can supply the enormous quantity of high-grade ore that has been required. On the other hand, the meager response of domestic manganese mines to prices that are three times normal, though not wholly unsuspected, is a source of apprehension. Some new deposits have been found, but there is no assurance that they are larger than those previously known. There can be little doubt that if conditions demanded the maintenance of the 1916 output of steel and if imports of manganese ore and ferromanganese were shut off, the deposits of manganese ore now developed in the United States could not meet the demands, and much readjustment in the steel industry would be necessary.

In any industry shortage of material may develop either through actual deficiency of supplies or because it ceases to be profitable to produce the grades of raw material hitherto considered acceptable. In the case of manganese it appears that the United States faces the second situation. The supply of high-grade manganese ore is deficient, but there is reason for expecting that if the lower-grade manganiferous iron ore and materials of similar composition can be more widely utilized, an adequate supply of raw material can be obtained for several years at least. It is not clear what increase in price of manganese alloys would be necessary to bring forth the required supply, but it seems certain that the needs could be met by the combined output of manganiferous iron ore, manganiferous silver ore, and manganiferous zinc residuum.

There can be little doubt that, under necessity, the manganese and manganiferous iron deposits of Virginia, Georgia, Tennessee, and Arkansas can be made with little additional equipment to yield twice or three times the present output for several years. Undoubtedly, however, the deposits of the Cuyuna range, Minn., offer a greater supply in a smaller area, and as a number of mines are reported to be exploring that range in advance of production only small additions to equipment should be necessary to make large tonnages available.

The recent increase in prices of alloys has diverted for the manufacture of spiegeleisen large quantities of manganiferous silver ores that previously had been used only as flux. Mines at Leadville, Colo., and Pioche, Nev., have shipped a large aggregate quantity and will probably continue to ship, but in such districts explorations are rarely carried on greatly in advance of production. The ratios of iron, manganese, and siliceous matter in the manganiferous siderite from which the oxidized ores of Leadville appear to have been formed closely resemble those in other materials that are now smelted to spiegeleisen. Systematic investigation in Pioche, Leadville, and elsewhere may show that these districts contain large quantities of manganiferous siderite which may be smelted to spiegeleisen. Although manganiferous silver ore is being shipped by other districts, such as Tombstone, Ariz., Silver City, N. Mex., and Philipsburg, Mont., there is no prospect that they are capable of shipping as much as Leadville and Pioche. The most recent information from Eureka, Nev., and Tintic, Utah, does not encourage the hope for production from those districts.

The largest resources of manganiferous materials in the United States are those from which only spiegeleisen may be made by processes now in use. It would be well to inquire whether there is a prospect of making from such materials, by milling methods or preliminary smelting, a product rich enough in manganese to be smelted to ferromanganese. Most of the manganese ore now produced in the United States is subjected to washing and other processes of concentration, and some of the manganiferous silver ores of Tombstone, Ariz., yield by concentration a high-grade manganese ore. According to press reports, experiments are being made with ores from the Cuyuna range, Minn., with the hope of extracting a part of the iron minerals and thereby raising the manganese content of the remainder.

The suggestion has been made recently that it is possible to smelt manganiferous iron ores in such a way that most of the iron is reduced to metal and the manganese thereby concentrated in a slag from which ferromanganese might be smelted. It is possible that some ores might be treated in this manner, but as the silica of the ore would also be concentrated in the slag and the losses of manganese would reach a maximum when it is reduced from material with high silica content, it is doubtful whether such a process could be used profitably to make ferromanganese from most of the ores now available.

The possibility of using this or similar processes to make ferromanganese from materials not available by present methods must be weighed against the alternative of extending the uses of spiegeleisen to the manufacture of all kinds of steel, rather than to that of steel

made by the Bessemer process alone. These questions require investigation by competent metallurgists, but it may serve a purpose to call attention to them. The problem of adequate manganese supply resolves itself into two parts—production, on the one hand, and utilization, on the other. Most manufacturers of steel are aware of the conditions that affect the current supplies of manganese ores and alloys, but it is possible that they have not adequately considered the prospect of utilizing other manganiferous ores. Of course, the need for using these ores will not arise until imports of high-grade ores have been stopped, but it is evident that experiments should be made now and that the steel makers are best equipped to undertake them.

In order to insure the maximum production of ores of all grades, the cooperation of competent economic geologists, mining engineers, and owners of manganese deposits is suggested. As the manganese deposits of the United States have not yet been able to supply large quantities of ore in competition with several foreign sources, the operation of most domestic manganese mines has ceased to be profitable, and much of the annual output is derived from brief campaigns of operation by optimistic investors who know little about the business and its risks. The mining of manganese ores therefore does not appear to attract the able engineers and workmen who make a success of mining iron ore and coal in the same or near-by regions. It is not impossible that the production of high-grade manganese ore might be made profitable and be increased three or even six times if the owners of the mines had the benefit of competent technical advice and supervision. It would be worth while to consider the advisability of procuring for the owners of properties more or less developed the cooperation of members of the Geological Survey, the Bureau of Mines, and the American Institute of Mining Engineers. Geologic reconnaissance of a number of new deposits by the Geological Survey and prospecting by individuals may also extend the known occurrences.