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THE MANCHURIAN IRON AND STEEL INDUSTRY AND ITS RESOURCE BASE

ALLAN RODGERS

THE future of Chinese industrialization depends in part on a resurgence of basic industry in Manchuria. The recent release of wartime data enables us to evaluate the possibilities.

In the period from 1932 to 1944 one of the largest iron and steel centers on the Asiatic continent came into being in Manchuria, comparable in size with the developments at Kuznetsk and in India. To understand the nature of this Japanese creation, it is necessary to examine the relationship that existed between Manchurian industry and that of Japan. Since the Russo-Japanese War, Japan had been a heavy investor in Manchuria and by 1930 had succeeded in eliminating most foreign competition. After the "Manchurian Incident" in 1931 and the establishment of effective Japanese control Manchuria became an integral part of the Yen Bloc economy. The economic structure, however, assumed a peculiar pattern. In Korea and Formosa, Japan had followed the time-hallowed pattern of colonial exploitation. Manchuria, on the other hand, was to be developed as an extension of the homeland. Capital and effort were poured into the creation here of a mainland industrial base strong enough to support Japan's military ambitions on the continent. The larger part of the effort was devoted to the iron and steel industry.

The Resource Base: Iron Ore

Iron ore is not plentiful in China proper, and although it is much more abundant in Manchuria, the amounts are not adequate for a large-scale iron and steel industry. According to the latest available prewar Japanese estimates, the iron-ore reserves of Manchuria totaled about 1800 million metric tons, and only about 114 million tons of this were believed to be rich ores.[1] At the time such estimates were considered overoptimistic by American mining experts, but Japanese estimates in 1945[2] were much higher—a total for the two chief deposits of 4450 million metric tons of low-grade ores and 59

[1] *Japan-Manchoukuo Year Book*, 1939, p. 802.

[2] "Iron and Steel Metallurgy of the Japanese Empire," *Natural Resources Section Rept. No. 50*, General Headquarters, Supreme Commander for the Allied Powers, 1946 (referred to hereinafter as *SCAP Report No. 50*), Summarized in *Mineral Trade Notes*, U. S. Bureau of Mines, Jan. 20, 1947, pp. 12–28; reference on p. 24.

➤ Mr. Rogers made this study in connection with a graduate seminar under the direction of Professor Glenn T. Trewartha, University of Wisconsin.

million metric tons of high-grade ores. These estimates seem to be the extreme of optimism and must be treated with caution. The Chinese, on the other hand, tend to be overcautious in their estimates. For example, Dr. J. S. Lee of the National Geological Survey of China[3] credits Manchuria with only 873 million metric tons of iron-ore reserves, but it must be re-

TABLE I—IRON-ORE RESERVES OF MANCHURIA*

In millions of metric tons

NAME	TYPE OF ORE	GRADE	TONNAGE	IRON CONTENT %
Anshan-Kungchangling	magnetite and hematite	low	1,089	averaging 35
		high	25	53–61
Miaoerhkou-Waitoushan	magnetite	low	500+	33
		high	5+	64
Tungpientao				
Talitzukou	hematite	high	84+	50–63
Chitaokou	"	low	27+	40–43
Laoling	"	low	80	lean (probably 35)
Approximate total			1,810	

* Adapted from material in "Mineral Resources of Japan," *Foreign Minerals Survey*, U. S. Bureau of Mines, Vol. 2, No. 5, 1945, pp. 30–31.

membered that Chinese geologists had not been in Manchuria since 1932, and that a great many discoveries were made after the Japanese occupation. Iron ores are found in a narrow belt in southern Manchuria. They are mainly low-grade hematites and magnetites, averaging 35 per cent iron content. Intermingled with these lean ores are pockets and veins of richer ores with iron content of as much as 68 per cent. These range in size from 5 to 25 million metric tons. Manchurian iron ores are low in sulphur and phosphorus; but the silica content is relatively high, and this proved to be a major problem in their utilization.[4]

THE IRON-PRODUCING DISTRICTS

The three chief iron-ore centers in southern Manchuria are Anshan-Kungchangling, Miaoerhkou-Waitoushan, and Tungpientao (Eastern Frontier District).

The Anshan-Kungchangling district, the most important iron-ore center of Manchuria, comprises the deposits of Anshan, on the Mukden-Dairen

[3] *China Year Book*, 1944, p. 655.

[4] The Japanese, faced in Manchuria with this problem of low-grade ores, high in silica, invented the "Showa process," which enabled them to utilize low-grade hematite ores. Where the lean ores were predominantly magnetites, they used the Krupp-Renn concentration process (1938); thus they succeeded in putting to use ores considered almost worthless at the time by foreign producers of iron and steel. However, in the Adirondacks today ores are being used which average 28 per cent iron.

railroad about 60 miles southwest of Mukden, and of Kungchangling, about 20 miles southeast of Anshan. According to the latest Japanese estimates,[5] reserves at Anshan probably totaled about 650 million metric tons of ores containing from 25 to 37 per cent of iron; only small amounts of rich ores are present. The ores are predominantly hematites and are worked in both

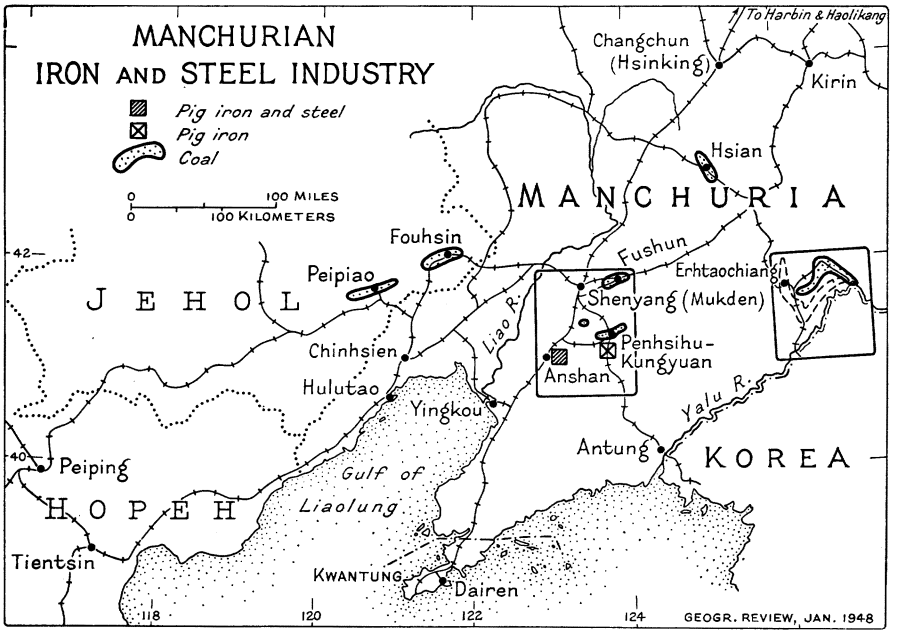

FIG. 1—Centers of the Manchurian iron and steel industry. The Anshan-Kungchangking and Miaoerhkow-Waitoushan districts are shown on a larger scale in Figure 2, the Tungpientao district in Figure 3.

For detailed study see the excellent sheets of the Army Map Service Map of Manchuria, 1 : 250,000 (A.M.S. L 551), 1944–1946.

open-pit mines and underground workings. Kungchangling deposits are estimated at more than 380 million metric tons of lean ores and about 25 million tons of rich ores,[6] both mined in underground workings.

The Miaoerhkou-Waitoushan district ranks second in importance. The Miaoerhkou field is on a branch of the Mukden-Antung railroad about 15 miles south-southeast of Penhsihu. According to Japanese estimates of 1938, its deposits then totaled some 227 million tons of ores with about 33 per cent iron content and more than 5 million tons of high-grade ores

[5] *Japan-Manchoukuo Year Book*, 1939, p. 802. The amounts given for the individual deposits do not add up to the cumulative total in Table I, but they are the most recent figures available for these deposits.

[6] H. F. Bain: Manchuria: A Key Area, *Foreign Affairs*, Vol. 25, 1946–1947, pp. 106–117; reference on p. 116.

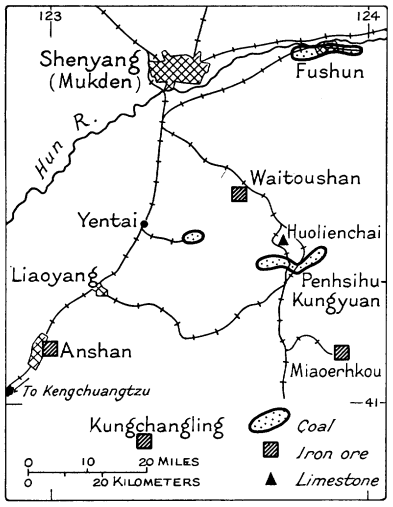

FIG. 2—The industrial heartland of Manchuria.

in two richer zones. The ores were mined in underground workings. The Waitoushan deposit, about 15 miles northwest of Penhsihu, was estimated by the Japanese at 150 million tons of ores containing more than 30 per cent iron. The ores of both these deposits are predominantly magnetites, which require no preliminary roasting.

The Tungpientao development is comparatively recent.[7] The reserve consists of scattered deposits of rich and poor ores along or near the Yalu River in southeastern Manchuria. This is the only important source of high-grade ore in Manchuria; the ores are hard red hematites containing as much as 63 per cent iron and low in silica, phosphorus, and sulphur. Medium and low-grade ores are also present in considerable amounts. The three main deposits are estimated to total more than 191 million tons.[8] The most important is that at Talitzukou, with 84 million tons of high-grade ores averaging 50–63 per cent iron. It was on this deposit that the Japanese geologists placed their highest hopes. The

TABLE II—TOTAL IRON-ORE OUTPUT BY MAJOR MINING DISTRICTS, 1943

In metric tons

MINING DISTRICT	OUTPUT*	PERCENTAGE OF OUTPUT
Anshan	3,125,000	59
Penhsihu†	1,125,103	21
Tungpientao‡	849,933	16
Others (est.)	200,000	4
Total	5,300,036	100

* *Mineral Trade Notes*, Jan. 20, 1947, pp. 25 and 27.

† Penhsihu production principally from Miaoerhkou.

‡ Personal communication from Mr. Nelson Dickerman (see footnote 8). Talitzukou iron-ore production in 1943 was 523,751 metric tons, and Chitaokou production in 1943 was 326,182 metric tons.

[7] Although references can be found as early as 1922 to iron-ore resources in the area, no extensive prospecting seems to have taken place until 1936. In 1938 the Japanese commissioned H. Foster Bain to make a survey of the Tungpientao district. The results are not available to the public at this time, but Bain refers to the area in the article cited in the preceding footnote (pp. 116–117). Some of the material in the above discussion came from a personal communication from him, dated December 26, 1946.

[8] Personal communication from Mr. Nelson Dickerman, Bureau of Mines, U. S. Department of the Interior, dated November 18, 1946.

second is that at Chitaokou, with some 27 million tons of ore averaging 40–43 per cent iron. The Laoling deposit is the least important; although it is large, about 80 million tons, the ore is of low quality. According to latest reports, the Laoling deposit was never worked.

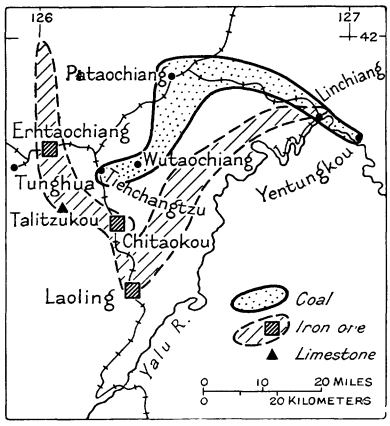

FIG. 3—The Tungpientao industrial region.

IRON-ORE PRODUCTION

Production of iron ore proved to be a major problem in the expansion of the Manchurian iron and steel industry, especially after the adoption of the Manchurian Five-Year Industrial Development Plan in 1936. Ore output failed to keep pace with the expansion of the iron and steel plant. This lag plus a shortage of coking coal may partly explain the failure of the iron and steel industry to produce to its maximum potential. However, the Japanese did succeed in increasing iron production far beyond that of the early thirties—from less than two million tons in 1936 to a maximum of more than 5,300,000 tons in 1943, about half in medium and high-grade ores.

TABLE III—WARTIME PRODUCTION OF IRON ORE AT ANSHAN AND PENSHIHU*

In metric tons

	ANSHAN			PENHSIHU			TOTAL
	High Grade	Low Grade	Total	High Grade	Low Grade	Total	PRODUCTION
1940	846,000	1,619,000	2,465,000	402,366	75,066	477,432	2,942,432
1941	1,117,000	2,034,000	3,151,000	460,087	296,404	756,491	3,907,491
1942	1,146,000	1,943,000	3,089,000	409,799	271,681	681,480	3,770,480
1943	1,232,000	1,893,000	3,125,000	492,811	632,292	1,125,103	4,250,103
1944	1,264,000	514,000	1,778,000	554,244	463,274	1,017,518	2,795,518

* *Mineral Trade Notes*, Jan. 20, 1947, pp. 25 and 27. Penhsihu production principally from Miaoerhkou.

In 1943 the Tungpientao region produced almost 850,000 tons of presumably high-grade ore. Some of the output was sent to Japan, but most of it was used at Anshan and Penhsihu. Japan profited little from Manchurian iron-ore production; the exports to Japan at the maximum reached only 62,000 tons in 1942, and Manchuria imported 477,000 tons of high-grade ore from Korea during the three years 1943–1945.[9] As the war progressed, shortages in amount increased and the quality of the ore declined.

[9] *SCAP Report No. 50* (*Mineral Trade Notes*, Jan. 20, 1947, p. 21).

Coal Resources

In neither quantity nor quality do Manchurian coals equal the coals of the Shensi-Shansi region of China. Nevertheless, the deposits are sufficient to work up the potential reserves of iron ore and to meet the varied needs of a modern industrial area. Estimates of Manchurian reserves differ considerably; the most reliable is probably Bain's nine billion tons.[10] His estimate

Table IV—Coal Reserves and Production in Manchuria*

In thousands of metric tons

MINING DISTRICT	RESERVES	TYPE	PRODUCTION	YEAR
Fouhsin	4,000,000	bituminous	1,850	1938
Fushun	950,000	"	10,000	1944
Hsian	600,000	"	2,000	1944
Haolikang	600,000	bituminous-coking	343	1936
Peipiao	250,000	" "	293	1936
Tungpientao		" "		
Tiehchangtzu†	40,000		169	1944
Wutaochiang	100,000		166	1944
Pataochiang	66,000		611	1944
Yentungkou	30,000		36	1944
Total	236,000			
Penhsihu	220,000	bituminous-coking	739	1936
Yentai	40,000	semianthracite	500	1944
Mishan	300,000	bituminous-lignite	61	1936
Muleng	300,000	bituminous	273	1936

* Reserves from *Contemporary Manchuria,* Vol. 1, No. 4, 1937, pp. 68–69; production from various sources.

† Personal communication from Mr. Nelson Dickerman.

is rather conservative, however; some sources have placed the reserves as high as 17 billion metric tons.[11]

Manchurian coal is predominantly high-grade bituminous with a relatively high calorific value. Only about 10 per cent is considered to be of coking quality, but the coal combines readily with moderate amounts of coking coal to produce high-grade blast-furnace fuel. In general, the beds are relatively thick, continuous, and near the surface; hence mining costs are low.

The two most important coal fields in Manchuria are those at Fushun and Fouhsin. In production the Fushun field, which produced about 10 million tons of coal in 1944—some sources suggest 12 million tons—is undoubtedly the more important, but in reserves and potentialities for the future the Fouhsin field seems more promising. The Fushun field is about

[10] Bain, *op. cit.,* p. 115.

[11] *Far East Year Book,* 1941, pp. 707–708.

20 miles east of Mukden. Total reserves are about one billion tons. The coal is excellent for steaming, but its coking power is low; however, it can be used in the coke oven if mixed with proper proportions of coking coal. Of the total output, about one-third is produced by open-pit mining and two-thirds in underground workings. Fushun coal supplied 70–75 per cent of the coke-oven burden at the Anshan iron and steel center.[12] The Fouhsin coal field is about 75 miles north of Chinhsien. A railroad constructed for the express purpose of tapping this field was opened in 1937. A large part of its potential reserve of four billion tons can be mined by open-pit methods; the coal is not in itself generally coking, but it serves well as a mixture in by-product coking ovens. Production at Fouhsin increased phenomenally from 1936 to the end of the war. In 1936 less than 80 thousand tons of coal was produced, but by 1941 the Japanese had apparently raised this to five million tons.

The chief coking-coal areas are Penhsihu, Peipiao, Haolikang, and Tungpientao. Of these, Penhsihu was probably the most important as regards production, primarily because it is close to the larger iron and steel centers. However, production at Peipiao and Haolikang is known to have expanded considerably during the war. The Peipiao field is in southwestern Manchuria, about 75 miles north of the port of Hulutao, with which it is connected by rail. The Haolikang field, the least accessible, is in extreme northeastern Manchuria. Because of its extent and the high coking quality of its coal, the Japanese built a rail line to connect the district with the port of Rashin in extreme northeastern Korea, so that its coal could be exported to Japan and Korea. Tungpientao coal is present in sufficient amounts to work up the iron reserves of the area. Production in 1944 was estimated at one million tons, which would probably be adequate for the needs of a local iron and steel industry.

According to Japanese plans, Manchurian coal was intended both to supply its own needs and to serve as an auxiliary supply for the homeland. Production was stepped up from 13 million tons in 1936 to about 30 million tons in 1944. By 1941, however, the demands of Manchurian industry had reduced coal exports to a low of about a million tons, and at the same time imports from Occupied China had increased, so that an average of about a million tons of coking coal was being imported annually. Thus, in actuality, Japan directly profited but little from Manchurian coal production in the later stages of the war, if we remember that any imports from Occupied

[12] Bain, *op. cit.*, p. 113.

China into Manchuria meant so much less for Japanese mills. Another drain on Manchurian coal production was shipments to Korea.

Toward the end of the war, shortages of coking coal were felt increasingly. Manchurian coke (Table V) was produced in relatively modern by-product coking ovens.

TABLE V—MAJOR BY-PRODUCT COKE-OVEN PLANTS IN MANCHURIA*

Coal carbonizing capacity in 1000 metric tons

	NO. OF BATTERIES	NO. OF OVENS	COAL CARBONIZING CAPACITY	% OF TOTAL
Anshan	17	598	3,986	66
Kungyuan	2	120	789	12
Others	unavailable	unavailable	1,340 est.	22

* Adapted from "Mineral Resources of Japan" (*op. cit.*), p. 85. Based on estimates made before the Japanese surrender.

Of the needed blast-furnace materials, limestone is found throughout Manchuria, and although quality is not the best, reserves are fairly extensive. Deposits are located at Penhsihu, Huolienchai, Kanchingtzu, and Talitzukou. The first three supplied the iron and steel centers at Anshan and Penhsihu. In addition, fire clay, dolomite, and magnesite deposits are found in southern Manchuria in sufficient amounts for the needs of the development.

THE IRON AND STEEL INDUSTRY

The history of the iron and steel industry of Manchuria has been treated in detail elsewhere;[13] here we are concerned with its course under the Japanese occupation. The expansion program continued at a rapid rate until 1944, when a number of interrelated factors combined to slow up production. Finally, in August, 1945, with the end of the war, production ceased completely.[14] Although the Manchurian iron and steel industry is correctly described as one of the greatest in Asia, it must be viewed in world perspective. In comparison with the American iron and steel industry, it was a pygmy—less than half the size of the Bethlehem center at Sparrows Point, Md. Nevertheless, the industry was important, and it has significance in assaying the future of the country. From 1936 on, the Japanese maintained a rigid censorship on reports on the expansion of Manchurian industry, and

[13] J. E. Orchard: Japan's Economic Position, New York, 1930, pp. 292–311; E. B. Schumpeter and others: The Industrialization of Japan and Manchukuo 1930–1940, New York, 1940, pp. 326–408; T. T. Read: Economic-Geographic Aspects of China's Iron Industry, *Geogr. Rev.*, Vol. 33, 1943, pp. 42–55, reference on pp. 54–55; and various articles by John R. Stewart in the *Far Eastern Survey*.

[14] The details of the wartime expansion of the industry have been obtained from *SCAP Report No. 50*.

it has been only since the end of the war that official data have been released. Although they are still incomplete, sufficient information is available for a brief analysis.

Table VI shows the increase in iron and steel production in the 12 years following the Japanese occupation. Pig-iron production increased almost

TABLE VI—PIG-IRON AND STEEL PRODUCTION IN MANCHURIA, 1932–1944

In metric tons

YEAR	PIG IRON*	CAPACITIES	STEEL†	CAPACITIES
1932	368,181	637,750	....	unavailable
1933	433,523	637,750	....	"
1934	475,826	637,750	....	"
1935	607,948	637,750	137,000	"
1936	633,393	637,750	344,000	"
1937	762,138	857,750	451,000	"
1938	900,000	1,879,760	622,000	"
1939	unavailable	2,244,750	562,000	"
1940	1,061,200	2,244,750	554,000	"
1941	1,359,500	2,244,750	573,000	"
1942	1,682,500	2,244,750	724,000	"
1943	1,726,700	2,500,250	837,000‡	"
1944	1,174,877	2,500,250	437,000‡	"

* Source for data from 1932 to 1938: "Mineral Resources of Japan" (*op. cit.*), p. 34. Source for data from 1940 to 1944: *Mineral Trade Notes*, Jan. 20, 1947, pp. 26–27.

† *Summation of Non-Military Activities in Japan and Korea*, No. 3, 1945; *SCAP Report No. 50*, Table 10.

‡ Showa Works only.

fourfold. Before 1935, Manchuria had concentrated on pig-iron production for export to Japan; in 1935, in conformance with Japan's expansion plans, steel production was begun at the Showa Works. By 1936 steel-ingot production amounted to more than a third of a million tons, and by 1943 it had increased almost threefold. However, production in Manchuria failed to keep pace with the rapid plant construction.

In the early thirties difficulties in the use of low-grade, siliceous ores were surmounted, and by 1936 pig-iron production had reached capacity. In 1936 the Japanese inaugurated the Manchurian Industrial Development Plan, which included a rapid expansion of the iron and steel industry. Thereafter pig-iron production lagged far behind plant capacity, and although production eventually reached 1,700,000 tons, it was still 800,000 tons behind potential output. Figures on steel capacity are unavailable at present, but a similar lag probably occurred in this phase of the industry.[15] By 1938 the Japanese had invested heavily in Manchuria, but the prolongation of the

[15] E. Brewin: Details Rise and Fall of Japanese Industrial Empire, *Iron Age*, Vol. 158, 1946, pp. 114–125. Contains details of the wartime expansion of the Manchurian iron and steel industry.

war in China imposed a heavy strain on the industrial structure of the homeland. By 1940 it had been decided that production in Manchuria should be geared to the needs of the homeland, with an increasing emphasis on exports of both raw materials and pig iron to Japan. As a consequence, exports of pig iron increased from 383,000 tons in 1935 to 553,000 tons, more than a

TABLE VII—PIG-IRON CAPACITY AT ANSHAN*

BLAST FURNACE	TYPE	YEAR BUILT	DAILY CAPACITY (*Metric tons*)
Nos. 1 and 2	German	1919	800
No. 3	American	1930	550
No. 4	German	1937	600
Nos. 5, 6, 7, 8	German	1938	2,800
No. 9	German	1943	700

* *Mineral Trade Notes,* Jan. 20, 1947, p. 25.

third of the total pig-iron production, in 1941 and to 715,000 tons a year later.[16] Statistics on steel-ingot exports are lacking; they may show a corresponding increase.[17] Besides the strain imposed by the needs of Japanese industry, those of Manchurian industry must also be taken into consideration.

IRON AND STEEL CENTERS

The two main production centers were Anshan and Penhsihu-Kungyuan (Miyanohara). A minor enterprise was at Erhtaochiang. The Anshan district was by far the more important. The Showa Steel Works at Anshan had been founded in 1916 by Japanese interests. From the first, lack of water facilities proved a handicap. The difficulty was partly resolved by the construction of a large waterworks in the twenties, but development continued to be retarded by the lack of facilities for cheap water transport. The Showa Works is almost 200 miles by rail from the port of Dairen and about 400 miles from Peiping and Tientsin, a relatively long distance if China is to be a market for Manchurian iron and steel products in the future.

The disadvantages at Anshan are offset, however, by the fortunate clustering of raw materials in the area: relatively large local ore deposits, coal from the Fushun and Penhsihu fields, respectively 78 and 85 miles away,[18]

[16] *Ibid.,* Table 9; *SCAP Report No. 3,* Table 10, Dec., 1945 (Summation of Non-Military Activities).

[17] It has been suggested that as the war progressed the demand for raw materials increased in Japan and that this may have caused depletion of stock piles in Manchuria. However, Manchuria never was a major source of iron ore or coal for Japan, and available statistics show no sizable increase in exports of raw materials in the early forties.

[18] During the war, coal from Fouhsin, Peipiao, and North China was used at both Anshan and Penhsihu, and a railroad was constructed from Liaoyang, on the Anshan-Mukden Railroad, to Penhsihu, which shortened the rail distance from Penhsihu to Anshan considerably.

and limestone from Huolienchai, near Penhsihu, and Kengchuangtzu, about 14 miles southwest of Anshan. Pig-iron production at Anshan developed slowly and in 1931 was still less than 300,000 tons. Thereafter the industry underwent a rapid transformation (Table VII).

Increase in pig-iron capacity was accompanied by a rapid rise in open-

TABLE VIII—WARTIME PIG-IRON AND STEEL PRODUCTION AT ANSHAN*

In thousands of metric tons

YEAR	PIG IRON	STEEL INGOT	ROLLED PRODUCTS				
			Small and large bars	Small bar	Rod	Plate	Sheet
1940	939	532	129	65	75	..	42
1941	1,192	561	127	76	75	..	37
1942	1,304	732	138	70	82	19	36
1943	1,325	843	131	74	64	59	35
1944	801	438	64	38	33	24	19

* *Mineral Trade Notes*, Jan. 20, 1947, p. 26.

hearth-steel capacity. Steel production at the Showa Works began in 1935, but, unfortunately, detailed statistics are lacking, so that interpretations must be made from wartime production figures.

Anshan pig-iron production averaged 78 per cent of Manchuria's total output. The same trend evident in the total Manchurian picture was present here: the failure of production to keep pace with the rise in plant capacity. Pig-iron production lagged as much as 800,000 tons behind plant potential. Of the total pig-iron production at Anshan, 59 per cent was sent molten to open-hearth furnaces on the spot and 41 per cent was cast into pigs and shipped to Japan. The Showa Works was the only finished-products center in Manchuria (Table VIII) with the exception of a small industry localized in the near-by city of Anshan and at Mukden (centered in the Mukden Arsenal). Although production of these semifinished products was low compared with total steel-ingot production, even this small output indicates that some of the earlier conceptions of the Manchurian iron and steel industry must be revised. These conceptions led most writers to speak of the industry solely as a "primary" one, whose products were finished in Japan. Although the output of finished steel was not large, it gives some indication of the possibilities for a mature industry in the future.

The Penhsihu-Kungyuan center has been treated in some publications as two separate entities, but the enterprises were so closely interrelated that they should be considered as a unit. The development at Penhsihu was probably the earliest in Manchuria, except for native furnaces. It started in 1915 as a combined Sino-Japanese enterprise, but from the first it was an

integral part of the mother Japanese industry. It never became a full-fledged industry, and production concentrated solely on pig iron. The industry was based on iron ore from Kungyuan, about 3 miles to the south, coal from the Penhsihu and Fushun fields, and limestone from Penhsihu and Huolienchai. Development proceeded much more slowly than at Anshan, and by

TABLE IX—WARTIME PIG-IRON PRODUCTION AT PENHSIHU-KUNGYUAN*

In metric tons

YEAR	LOW PHOSPHORUS	ORDINARY	TOTAL
1940	114,578	7,622	122,200
1941	149,695	17,805	167,500
1942	222,910	155,590	378,500
1943	195,040	206,660	401,700
1944	263,252	110,625	373,877
1945	72,339	15,730	88,069

* *Mineral Trade Notes*, Jan. 20, 1947, p. 27.

1926 only 51,000 tons of pig iron was being produced. In 1932 the Chinese interests were ousted, and an expansion program was undertaken, but by 1936 production was still only 160,000 tons. In 1937–1938 plans were formulated to expand the Penhsihu works by starting a modern development in a new industrial suburb south of the city. Construction on the new works, Kungyuan (Miyanohara), was begun in 1938, and by 1939 two new 500-ton modern blast furnaces had been installed. The district's annual pig-iron capacity rose to about 511,000 tons. However, this district produced only a relatively small part of Manchurian pig iron, an average of 23 per cent. Production at Penhsihu-Kungyuan concentrated on both ordinary pig iron and low-phosphorus pig iron, the latter for use in special-quality steels in Japan.

The Japanese had high hopes for the Tungpientao area, but their plans failed to materialize in any effective form, though construction on a modern iron and steel development was reported to have been 20 per cent complete in August, 1945. The industry was to be based on local coking coal, limestone from the Talitzukou quarries, and high-grade iron ores from the Talitzukou and Chitaokou mines. A railroad was constructed to the area to exploit its resource wealth, and a new city, Erhtaochiang, was built on this railroad about 40 miles from the Yalu River. Very little information has been forthcoming as to why the venture failed. It is known that there was a pressing need for high-grade iron ore at Anshan and Penhsihu as well as in Japan and that much of the ore mined in the Tungpientao area was shipped elsewhere. It has been reported that the high-grade iron ores proved

to be too highly parceled and that resulting mining difficulties prevented development of the area. It has also been suggested that the plan of erecting an iron and steel plant here was delayed so long that it was impossible to obtain equipment from Japan. And it must not be forgotten that in wartime a country may be faced with the choice of using iron and steel resources for armament and munitions or building another plant. At any rate, the Tungpientao area has definite possibilities for development in the future, when stability returns.

The Industry after 1943

The decline of the Manchurian iron and steel industry after 1943 was due to a combination of factors, among them shortages of coal, manganese ore, spare parts, repair material, and skilled and unskilled labor; scattering of industrial power; air raids; and shortages and decline in quality of the iron ores produced. Finally, in August, 1945, with the end of the war, production ceased completely. In September the Russians occupied all of Manchuria and began a systematic removal of industrial material—electrical, hydraulic, and other operating equipment plus valuable machine tools. According to the Pauley Report, issued by the State Department in December, 1946, damages to the iron and steel industry totaled more than 150 million dollars. Percentages of damage ranged from 50 to 100. In addition, the Chinese Communists are reported to have removed whatever movable equipment the Russians may have left behind. As late as the fall of 1946 the industry, under Chinese government control now, was at a standstill; many of the mines had flooded because of the removal of hydraulic pumping equipment. The Fushun mines were operating, but labor shortages, flooding, inflation, and other factors had greatly curtailed output. The skilled Japanese technicians had been repatriated or removed to Russia; and the onset of large-scale civil war in Manchuria would seem to leave little prospect for a revival in the near future.

Summary and Conclusions

It seems evident that Manchuria possesses reserves of iron ore and coal capable of supporting an iron and steel industry of moderate proportions. These basic resources are located close enough to each other and to transportation facilities to provide an output of iron and steel at a cost[19] comparable

[19] Data on wartime production costs are not available at the present time. Bain (*op. cit.*, p. 116) states that a unit of ore in the form of a sinter can be delivered to Manchurian furnaces at a considerably lower cost than the same amount can be delivered from the Lake Superior mines to most American blast furnaces.

with costs in the various American iron and steel centers. An industry could be developed that could provide the preliminary basis for an industrial revolution in China. It is doubtful, however, whether the Manchurian iron and steel industry could expand much beyond its wartime capacity, and its wartime potential could be achieved again only under heavy government subsidization and control. The industry is at a standstill at present and can resume production only when new equipment is installed and political and economic stability returns. On the brighter side, if China receives the larger share of Japanese reparations, as seems likely, presumably operating equipment of heavy fixed installations will constitute a considerable part. However, Manchuria is faced with yet another serious problem—the Sino-Soviet treaty of 1945 and its implications. Some writers have voiced the fear that strict interpretation of the treaty by the Russians could include joint operation and ownership of a number of key mines and industries in Manchuria. In such case the industrial future of the area would have to be reexamined in the light of the attendant political complications.