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THE PRESENT STATUS OF CHINA'S IRON ORE DEPOSITS

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- COMMUNIST CHINA -

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BIBLIOGRAPHY

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2. The People's Daily

3. Iron and Manganese Ores in Asia (Research Data No. 9 by the Committee on Foreign Raw Materials for the Manufacture of Iron)

[Translator's Comments]

1. Shan-yüan should read "base of the mountain" throughout.

2. Last sentence on page 27 should read, "I discovered that an iron base is being constructed in Chiu-ch'uan with this mine as its basis; however details are unknown."

I. THE GENERAL CONDITION OF CHINA'S STEEL INDUSTRY

The general picture of China's steel industry is as follows: (I intend to treat and report the details in a somewhat different manner.)

A. Output of Pig Iron and Blister Steel

	Pig Iron	Crude Ore	Steel Materials
1952	1,930 metric tons	1,350 thousands of metric tons	1,312 thousands of metric tons
1953	2,175 "	1,774 "	1,754 "
1954	2,962 "	2,225 "	1,965 "
1955	3,630 "	2,853 "	2,205 "
1956	4,777 "	4,465 "	3,921 "
1957	5,940 "	5,350 "	4,478 "
1958	9,530 "	8,000 "	Unknown
1959	20,500 "	13,350 "	Unknown

B. The All-China Iron Manufacture Movement

The All-China Iron Manufacture Movement which made its unexpected debut in August of 1958 had by the end of the year reached its high water mark with several ten millions under mobilization. It was also said that over 60,000 small blast furnaces of the domestic type (土法高炉)(in the beginning the majority of these blast furnaces had a capacity of around three cubic meters) had been built and the policy of domestic manufacture of pig iron was being enforced; moreover there was even an attempt at the manufacture of steel with domestically produced converters (土法転炉).

As a result the 1958 production figure for crude ore reached 11,080,000 metric tons; however by August of 1959 the Eighth Plenum of the Chinese Communist Party announced that 3,080,000 metric tons of the 1958 figure had been domestically manufactured steel and used only for agricultural needs (these figures henceforth will be removed from the plan). The revised figure announced for the industrial consumption of crude ore was 8,000,000 metric tons. They announced at the same time the revised figures for the production goal for 1959 which were as follows:

	Pig Iron	Steel
Results for 1958 before revision	13,680,000 metric tons	11,080,000 metric tons
After revision	9,530,000 "	8,000,000 "
Production Plan for 1959	Unknown	18,000,000 "
After revision	23,000,000 "	12,000,000 "

The figures 23,000,000 metric tons for pig iron and 12,000,000 metric tons for steel of the production plans for 1959 are considerable reductions from the plan at the early part of the year; nevertheless when compared with the actual record of the previous year the amount is truly remarkable. Since the plan was revised, there was probably no doubt as to its realization, and yet the newspapers, magazines, and the like continued their efforts through their media to keep up running exhortations for the realization of the production plan.

Figures for the foreign type manufacture of pig iron and steel for the midway mark of production, i.e., covering January through June, have been announced as 9,500,000 and 5,300,000 metric tons respectively. During the beginning of 1960 Vice Premier Li Fu-ch'un made it known that the production total of crude ore for 1959 had been 13,000,000 metric tons, a figure which exceeded the planned figure. Furthermore the figures 20,500,000 metric tons for pig iron and 13,350,000 metric tons were officially announced on 22 January.

We can say that the rapid advances made during the early stages of the All-China Iron Manufacture Movement are still being continued today in spite of the fact that the movement has been rationalized to a large degree. The small scale domestic blast furnaces (i.e., those with a capacity of under three to five cubic meters) which were the central feature of the movement were eliminated. In addition, the domestic method of producing iron was removed from the plan. They are now in the process of devising a plan which would modernize the equipment of the small scale blast furnaces (i.e., those having a capacity of from ten to 100 cubic meters), e.g., by adding small coke furnaces and hot blast equipment.

I think that the results for the past 16 months of the movement could be summarized as follows:

1. There was a large amount of rejects from domestically produced pig iron. Domestically produced steel was not able to satisfy the re-

quirements of modern industry; consequently this type of production was removed from the plan.

2. Transportation organs of the entire country were thrown into confusion, thus creating the danger of unbalancing the whole economy. (It is acknowledged that eight metric tons of material is required to be transported from outside areas in order to produce one metric ton of steel.)

3. The movement has become a history making policy of great waste in a peace time period.

The points which I have related above I consider to be failures; however they are succeeding in turning out good quality pig iron by selecting those small scale blast furnaces which have high efficiency from among several ten thousand blast furnaces and by adding the benefits of modern technology to them.

The production of pig iron by these selected blast furnaces constitutes about one half of the total production output of the nation, and this percentage will no doubt continue for quite a time. The problem of cost and quality of pig iron produced by these small scale furnaces still remains. As for cost, the government has more or less solved this problem through [direct] assistance. (Apparently the government is buying up these products at 200 yüan, which is 50 yüan higher than the price of products turned out by the foreign type medium sized blast furnaces.) (Note: One yüan = 150 yen.) As to the question of quality, for example, they are sending pig iron produced by small scale blast furnaces in Anhwei Province, in short pig iron which has the highest sulphur content, to the steel mills in Shanghai and reducing the sulphur content by processing it through their converters; as a result the mills are able to use a large quantity of this pig iron for steel manufacture. In fact they are exerting considerable efforts to reduce sulphur content in the products of small scale blast furnaces of the entire nation.

So we can see here that the reason these blast furnaces are effectively contributing to the nation is that the All-China Pig Iron Manufacturing Movement [sic] modified itself as it developed. It is from this standpoint that we can say that the movement was successful.

C. Large Scale Iron and Steel Works

China was able to construct large high-performance iron and steel bases at An-shan, Wu-han, and Pao-t'ou. The fourth base is in the process of being prepared for construction at Chiu-Ch'üan, a hinterland area far from Lan-chou. All of this was made possible through Soviet assistance. Of these, An-shan is well-balanced in its equippage and is the largest completed base in China. The An-shan base has ten blast furnaces, 24 open hearth furnaces, and 13 blooming and rolling mills. The present production capacity of the base is estimated at 4,400,000 metric tons of pig iron, 5,000,000 metric tons of steel ingots, and 3,000,000 metric tons of steel materials.

In Wu-han two blast furnaces have been completed, each with a 2,000 metric ton pig iron output capacity. The third is in the planning stage. One open hearth furnace with a 250 metric ton output and two with 500 metric ton outputs have been installed; the third is in the planning stage. The rolling mill has not yet been completed; however it will have a production capacity approximated at 1,500,000 metric tons for the first period of 1960 and 5,000,000 metric tons for the second period.

In Pao-t'ou a blast furnace and an open hearth furnace with daily outputs of over 2,000 metric tons have been completed and two rolling mills launched. This base is scheduled to produce 1,460,000 metric tons of pig iron, 1,470,000 metric tons of steel, and 1,100,000 metric tons of steel materials upon its completion in 1961.

As for Chiu-ch'üan, I was able to ascertain that they are presently readjusting the land for construction; however the contents of the plan itself are still not clear.

This is the general situation of China's large scale iron and steel bases. These have heretofore been referred to as the "18 important points in iron and steel works;" recently, however, they have constructed 47 iron and steel bases in each area and have been using the method of citing the large and medium /̲ scale bases_7 together. Efforts are also being made to install blast furnaces with 100-300 cubic meter capacity in each area. Most likely this is what they are referring to when they say that they are constructing 47 iron and steel bases.

I have made a chart on these various enterprises based on information collected from various channels. /̲ Chart appears at end of translation._/ (Since the Chinese do not make public the nature of the equipment used in these enterprises in a consolidated fashion as they do in other industrial fields, I am compelled merely to piece together the fragmentary information released from various sources.)

II. IRON MINES OF CHINA

A. A Survey

It is common knowledge that the Chinese have used their utmost endeavors in the research and development of their underground resources since the founding of their nation in 1949; however they have increased their efforts even more from the second half of 1958 through the All-China Iron Manufacture Movement by mobilizing the masses in prospecting for iron mines. I would like to draw your attention to the results of these efforts. In 1957 they had already announced that the iron ore deposits were over ten billion metric tons. This figure includes many newly discovered iron mines of which the more notable ones are as follows:

1. Ching-t'ieh Shan

Located in the Ch'i-lien mountain range in Kansu Province. Has the capability of supplying an iron foundry with an annual pig iron output of 1,500,000 metric tons for 50 years. Grade = 40 percent.

2. Pai-yün-ao / also pronounced "e" /-po
Can supply the Pao-t'ou Steel Works with 4,500,000 metric tons a year.
3. Chiang-hsi Province
New mine discovered with an ore vein width of ten to 30 meters. Ore deposits total several hundred million metric tons.
4. P'an-chih-hua
Located in Szechwan Province. Has the capability of supplying an iron foundry with an output of 1,500,000 metric tons for 130 years.
5. The New Mining District of the Northeast Region
Has the capability of supplying the An-shan Steel Works with 4,000,000 metric tons of iron ore a year for 70 years.
6. The Western Part of Hu-pei Province
Two large ore veins discovered with iron content of 40-50 percent. Just one vein would be able to supply an iron foundry with a 1,500,000 metric ton output for 200 years.
7. P'ing-wu-t'ieh Shan
Located in the eastern part of Szechwan Province.

In addition there were many instances when a re-investigation of existing mines yielded increases in ore deposits; consequently we can say that the "Great Leap Forward" in the steel industry is amply insured insofar as iron ore resources are concerned.

However the tremendous amount of iron ore necessitated by the present rapid developments of China's steel enterprises is for the most part furnished by those mines about which we had already more or less known. The present situation is the fulfillment of the gigantic national requirements by either augmentation of facilities or redevelopment on a large scale of those mines mentioned above. Of course those 240 small scale mines scattered throughout the nation still occupy an important role in present-day China because these are the mines which supply iron ore to the smaller blast furnaces.

I would like to summarize here an article which appeared in the first issue of Metallurgy (published 1 January 1959) on the matter of China's iron ore deposits.

"According to a general survey of China's iron ore deposits, the estimates total around ten billion metric tons; however this does not necessarily mean that we can immediately begin mining operations. The reason we cannot do this is that, first of all, the estimate is rudimentary and, secondly, only a portion of the / results / of prospecting and estimates / derived / from exposed / deposits / were totalled. Even after completion of investigation there were many / deposits / where construction was found to be impossible to undertake because of lack of electrical power and transportation, submerged areas, meagre ore beds, excessive underground water, and areas which involved complicated mining techniques. As far as mass prospecting is concerned, we are left with a difficult situation because, in most cases, we cannot make on the spot investigations for confirmation purposes. An analysis of the present condition of resources for the 47 large, medium, and small iron and steel bases follows:

1. Four without mining bases.
2. 17 with inadequate mining bases.
3. Nine with mining bases but the extent of resources is unknown.

In other words, there are 30 in all which suffer from the problem of ore deposits. This is 64 percent of the total. We must conclude, therefore, that China has rich iron resources; however their extent remains unconfirmed. This is a situation which cannot hope to catch up with the development of production. When the facilities of the iron and steel bases have been expanded and production begun, then the construction of the new mines lags behind. Of the 21 newly built iron and steel bases, which in 1959 were carrying out the assignment of producing 4,000,000 metric tons of pig iron, only four were able to finally eliminate their worries about ore supply. Although 12 of these enterprises are reliant upon newly equipped mines, they are still not being supplied, for even though other facilities may have been completed, there is still a danger that they will not receive the ore. There are three enterprises which have mining facilities, yet because the grade of the ore is poor and they are not equipped with ore dressing facilities, in short, not wholly self-sufficient, they still have to be supplied from other areas. The mining bases for the other bases have yet to be confirmed." (Metallurgy, Issue No. 1, 1959)

As it is clear from the above, the construction of China's blast furnaces and open hearth furnaces is developing, while the supply of ore and rolling activities are lagging. A first rate high-pressure blast furnace with a capacity of 1,500 cubic meters has a daily output capacity of 2,000 metric tons. (Note: The Soviet Union constructed a 2,300 cubic meter blast furnace in 1958. The Yawata Kobata No. 1 blast furnace is scheduled to have a capacity of 1,676 meters / sic / with a daily output of 1,500 metric tons.) Open hearth facilities / which will accommodate / 500 metric tons have been mastered through Soviet assistance. They designed these themselves and completed construction in half a year. On the other hand, however, the development of mines could not hope to match this speed. According to Metallurgy six years would be needed to develop an open pit mine with an annual output of 3,000,000 metric tons and three years for a shaft mine.

B. Large Scale Iron Mines

There are six key enterprises concerned with iron mines of China. (According to a decision reached by the Sixth Plenary Session of the Chinese Communist Party Central Committee, an increase of 90 percent of the 1958 / gross / weight was to be accomplished with the 16 key enterprises.) The details have not as yet been announced; however I have collected the following information on the principal mines which presently service the existing large and medium scale blast furnaces.

1. The An-shan Iron and Steel Works -- serviced by the Ta-ku, Kung-chang-ling, Ying-t'ao-yüan, Tung-an-shan, Ch'i-tao-k'ou,

and Ta-li-tzu Iron Mines, all of which are located near the Works and act as its principal source of ore. Hua-pei, Chin-ling, Li-kuo, and Lung-yen act as secondary sources.

2. Pen-Ch'i Iron and Steel Works -- serviced by the Miao-erh-k'ou, Nan-fen, and Wai-t'ou Shan Iron Mines, all of which are located near the Works. (Apparently the term Nan-fen Iron Mines is a collective one referring to all three.)

3. The Wu-han Iron and Steel Works -- serviced by the Ta-yeh Iron Mines and also the Hai-nan Tao Iron Mines.

4. Pao-t'ou Iron and Steel Works -- serviced by the Pai-yun-ao (or "e")-po (/ Japanese transliteration / PA-IN-BO-KU-TO) Iron Mines.

5. Shih-ching-shan Iron and Steel Works -- serviced by the two mountains Yen-t'ung and P'ang-ta-pao of the Lung-yen Iron Mines and Chin-ling Iron Mines.

6. T'ai-yüan Iron and Steel Works -- serviced by Lung-yen and Chin-ling.

7. Chungking Iron and Steel Works -- serviced by the Ch'i-chiang Iron Mines.

8. Ma-an-shan Iron and Steel Works -- serviced by the Wa (or Yao)-shan Iron Mines and the Nan-shan Iron Mines, both of which are located near Ma-an-shan.

9. Ch'i-nan -- Sheng-chien Plant -- supplied by small scale iron mines found in Shantung Province.

10. An-yang Iron and Steel Works -- serviced by small mines found in the vicinity.

11. Pei-ching-sha-ho Iron Works -- serviced by Lungyen.

The figure called for by the 1959 production plan was 30,000,000 metric tons for the 27 large and medium scale iron mines including the key mines mentioned above. However the actual production figure achieved by the first half of the year (January - June) was almost 20,000,000 metric tons.

Since the Chinese have not announced any details concerning the above mines, I have had to collate information gathered from both pre-war and post-war sources. The results were as follows:

1. The Ta-ku-shan Iron Mines

Located in Liao-yang Hsien, Liaoning Province 13 kilometers southeast of the An-shan Railroad Station. Large scale operations were initiated in August 1921 (i.e., the South Manchurian Railroad Period) following the completion of the reducing roasting method for processing low grade ore. The ore deposit is a banded vein which is developed in the vicinity of contact between the quartzite and schist with the granite. The strike runs south to east and has a north inclination of approximately 60 degrees. The length is 1,000 meters, the width approximately 260 meters. The magnetite has a 30 percent hematite content; consequently the ore is not very hard; thus it is suited for ore dressing.

Grade and Ore Reserves

Rich Ore: approximately 60%, 125,000 metric tons (pre-war)

Lean Ore:

FeO	Fe	SiO_2	Mo	S	P	Al_2O_3	MgO	Cu
11.00%	36	46.5	0.2	0.05	0.02	0.4	0.15	Tr.

Lean ore below 77 meters	95,300,000	metric	tons
Lean ore below 130 meters	87,230,000	"	"
	172,530,000	"	"
Mined	20,854,000	"	"
Remainder	151,676,000	"	"

a. Pre-war Disposition of Ore

Blasted at 250 m/m, 100 m/m and sent as is to An-shan. All ore processed through reducing roasting, becoming 54 percent. (Above according to pre-war records.)

b. Post-war Estimate

0 meter and above	approx.	100,000,000	[metric	tons]
0-100 meters	"	80,000,000	"	"
100-200 meters	"	80,000,000	"	"
200-300 meters	"	80,000,000	"	"
	Total	340,000,000	"	"

c. The present target grades for the An-shan Iron and Steel Works are as follows:

The No. 1 Sintering Plant	Fe 50 - 51%
The No. 2 Sintering Plant	Fe 54%
Pellet Ore	Fe 57%

(See "Pellet Ore" under separate heading.)

Ta-ku is the world's largest open pit mine and is mechanized to a high degree. It supplies the An-shan Iron and Steel Works.

2. Kung-chang-ling Iron Mines

Located in Liao-yang Hsien, Liaoning Province, 37 kilometers east of the Liao-yang Railroad Station.

a. Discovered by a geological survey conducted by the South Manchurian Railroad in 1907. Mining operations begun in 1931 under the auspices of the An-shan Iron Works.

b. The ore deposit is a banded vein which is developed in the vicinity of contact between the Pre-Cambrian quartzite and schist with the granite gneiss and amphibole gneiss. The rich ore is sandwiched in between.

c. Lean Ore: surface and above, 30 - 36% -- 371,806,000 metric tons.

Rich Ore: 280 meters and above -- 45,000,000 metric tons.

d. Grade --

	Fe	Mn	SiO_2	P	S	Cu
	61-67	1-3	14-4	0.01	0.03	0.05

e. Distance to An-shan: From Shan-yüan to Liao-yang Railroad Station is 37 kilometers; from Liao-yang to An-shan is 2.4 kilometers.

f. Production:

1940	735,818 metric tons
1941	884,000 " "
1942	896,000 " "
1943	924,000 " "
1944	987,000 " "
1945	300,000 " "

(above according to pre-war records)

g. Small scale mechanized mining in operation. It is neither a large scale open-pit mine nor an underground shaft type mine. Open-pit, level, and inclined hoisting methods are all utilized. This is the result of six years of reconditioning [of the mine.] They are in the process of constructing a concentrate-magnetic separation plant (精鉱磁選工場) which will have an annual production capability of 3,600,000 metric tons.

3. The Ying-t'ao-yüan Iron Mines

Located 13 kilometers east of An-shan in Liao-yang Hsien, Liaoning Province.

a. Started mining rich ore in 1919; operation terminated in 1927. Mining operations started up again in 1943 after the discovery of rich ore bodies to the southeast and north.

b. The ore deposit is a banded vein which is developed in the vicinity of contact between the quartzite and schist with the granite gneiss. The rich ore body is diffused throughout the hang and foot walls of the lean ore body and is almost vertical. It is high grade magnetite. The lean ore is also magnetite.

c. Rich Ore:

Fe	FeO	SiO_2	Al_2O_3	CaO	MgO	Mn	S	P
62.82	19.34	8.91	1.8	0.314	0.45	0.13	0.562	0.021

Lean Ore: Fe - 30% at surface, 50 meters and above -- 27,450,000 m/T.

d. Distance between Shan-yüan and An-shan is 13 kilometers.

(all of the above according to pre-war records)

The Ying-t'ao-yüan Mines are using both shaft and open-pit mining methods. The mines supply the An-shan Iron and Steel Works.

4. Tung-an-shan Iron Mines

Located 61 kilometers from An-shan in Liao-yang Hsien, Liaoning Province.

a. In the pre-war period mining was discontinued because of poor ore dressing.

b. The ore deposit is a banded vein like that of the Hsi-an-shan ore deposit and contains a large amount of hematite.

c. Grade

Fe	FeO	SiO_2	Al_2O_3	CaO	MgO	P
36	11.62	46.2	0.635	0.924	0.830	0.045

S	Cu	MnO
0.029	0.003	0.150

d. Ore Reserves:

West: 36% 30 meters and above	98,100,000 metric tons	
30-10 meters and above	8,480,000 " "	
Total	106,580,000 " "	

East: 27% 100 meters and above 50,000,000 metric tons
(above according to pre-war records)

e. Distance between Shan-yuan and An-shan is 8.2 kilometers.

f. During the post-war period an ore crushing plant, a flotating plant and two large scale sintering plants were constructed and are presently operating.

g. Flotating plant: concentrate quality was 63%; they were successful in reducing the water content to 10-12%.

h. Daily output: They raised the former record of 1,500 metric tons to 5,000 metric tons (i.e., 1,800,000 metric tons annually) in 1959.

i. The mines supply the An-shan Iron and Steel Works.

5. Ch'i-tao-k'ou Mines

Located eight kilometers from the Kuo-sung Railroad Station on the T'ung-hua - Chi-an Railroad line in Liaoning Province.

a. The ore deposit is divided into east and west segments. The east mine follows the mountain range and is exposed. The length is around one kilometer and the greatest width is nine meters. This deposit contains a large quantity of hematite. The west mine contains magnetite and stretches for 150 meters from Nan-k'ou-ho-yü to the eastern slope of the west mine. There are several places where the thickness exceeds ten meters. Iron content is around 50%, 5% mm, and lime content is 3-16%.

b. Hematite and magnetite -- 20,000,000 metric tons.

c. Grade --

Fe	Mn	SiO_2	P	S	CaO
52	5	10	0.03	0.06	3-16

d. Distance to An-shan is 520 kilometers.

e. Production Output:

1941	134,000 metric tons
1942	260,000 " "
1943	326,000 " "
1944	361,000 " "

Daily output just prior to the conclusion of the war was 2,000 metric tons. (above according to pre-war records)

f. Presumably they supply the An-shan Iron and Steel Works.

6. Ta-li-tzu Iron Mines

Located in Ta-li-tzu, Lin-chiang Hsien, Liaoning Province.

a. Iron Works constructed in Tung-tao-hua by the Tung-pien-tao Development Company in 1938. Iron mines also developed on a large scale.

b. The principal area of the mine is composed of a complex formation of phyllite and limestone. The hematite is impregnated in these. In the north there is a large batholith of granite which has brought about a noticeable change in the quality of the surrounding rocks, and in the vicinity of contact with the quartzite a magnetite deposit is being formed.

c. Hematite and magnetite deposits are said to be 10,000,000 metric tons.

d. Grade:

Fe	Mn	SiO_2	P	S	Cu	CaO
54-55	4.0-4.5	6-7	0.04	0.03	0.01	± 10

e. During the pre-war period the ore was crushed to under 100 m/m and shipped to An-shan and Chien-erh-p'u.

f. Distance from Shan-yüan to An-shan is 579 kilometers. (above according to pre-war records)

g. Even as late as 1957 when they (i.e., the 404th Survey Unit of the An-shan Geological Survey Company) conducted a survey, the ore reserve was found to be only 60,000 metric tons because of decay; however according to the results obtained from a 1958 survey, it was shown to be 31,000,000 metric tons, and the annual production had been raised to 300,000 metric tons. By 1959 the annual production was to have been raised to 800,000 metric tons.

h. Shaft mining is utilized.

i. Ore shipments are made to the An-shan Iron and Steel Works.

7. The Chin-ling Iron Mines

Located in Shantung Province and straddle the three Hsien of I-tu, Lin-liu, and Huan-t'ai.

a. Mine returned to Japan in accordance with the 1919 German-Japanese treaty. Then for a time it was returned to China in accordance with the Washington treaty of 1922. Occupied by Japan in 1942; subsequently came under the management of The

Japan Steel Pipe Manufacturing Company (Nihon Kōkan). Large scale mining operations began in April 1943.

b. A contact metamorphized ore deposit is impregnated in the contact area of the diorite and limestone. The hangwall is limestone; the footwall is diorite. The strike runs north and east and has an inclination of 40°- 50°. The magnetite and hematite ore deposits are in an expanding lenticular condition. Although it has the drawback of having a comparatively high sulphur content which crumbles with weathering, the ore is still of good quality.

c. Ore Reserves and Ore Grade:

Ore reserves estimated at 3,000,000 metric tons (pre-war estimate).

Fe	FeO	Fe_2O_3	Mn	SiO_2	S	P
58.4	23.62	5.192	0.24	5.66	1.009	0.099

Cu	CaO	As	Al_2O_3
0.124	3.51	0.003	0.67

d. Production:

1942	32,606 metric tons
1943	250,093 " "
1944	145,942 " "
1945	36,000 " "

e. Distance from Shan-yüan is 260 kilometers.
(above according to pre-war records)

f. A Pre-war Analysis by Mines (from source material #119 of The China Research Institute)

	Iron content	Silicic acid	Phosphorus content	Sulphur content
Shaft No. 1				
Pit #1	61.67	5.46	0.011	0.080
#2	64.24	5.38	0.034	0.078
#3	48.00	15.27	0.011	0.053
#4	49.40	10.10	0.013	0.260
#5	44.00	12.25	0.025	0.230
#6	64.18	4.87	0.029	0.063
#7	39.11	16.88	0.025	0.153
Glory hole	65.66	1.76	0.088	0.043
Outcrop	66.46	4.94	0.057	0.063

The work situation for this mine is described in an article entitled "The Chin-ling Iron Mine Is an Advanced Enterprise Unit" in the 28th issue of <u>Metallurgy</u> (1959). I have translated this article because I think it is good reference material for ascertaining the situation of mining development in China. (The tone of this report is at variance with other reports in that it does not particularly emphasize the role played by the Communist party committee members in on the spot guidance.)

The Chin-ling Iron Mine, Shantung Province
("The Chin-ling Iron Mine is an Advanced Unit of Mining", Metallurgy #26 [sic])

Production and stripping operations of the Chin-ling Iron Mine in 1959 exceeded the 1958 level by 57% and 65% respectively. In spite of the fact that there was a decrease in personnel and no increase in facilities, the respective goals for 1959 were attained during the period from January to May. There was a rapid rise in labor efficiency and a noticeable drop in the cost of ore. The target quota for May saw an increase of 106.47% with the labor efficiency rate at around 138%. The cost of ore for April was 7.027 yüan, and it is estimated that the cost for May will be 5.08 yüan. The attainment of such excellent results by this mine was due to two factors, full utilization of existing excavation facilities and rationalization in the organization of labor. With regard to the utilization of the latent capacity of the existing facilities, the Chin-ling Iron Mine has modern drilling machines, electrically powered shovels, and electric locomotives [character missing in the compound, but presumably it is part of the compound for "locomotive"], all of which are important equipment; furthermore the full utilization of this equipment and development of its potential have a profound effect upon the production and stripping operations of the mine. During the first period of this year the utilization rate of equipment was extremely low. Electrically powered shovels still had a latent power potential of 37.84%, rock drills 36.28%, and hoists 22.01%. The reason for this low rate of utilization was due to long overtime work and frequent mechanical breakdown. During the first period over half of the time was expended in supplementary and repair work, so if we could reduce this work, the rate would go up to 275%, doubling the total amount of rocks drilled. If the time expended in supplementary work, inspection, and repair could be reduced for the rock drills, then the working ratio would become 70%. Provided that this could have been accomplished, stripping operations for 150,000 cubic meters should have been successfully completed within the first period. Following the analysis of this situation from the standpoint of management, a series of devices were utilized, of which the following are some examples.

1. They established a parts manufacturing unit. In the past, time expended in inspection and reapir was so lengthy because they suffered from a shortage of parts. When electric

shovels broke down, the mine was closed for several days because of this shortage. However they have recovered themselves through several months of effort. At present they are able to manufacture all parts themselves with the exception of a few large and precision parts; moreover the electric rock drills are all in operation, and they have also exceeded their quota for March.

2. They are concentrating on the policy of repair and actual use with 70% devoted to operation and 30% to repair. They are emphasizing daily maintenance work for the purpose of raising the percentage of equipment utilization. They have made the intermediate repair of electric shovels the responsibility of the work sites themselves by placing specialists in the factory proper. By these means alone they have been able to manifest the positiveness of the plant. Furthermore the engineers have become more proficient with the performance of the equipment because of the [system] of inspection and repair.

3. They have instituted a holiday rotation system which enables them to fully utilize the equipment. Heretofore the work ratio for stripping was poor. Because they mobilized a relatively small work force all at once [for stripping], it produced the defect of having various other sections disengaged. After the establishment of this holiday rotation system, production personnel was not only reduced, but they were able to utilize work time efficiently because the conditions for equipment and work site were well-defined. In short, the fruits of the efforts in this direction have sufficiently materialized.

4. They are rigidly enforcing regulations governing work and intensifying ideological education.

Single File [(一条龍) I-t'iao Lung, "One Dragon"] Operation for Coordinated Work Units

The work sites of the mines are always changing; consequently the work conditions also change in this connection. The distribution of the organization and personnel of a work unit, the management of tools, track laying, and operational procedures must all fit the fluctuations of production exigencies. The work units which were organized for specialized operations in 1958 usually produced the phenomenon of disengagement in other areas which in turn resulted in an extremely low rate of labor efficiency. In order to rectify this situation "free discussion" was conducted, and it was decided that those plants which were in the final stages of mechanization were to organize coordinated work units which were to have electric shovels as their principal equipment. They organized the following eight squads: rock drill, electric shovel, pneumatic drill, electric locomotive, railway, railway yard, overhead lines, and chai-kuei-kou? [question mark author's (摘挂/钩)]. They have adjusted the organic [operational] forms such as blasting, pneumatic drill secondary blasting, the electric shovel, and shipment by electric locomotive from the stone chip disposal area to the railway yard, thus creating an all-inclusive single file ("one dragon") operation. Each work process was performed in close cooperation with the others with the electric shovels acting as the "dragon's head" and the other work processes working to serve the "dragon's head." When the squads met the workers from "dragon head" to "dragon tail", they participated in mutual criticism of the respective work processes, and in this way they were able to resolve immediately the various problems of production confronting them; moreover they were also able to establish firm convictions within each of the work processes. At the work sites which are semi-mechanized coordinated work units comprised of blasters, haulers, rail workers, and reclamation workers were organized, and in this way a single file ("dragon") operation was formed with emphasis laid upon the hoists.

Control of tools has become adjusted in line with the improvement of labor organization. Supervisors are selected from among the workers to exercise self-management over tools. These supervisors are in turn controlled from an overall standpoint by a manager of a relatively large work force. Each squad was assigned specific areas of supervisory responsibility, hence putting into effect the "Encouragement to Safely Overfulfill Production". At the same time that ideological education was intensified, responsibility was proportionally alloted to labor. They have instituted "the method of encouragement of a comprehensive and safe overfulfillment of monthly production" for the purposes of driving home the basic principles, correctly manifesting the incentive function of material, and constantly raising the rate of labor efficiency.

Five goals were established for quantity and quality of mining and stripping, economic accounting facilities for each squad, personal safety, work attendance rate, and division into three classes and nine subclasses according to ideology. Supervisors at each work site are authorized to give incentive pay in accordance with the above mentioned method of overfulfilling production. The class and subclass of individuals are determined by discussion within the respective units. Although only a short time has elapsed since the institution of "The Method of Safely Overfulfilling Production", results have already become evident at this mine. The cooperation rate for all the workers saw an increase of 20% compared with the first period. The attendance rate in May was raised by 98%. Since May the accident rate has seen a drastic reduction; no heavy casualties were caused.

8. Li-kuo Iron Mines

Located 53 kilometers northeast of T'ung-shan, T'ung-shan Hsien, Kiangsu Province and four kilometers west of the Li-kuo (Chin-p'u) Railroad Station. Ore found at Li-chia-wan, T'ung-shan, T'ieh-shan, and Hsi-ma-shan. It has been mined as far back as the Han dynasty and was mined increasingly during the T'ang, Sung, and Yüan periods. This mine was abandoned for several hundred years because of the damaged fuel caused by a large amount of underground water produced by digging below the surface. The ore deposit is a contact deposit of black granite and limestone with a length of 220 meters and a width of 55 meters. The deposit is principally hematite, but at times contains magnetite. Operation is difficult because of the underground water. The residual deposit is meagre; consequently large scale planning is impossible.

a. Residual deposit = 500,000 metric tons
   Fe: 54 - 65 S: 0.1 - 0.6 P: 0.04 - 0.2
   (above according to pre-war records)

b. Distance to Lien-yün-kang is 249 kilometers and to Ch'ing-tao is 694 kilometers.

c. It services the An-shan Iron and Steel Works.

9. Miao-erh-k'ou Iron Mines

Located five kilometers east of the Nan-fen Railroad Station in An-feng Hsien, Pen-ch'i Hsien, Liaoning Province.

During the pre-war period this was the principal mine servicing the Pen-ch'i-hu Iron Works. At that time they established a large ore dressing plant there under the impetus of the treatment of lean ore by An-shan. The ore deposit is also banded as in the An-shan vicinity. The hang wall is composed of white mica schist, granite gneiss, quartzite and tremolite; the foot wall is composed of mica schist, amphibole gneiss, chlorite schist, and quartzite. The ore deposit is stratified in the mica gneiss and the chlorite schist. Rich ore bodies which contain high grade ore can be found in limited areas. The ore deposit has a wide distribution. The length is six kilometers and has a 45° westward inclination; its greatest thickness exceeds 100 meters. It is a magnetic ore body.

The rich ore bodies, of which there are three large ones, are interposed between the lean ore bodies. The length is 150 meters, the thickness is 25 meters, and the depth exceeds 1,200 meters. 70 meters below this ore body is the Ling-nan ore body which has a length of 40 meters and a thickness of ten meters.

a. Ore Reserves and Grade

	Fe	Mn	SiO_2	P	S	Surface and below 760 meters
Rich Ore	55	0.3	5	0.02	0.14	3,000,000 metric tons
Lean Ore	34	0.2	51	0.02	0.04	273,000,000 " "

b. Production

1941	330,000 metric tons
1942	393,000 " "
1943	374,000 " "
1944	424,000 " "

The daily output at the close of the war was 1,000 metric tons of rich ore and 2,000 metric tons of lean ore.
(above according to pre-war records)

10. Wai-t'ou-shan Iron Mines

Located six kilometers west of the Wai-t'ou-shan Railroad Station, An-feng Hsien, Pen-ch'i Hsien, Liaoning Province.

a. The ore deposit is magnetite and hematite. It is impregnated in the banded gneiss and crystallized schist and has a length of 1,500 meters, a width of from five to 100 meters and an inclination of 25° - 50° for both.

b. Ore Reserves:

Lean Ore:	32%	15%	90,000,000 metric tons
Rich Ore:	54%		

c. Services the Pen-ch'i Iron and Steel Works.
(above according to pre-war records)

11. Nan-fen Iron Mines

Located in Pen-ch'i Hsien, Liaoning Province. Of the mines located in the vicinity of the Pen-ch'i Iron and Steel Works, the Nan-fen Iron Mine is the only new mine reported recently by the Chinese. However it might be that the "Nan-fen Mines" is a term which also includes the Miao-erh-k'ou, Wai-ch'iau-t'ou, and Pa-p'an-ling Mines. Even if this were the case, it is thought that the Miao-erh-k'ou Mine would be the principal one. The annual capacity of the Nan-fen ore dressing plant is said to be 3,600,000 metric tons. If we take the annual pig iron output capability of the Pen-ch'i Iron and Steel Works to be 2,150,000 metric tons (i.e., the annual plan for the No. 1 and No. 2 blast furnaces = 550,000 metric tons, and the output of the No. 3 and No. 4 blast furnaces is supposed to be three times this figure or 1,600,000 metric tons, hence the figure 2,150,000 metric tons), then we can say that supply and demand is more or less balanced because 63% - 65% of the 3,600,000 metric tons would yield around 2,150,000 metric tons of clean ore.

12. Pa-p'an-ling Iron Mines

Located in Sun-chia-pao-tzu.

a. Ore deposit is the same as Kung-chang-ling.

b. Ore reserves are 2,000,000 metric tons.

c. Grade:

Fe 58 -67% SiO_2 18 - 2 S - P 0.008 - 0.012

d. Distance from Shan-yüan to Pen-ch'i is 33 kilometers.

e. Supplies the Pen-ch'i Iron and Steel Works.
(above according to pre-war records)

13. Pai-yün-o-po Iron Mines (Japanese transliteration PA-IN-BO-KU-TO) (Note: BO-KU-TO means nomad demarcation point.)

Located 48 kilometers northwest-by-west of Pai-ling-miao and 165 kilometers north of Pao-t'ou. The relative height of the mine vicinity is 30 meters, and the topography is characterized by gentle rolling hills. The character of the ore is made up of two ore bodies with a [(大塊状) "ta-yü-chuang", literal translation -- large tuberous condition] which are contiguous with a replacement deposit in siliciferous limestone. The ore is composed of both magnetite and hematite.

Length	900 meters	700 meters
Breadth	200 "	100 "
Height	130 "	95 "

	Fe	SiO_2	P	S	Sgn.
No. 1	61.67	0.79	0.01	0.07	4.84
No. 2	51.18	4.87	0.11	0.05	

Estimated Ore Reserve: 15,000,000 to 60,000,000 metric tons (above according to pre-war records)

Although the mine showed promise, it was never developed. In 1954 a survey was begun with the assistance of Soviet geologists, and in the same year the Soviet government dispatched a party of experts consisting of the director of the Leningrad Branch of the Black Metallurgical Planning Institute, a chief engineer, and 30 others for the purpose of taking charge of selecting a site and planning (i.e., for mine and iron foundry). Experiments for the utilization of dolomite were successful under the guidance of the Soviet expert in this field, Professor Shumiko (Japanese transliteration) [could be Shumikov; Japanese transliteration sometimes drops the final "v".] In 1953 the ore reserve for this mine was said to be 150,000,000 metric tons; however the present estimate exceeds 400,000,000 metric tons. The installation of the largest ore crushing and concrete water dressing (コンクリート水選設備) facilities at the Shan-yüan ore base has already been completed. (It is said that this is a 20 story building with a large contour structure.)

14. Ta-yeh Iron Mines

A lime grotto is located 512 nautical miles (980 kilometers) from Shanghai toward the upper reaches [of the Yangtze River], Ta-yeh Hsien, Hupei Province. The mine is located 26 kilometers from this point by rail. It was discovered in 1890 by a German engineer under the employ of Chang Tzu [sic]-t'ung. Construction work for the Han-yang Iron Foundry was commenced in 1891. Later, however, the Ch'ing government was forced to sell the mine to Sheng Hsüan-huai. Japan started to procure ore from 1904.

The contact replacement deposit is situated between the granite (hang wall) and the limestone (foot wall); the strike runs from east to west and has an approximate northward inclination of 60°. The length is 5,000 meters, and there is a large outcrop. The top section is hematite, but as the lower section is approached the magnetite content increases. It contains some copper; however it is still a high grade ore body. Crumbling is rare, and the hardness is just right for mining.

Ore Reserve and Grade

Main Ore Bodies (Hsiang-pi-shan,		32,900,000 metric tons
Shih-tzu-shan, Chien-shan)		362,000 " "
Lung-t'ung		737,000 " "
Sha-mao-tzu		6,300,000 " "
T'ieh-men-k'an	Total	40,299,000 " "

20,000,000 metric tons were mined from the beginning of the mine to 1945.

a. Average Grade:

Fe	Mn	SiO_2	P	S	Cu	Al_2O_3
59.49	0.18	8.78	0.078	0.3	0.32	3.42

Cw [sic]	As
3.92	0.003

b. Handling of Ore: During the pre-war period lean and copper ores were hand-picked.

c. Production:

1939	77,000 metric tons
1940	399,000 " "
1941	1,101,000 " "
1942	1,455,000 " "
1943	1,104,000 " "
1944	883,000 " "
1945	---- Annual equipment capacity at time was 2,000,000.

(above according to pre-war records)

A geological survey was completed in 1954 with the assistance of the Soviet Union, and as a result the new mining districts of Chien-lin-shan and Chin-shan-t'ien were discovered; moreover a second layer of iron ore was discovered in the principal mining district of Shih-tzu-shan. On the basis of the discovery that the ore reserves of the Ta-yeh Iron Mines could be mined for the next several decades, it was decided that a large scale iron and steel enterprise was to be built in Wu-han. Mechanized mining and stripping operations were begun in 1955. The Shan-yüan ore dressing, electric power and water supply facilities and a railroad between Shan-yüan and Wu-ch'ang have all been completed. The annual output of ore for 1958 reached 1,210,000 metric tons.

There has not been any special material written on this year's output; however it has been noted that ore shipments to the Wu-han Iron and Steel Works have been smooth and regular. The sulphur content of the ore shipment is said to be 0.02%; consequently the ore has an acceptance rate of 100%.

15. Lung-yen Iron Mines (Collective Term for Yen-t'ung-shan and P'ang-chia-pao Iron Mines)

a. Yen-t'ung-shan Iron Mines

Located nine kilometers east of the Hsüan-hua Railroad Station, Hopei Province. The Chinese government created the semi-government operated Lung-yen Iron and Steel Works in 1918; however it was discontinued because it was unprofitable. In 1937 the Hsing-chung Company planned its development, and in the same year the Lung-yen Iron and Steel Co., Ltd. was formed. A simple sedimentary deposit consisting of three layers sandwiched between the limestone, quartzite and/or the quartzite of the lower section of the clay slate is located at a distance of approximately ten meters. Only the top two layers of this deposit were mined. The average thickness does not exceed 1.47 meters; however the range of distribution is broad, and no other examples of this condition can be found. The ore is dark red micaceous [(魚面狀) literally means fish-surface-condition = scaly = micaceous?] hematite which is lustrous. The inclination of the top section is 10° south; as it progresses downward it changes to 20° - 30°.

Ore reserves are approximately 400,000,000 metric tons.

Fe	SiO_2	Mn	Al_2O_3	CaO	S	P	Cu
52.06	21.64	0.18	0.24	0.62	0.03	0.133	0.025

(above according to pre-war records)

Distance to Shih-ching-shan is 210 kilometers; distance to An-shan is 1,162 kilometers.

As for the post-war period, operations were begun in July 1958.

According to issue No. 45 of Metallurgy, the mine's daily output was 3,300 metric tons in April 1959; consequently I think that the annual capacity has been raised to 1,000,000 metric tons.

The production plan for 1959 was 1,000,000 - 1,200,000 metric tons.

b. P'ang-chia-pao

Located 42 kilometers east of Hsüan-hua Station, Hopei Province. The Chinese government created the semi-government operated Lung-yen Iron and Steel Works in 1918; however operation was discontinued after the First World War because of unprofitability. The mine was amalgamated with the Lung-yen Iron and Steel Company that was formed in 1937. The ore deposit is the same as that of Yen-t'ung-shan.

Thickness of outcrop:

2.5 / 0.5	horse	0.7 - 0.8 m
0.3	horse	0.4 - 0.5 m

It is a three layered ore deposit and has a length of 8.6 kilometers. The deposit has the following distribution:

East section	Relative height	50 m
Central section	" "	340 m
West section	" "	350 m

The strike runs 25°N - 30°E. West of the central section is abbreviated East-West [sic]. The ore is micaceous reniformed hematite.

Ore reserve is 65,000,000 metric tons (pre-war estimate).

Fe	SiO_2	S	P
57.63	10.64	0.005	0.132

Average of mined ore is 52%.

This mine has been shipping ore to the mines located in Hua-pei, and at present they have increased the number of pits from three to five. Production has picked up. Since the total annual production plan for 1959 for both Yen-t'ung and P'ang-chia-pao mines is 3,500,000 metric tons, we can estimate the capacity of this mine to be 3,500,000 - 1,200,000, or 2,300,000 metric tons.

If we consider the present situation of the mine, it can be seen that transportation has been the bottleneck. Of the 154,000 metric tons mined in January 1959, only 75,000 metric tons were shipped; moreover since there are very few ore storage areas, storing large volumes of ore is impossible. Over half of the ore is sent to Shih-ching-shan; the rest goes to T'ai-yüan and An-shan.

16. The Ch'i-chiang Iron Mines

a. 35 kilometers south of the Hsien seat Ch'i-chiang, Szechwan Province, are three mining districts with the principal mines being T'u-t'ai, Ta-lo-pa, and Ma-liu-t'an.

b. The deposit is impregnated in the ore bed in the sandstone of the upper [missing character] and Lo (羅) era [most likely geologic period]. The inclination of the ore bed is 11° - 15° and thins to 0.6 - 2.5 meters. The ore is hematite. The deposit is a bedded vein.

c. Ore Reserves: The pre-war estimate was several million metric tons; however the production plan for 1959 alone was 2,500,000 to 3,000,000 metric tons; consequently they must have found a considerable amount of new ore reserves.

d. Production: T'u-t'ai and Ma-liu-t'an are Szechwan Province's oldest mining districts. Their annual output for the year 1958 was 437,000 metric tons. The production plan for the entire Ch'i-chiang mines was 2,000,000 to 3,000,000 metric tons. T'u-t'ai became the principal mining district and was made responsible for 1,000,000 metric tons.

The planned capability of the new facilities of Ta-lo-pa is 250,000 metric tons, to be completed in 1960 or 1961. The expanded segment of the T'u-t'ai level is to have a 350,000 metric tons capability and is also to be completed in 1960 or 1961.

Grade:	Fe	SiO_2	S	P
T'u-t'ai	57.75	4.59	0.060	0.083

e. Supplies the Chungking Iron and Steel Works.

17. The Nan-shan Iron Mines

Located 27 kilometers northeast of the Hsien seat Tang-t'u, Anhwei Province. Has been under the management of the Hua-ching Mining Industries since 1938. The ore is principally hematite. The length of the ore body is 350 meters; the width is 40 meters.

a. Ore Reserves: 4,000,000 to 6,000,000 metric tons (pre-war estimate)

The present situation is not definite; however the Tung-shan Mining District alone contains 5,000,000 metric tons.

b. Grade:

Fe	SiO_2	Mn	S	P	Al_2O_3	Cu
62	6	0.2	0.3	0.3	--	--
60.6	5.4	0.17	0.45	0.5	1.52	0.013

c. Supplies the An-shan Iron and Steel Works.

d. Distance from the base of the mountain is 20 kilometers.

At present it is an open pit mine with mechanized mining facilities. In 1958 290,000 metric tons were mined in the Tung-shan Mining District alone. The planned output for 1959 is scheduled to be 500,000 metric tons.

18. The Yao-shan Iron Mines

Located 22 kilometers northeast of the Hsien seat Tang-t'u, Anhwei Province. It contains the two mountains, Ta-yao-shan, and Hsiao-yao-shan. The length of the ore bed is 350 meters; its width is 60 meters. The ore is magnetite.

a. Ore Reserves: 3,980,000 metric tons (pre-war estimate)

b. Grade:

Fe	SiO_2	P	S	Al_2O_3	Mn	CaO
55-56	5-17	0.56	0.13	1.43	0.13	3.62

MgO	Cu
0.39	0.01

c. It is an open pit mine and has mechanized mining facilities.

19. The Feng-huang-shan Iron Mines

Located to the northeast of Mo-ling-ke, Chiang-ning Hsien, Kiangsu Province, and 30 miles south of Nanking. Development of the mine initiated by the Japanese in 1938. The railroad between the base of the mountain and Feng-hsiang (along the Yangtze River) was opened to traffic in 1940. It is a contact ore deposit impregnated in the contact area of the sandstone, limestone, and granite. The mine is an isolated mountain having two peaks with heights of 120 and 90 meters. The length of the mine is approximately 500 meters. The outcrop is hematite and is located behind the mountain; it is 130 meters long and 80 meters thick.

a. Ore Reserve: the residual deposit at the end of the war was 2,000,000 metric tons.

Fe	SiO_2	MnO	Al_2O_3	MgO	S
55.96	12.29	0.48	2.63	0.31	0.02

b. Past Output:

1940	30,000
1941	100,000
1942	200,000
1943	300,000
1944	100,000
1945	---

c. There have been reports that this mine has been shipping ore to the Wu-hsi and Tung-feng Iron Works. It is also possible that ore is shipped to the Nanking Iron and Steel Works.

20. The Tien-tu Iron Mines

Located at the southern tip of Hai-nan Island at Yü-lin-kang; the base of the mountain is 12 kilometers northeast of this site. There is a 3' 6" ore freight line for 11 kilometers between An-yu-yen-pi /or the An-yu dike/, which could be called the east harbor of Yü-lin-kang, and the base of the mountain. The mine was surveyed by the Ishihara Industries in 1939 with construction work begun in June of the same year. Within ten months the mine was in operation. 2,900,000 metric tons were shipped up to the end of the war. It is a chiao-hua /chiao-hua (交化) probable misprint for chiao-tai (交代) meaning replacement deposit/ type deposit developed in the vicinity of contact of the granite, phyllite, and quartzite. The ore is magnetite and the ore beds are located to north, east, and west. The length of the east ore body is 165 meters and the width is 100 meters, but it becomes narrower as it descends. The surface portion of the north ore body is covered with boulders. The north ore body is 70 meters long and 30 meters wide 50 meters below the surface. The west ore body has a tuberous /?/ condition and is 160 meters long and 45 meters wide. It is metamorphized 50 meters below the surface.

a. Ore Reserve: 1,800,000 metric tons (pre-war estimate) At the end of the war there were 240,000 metric tons of ore in storage.

b. Grade:

FeO	Fe	Mn	SiO_2	P	S	Cu
8.8	63	0.5	5	0.03	0.01	0.01/0.02
	65	0.6	4	0.04	0.02	

CaO	Al_2O_3
0.4	2.2

c. Pre-war Production:

1940	169,599	metric	tons
1941	355,921	"	"
1942	893,824	"	"
1943	918,511	"	"
1944	359,777	"	"
Total	2,697,632	"	"

(above according to pre-war records)

Detailed information concerning the developmental situation in the post-war period has been unobtainable; however according to issue No. 5 of Metallurgy in 1959 on the mining intensity for the open pit mine at Tien-tu Mines, the average monthly output was 395.8 metric tons with the highest monthly output reaching 1,186 metric tons. Consequently all we can ascertain here is that open pit mining operations are being resumed. There are indications that Yu-lin-kang is being utilized as a Soviet naval port.

In March 1958 Mr. Nakai, Chief of Operations, and Mr. Nagata, Chief of the Statistical Survey Section, both of the Yawata Iron Works, made an official trip to Hai-nan Island for the purpose of making an on the spot mining survey. According to their report the mine has a residual deposit of 800,000 metric tons covering the period from March 1958 to the present; however it appears that the Chinese have announced that presently it is not being mined.

According to World Charter Service dated 28 October 1959, a freighter (ship name unknown) was booked for 10,000 metric tons of ore to be loaded in December at FIO 58 shillings between Yü-lin and Poland; furthermore their report of 12 October states, "draught 30 foot freight space."

It is also reported that a loading date between December and January is being selected for shipping iron ore from Yü-lin to Poland at FIO 55 shillings. We can see from this that part of the ore has been shipped to Poland. (Note: According to an unconfirmed report, the Soviet Union has concluded a ten year lend-lease agreement with the Chinese for a submarine base on Hainan Island; consequently port entry into Yü-lin-kang might be restricted.)

21. The Shih-lu Iron Mine

Located at Ch'ang-chiang Hsien (at the upper reaches of the Ch'ang River) 54 kilometers from Pei-li and 52 kilometers east of the western bank of the port of Pa-so (Pa-so-kang). It was discovered by the Japan Nitrogen Industries in 1940 with developmental work initiated in 1941. A railway was put into operation just two years after initial construction. By 1944 410,000 metric tons had been exported. When the war ended, 450,000 metric tons were in storage at Pa-so-kang.

a. Special characteristics of the ore deposit: It is a replacement deposit of hematite and magnetite which is developed in the vicinity of contact of the granite, quartzite, limestone, and sericite. The deposit parallels the country rock bedding and is almost perfectly replaced; however there are numerous horses contained within the ore body. The quality of the ore decreases the more the mine is developed. Ore reserves at the end of the war were 60,000,000 metric tons. There is, however, an estimate which sets the ore reserves at around 400,000,000 metric tons.

b. Grade:

FeO	Fe	Mn	SiO_2	S	P
1.2	58-63	0.05-0.14	9-14	0.008-0.019	0.012-0.027

Cu	Al_2O_3	CaO
0.007	0.74-2.4	0.3-0.6

c. Shipping: The distance from the base of the mountain to Pa-so-kang is 54 kilometers. There is a 3' 6" gauge railway.

d. Pre-war Mining Situation:

	1941	1942	1943	1944	Total
Mined	5,000	84,348	393,787	360,305	843,440
Shipped by rail	1,620	84,966	383,579	204,435	678,600
Loaded on Japanese ships		51,456	248,012	110,900	410,358

Pa-so-kang: The Pa-so dike (Yen-pi) was completed in 1943 and was capable of disembarking two 10,000 metric tons class ships simultaneously. Water depth is from 15 to 16 meters. It has the following loading facilities: (1) type 1 42" wide conveyor belt, (2) two loaders (each loader has the capacity of loading 31,000 tons an hour,) (3) ore storage capacity for a loading year is 5,000,000 tons. It has been reported that the annual shipping capacity of Pa-so and Shih-lu was 3,000,000 tons.

The Chinese have published very few documents concerning the post-war status of this mine; however issue No. 12 of Metallurgy (April 1959) had the following to say: "Iron mines on Hai-nan Island have the responsibility of supplying several key enterprises on the mainland. The national plan has been realized both in time and quality; the average grade of the ore has been assessed at 55%." So we can see, at least, that the ore is earmarked for internal consumption within China proper.

The average mining intensity for open pit mining for 1958 has been reported to be 153.2 metric tons per month.

This mine was surveyed by Mr. Nakai, the present Chief of Operations, and Mr. Nagata, Chief of the Statistical Survey Section of the Yawata Iron Works, together with Mr. Shang Kuang-wen, manager of the China Mining Company.

According to their report --

a. Developmental work was begun on the Shih-lu Mine on Hai-nan Island in 1955. By July 1957 they had tentatively restored all facilities.

b. By February 1958 they had exported 400,000 metric tons to the An-shan Iron and Steel Works and other companies.

c. The principal motive power is primarily thermal (diesel independent electric power plant); however one part of the mine is also using power from the Tung-fang hydro-electric power station of Japanese vintage. There is also another hydro-electric power station which is being built.

d. Ore reserves: The Chinese estimate the reserves to be at least 250,000,000 metric tons; consequently they are promoting developmental plans on this basis. They are continuously encouraging survey of the mine. The conservative figure of 250,000,000 metric tons is probably wrong, for they have discovered a new mine in the interim.

e. The iron content ranges from 50-60%. If 50% were acceptable, then the amount supplied to Japan could be sharply increased.

f. Production output of Shou-chien (手間) [?]: A mining engineer at Shih-lu has said that it was possible to produce 5,000,000 metric tons a year. If this were the case, then they would have to expand their railway to a broad gauge.

g. Pa-so-kang: It has been completely restored. Water depth is 5-7 meters. There are two piers, and they are in the process of building another. When completed, they will be able to handle loading for three ships at a time.

A Summary of the 1958 Shih-lu Iron Ore
Sales Contract Contained in the 1958 Sino-Japanese
Iron and Steel Agreement

1. Item: Iron from Shih-lu, Hai-nan Island.
2. Specification:

Fe	dry measure	above 58%	minimum 56%
SiO_2	" "	" 15%	
Al_2O_3	(unknown)		
S	dry measure	under 0.11%	
P	" "	" "	
Cu	" "	" 0.06%	
Grit	wet weight	under 10 m/m under 40%	
		10 m/m to 203 m/m under 60%	
Total water volume		under 5%	

3. Quantity: 400,000 metric tons (wet weight)
4. Unit price: The dry measure analysis of 58% is used as the basis for calculating price. FOB Pa-so wet weight K.T. 53 shillings 7 pence (loading charge included). Price increases or decreases two shillings with each one percent increase or decrease of iron content. When water content exceeds five percent, the equivalent in weight (i.e., of the exceeded amount) is deducted from the price.
5. Time of delivery: Between May 1958 and December 1958.
6. Port of delivery: Pa-so-kang
7. Packing: Scattered piles.
8. Inspection: The final decision on weight and quality rests with the check list of the Chinese Commodity Inspectorate.
(Note: Shipments have been increasing each year. By 1964 they should be around 2,300,000 metric tons. Prices are fixed each year.)

22. Ch'i-lien and Ching-t'ieh Iron Mines

Located south of Chiu-ch'üan which is on the western fringe of Kansu Province. The Ch'i-lien mountain range is considered to be the Ural Mountains of China. They are making steady progress in surveying this range. The Ching-t'ieh Mine is estimated to be located 100 kilometers south of Chiu-ch'üan. I discovered that an iron base is being constructed with this mine as its basis; however details are unknown.

MINING INTENSITY FOR IRON MINES PER METRIC TON

		Average for 1958	Maximum for 1958	Feb. 1959	Apr. 1959	July 1959
Ta-ku-shan	Open pit	248	444	254	267	347
T'ien-tu	" "	395.8	1,186			
Yao-shan	" "	393	545			
Nan-fen (Pen-ch'i)	" "	384	557	435	307	297
Tung-an-shan	" "	324.7	569	283		170
Nan-shan	" "	224	310	304		440
Li-kuo	" "	215	274		300	
Shih-lu	" "	153.2	250			
Ying-t'ao-yüan	" "	149.1	194	237		93
Chin-ling	" "	133	164	475	483	856
Feng-huang-shan	" "			314	328	
Pai-yün	" "				337	218
Hei-wang (Shantung)	" "				661	
Kung-chang-ling	Shaft mining	5.05	15.00	7.65	22.20	10.0
Ying-t'ao-yuan	" "	5.86	9.73	6.63	12.41	5.94
Nan-fen	" "	5.29	14.11			
Ch'i-tao-k'ou	" "	6.01	7.39			4.8
Ch'i-chiang	" "			24.44	25.53	25.30
Ta-li-tzu	" "			5.20		6.3
Ta-ku-shan	" "					
Nan-shan	" "					

C. With Respect to the Question of Importation of Chinese Produced Iron Ore

China is promoting a crash production increase plan for iron and steel; however the present situation is that there is not enough iron ore to meet these demands. Although we could say that the possibility of exporting ore is slight until a domestic surplus is achieved, there have been not a few cases where China has given priority to exports for the purpose of obtaining construction materials in spite of the condition of the domestic scene. Consequently I would like to examine this kind of possibility with regard to steel export.

1. Mines with a possibility for export from the standpoint of the conditions of location.

   a. Iron Ore from Hai-nan Island

   Metallurgy has reported that China is giving strategic considerations in the construction of her iron and steel bases; however no announcements have been made as yet which indicate that there is to be a large scale iron and steel base constructed on Hai-nan Island. Even if we supposed that the annual shipment to the mainland was to be 1,000,000 metric tons, this would still necessitate 100 ships of the 10,000 ton class for a one-way operation. It seems unlikely that China would be able to afford the wear and tear on that much tonnage until some time in the future. So from this point of view, there should be a large chance of Hai-nan Island ore's becoming the object of export; therefore I would like to look forward to a conclusion of an importation agreement in line with the First Iron and Steel Agreement if trade is re-opened.

b. Iron Ore Produced in Shantung Province

The iron ore produced by the key enterprises, the Chin-ling and Hei-yao Mines, is not consumed within the province itself but shipped to Tai-yüan and An-shan. Although the quantity of ore from these mines is not as large as that from Hai-nan Island, I feel that there is still a chance for export to Japan.

D. Small Scale Iron Mines

1. There are 240 medium and small scale iron mines in China, and the majority of these were developed as a result of last year's All China Iron Movement. These medium and small scale mines are responsible for supplying the small blast furnaces. Most of these mines are mined by hand. When the All China Iron Ore Medium and Small Scale Mines Conference was held in the spring of 1959 at Peiping, the principal problems that were raised were the "hand-made" mechanization /handmade machines/ of mining work done by hand and the initiation of a mass movement for the purpose of reforming operations. It appears that various measures are being contrived to curtail cost and maintain "increased production by leaps and bounds", notwithstanding the fact that resources are insufficient in most cases.
2. Production Output: They have decided on the policy of having the medium and small scale mines produce two-fifths of the total national iron ore output. Since they have announced that the medium and small scale mines produced 20,000,000 metric tons during the first half of 1959, I think that their annual production must have been above 40,000,000 metric tons.
3. Grade: China's Ministry of Metallurgical Industries has specified that ore earmarked for small blast furnaces must be 40% Fe and above and the grit must be 2-25 m/m. Evidently the policy is to have ore with 50% Fe and above supply medium and large scale blast furnaces. So I think that it would be permissible to think that the grade for the majority of the small scale iron mines is around 40%.
4. Small Scale Mines -- with Special Emphasis on Purchasing Price for Ore

Information regarding price regulations for iron ore has not yet been received; however apparently each mine is not disregarding cost, but instead they are pouring more of their efforts toward rationalization of management in order to curtail cost. An analysis of cost for pig iron from small scale domestic and foreign type blast furnaces during the month of August 1959 was treated in the 9 October 1959 issue of Metallurgy as follows.

Name of Enterprise	Cost per metric ton	Ore	Coke	Wages	Administrative Expenses
Kuei-chou Shui-i Iron and Steel Works	84.36	24.07	35.19	4.19	15.53
Wan-fu Iron and Steel Works (Szechwan Province)	96.54	41.87	27.8	4.5	14.13
An-fu Iron and Steel Works (Kiangsi Province)	159.37	28.82	90.86	5.83	11.80
Jen-ho Iron Foundry (Hunan Province)	172.42	61.25	69.61	16.17	23.48
Chang-chih Iron and Steel Works (Shansi Province)	195.84	90.26	39.0	9.26	43.99
Shih-chia-chuang Iron and Steel Works (Hopei Province)	207.99	64.76	54.31	6.54	43.20
Shui-chih Iron Foundry (Honan Province)	218.62	41.62	129.53	5.39	14.07
An-shan Kung-chang-ling Mines, 55 m^3 small blast furnaces	237.52	24.34	88.66	19.07	94.97
K'ai-yüan #1 Iron and Steel Works (Liaoning Province)	451.10	102.23	238.62	10.12	69.13
Chia-mu-ssu #1 Iron and Steel Works (Heilungkiang Province)	553.80	51.99	211.97	80.49	162.11

When estimating ore cost from the above chart, we can take the average cost to be 45 yüan per ton of iron ore, although there are great differences /in the capacities/ of the small blast furnaces. So if one ton of pig iron takes three tons of ore, then the price for one ton of iron ore will be 15 yüan.

5. Problems of Small Scale Iron Mines

The 29 August issue of Metallurgy, No. 35, has announced that the Iron and Steel Bureau of the Ministry of Metallurgy has decided on the policy of large quantity production of good quality pig iron by small blast furnaces. The following are extracts of the sections concerning iron ore.

a. Increasing Iron Content of the Ore by Washing

When the iron content is extremely low, the quantity of ore coke consumption is to be increased to raise the sulphur content and also to raise the cost. Where there is lean ore, the ore is to be hand-picked, the mud and sand washed, the ore roasted, and the fine ore sintered.

b. 50 Percent of the Sulphur Content Can Be Eliminated from High Sulphur Ore by Roasting

80-90% of the sulphur content can be eliminated by roasting fine ore; this also means that the fine ore is being utilized. The limestone is also to be used after it is fired into calcium oxide. Heat waste can also be prevented because the limestone becomes calcium oxide in the furnace.

c. Raw Ore Should Be Used after Sufficient Mixing

It looks as though the utilization and collection of fine ore produced in large quantities by small scale mines has become an important problem because the country is deficient in the supply of ore earmarked for small blast furnaces. There was an interesting article in issue No. 26 of Metallurgy using Shantung Province as an example of fine ore loss.

(1) A 20% loss incurred during mining.
(2) 34% becomes fine ore during shipment.
(3) 5% loss incurred from the mine to the furnaces.
(4) When lump ore is put into 10 HP crushers, 31.48% becomes fine ore.

If we use the above percentages and mine 100 tons of raw ore, we would have the following:

Stage 1		
Raw ore	Loss	Remainder
100	20%	80

Stage 2		
Raw ore	Loss	Remainder
80	34%	52.8

Stage 3		
Raw ore	Loss	Remainder
52.8	5%	50.16

Stage 4		
Raw ore	Loss	Remainder
50.16	31.48%	34.36

In short, only 34.36 tons of raw ore can be utilized; furthermore if it takes three tons of iron ore to produce one ton of pig iron, then 81.3 tons of raw ore would be needed.

6. It is difficult to gather detailed information on individual mines; however the general situation by provinces is made public sporadically. I have compiled this information as follows:

a. Shantung Province

(1) The 1959 production target for 40% and above was 7,000,000 metric tons. (This figure is prior to revision; the revised figure was 35% less so it would be 4,550,000 metric tons.)

(2) Key mines -- Chin-ling, Hei-wang, and Kuo-t'ien are the main producers. Chin-ling and Ssu-pao-shan Iron Mines export

to other provinces.

(3) Ore with grades of 45% and above is supplied to blast furnaces with 55 m^3 capacity and above; ore with a grade of 40% is supplied to blast furnaces with capacities of 50 m^3 or less.

b. Hopei Province

(1) Wu-an Iron Mine -- lean ore, Ma-hsia-k'ou -- high grade, Ch'ing-yüan Iron Mines -- autolytic ore, Chang-ting Iron Mine -- 40% Fe, and Tung-chiao Iron Mines -- /no information./

Most of the ore from Hopei is lean ore. Judging from their regulation that a grade of below 40% cannot be used, self-sufficiency is difficult. A good part of it is fine ore.

c. Shansi Province

(1) The 1959 pig iron production goal was 1,600,000 tons (figure before revision); however the province is not self-sufficient in ore.

(2) Ore reserves for the province exceed 350,000,000 metric tons. Grade is 45% Fe and above; some is 70%. All mines are within ten kilometers of railways.

(3) 27 iron mines are being developed. It has been decided to develop the large mining district of Wu-t'ai, Lan Hsien. The old mining districts of P'ing-shan, Hsi-an-li, Lin-fen, O-k'ou of Wu-t'ai, and Ku-chiao-hu-yen-shan are being reconstructed.

d. Hunan Province

The 1959 production target was 3,680,000 metric tons (before revision). Six key mines were to be developed.

e. Anhwei Province

This is a key iron manufacturing province which produced 1,116,000 metric tons of pig iron during the period from January to August 1958. The mines are distributed along the southern bank of the Yangtze River. Information on mining production is not clear; however it is possible that the province is self-sufficient.

f. Szechwan Province

In the past Szechwan imported about 80% of her pig iron for steel manufacture from An-shan, T'ai-yüan, Pen-ch'i and Ta-yeh; however the province produced 830,000 metric tons of pig iron in 1958. By July 1959 small blast furnaces with a total capacity of 6,087 m^3 had been constructed which produced 1,000,000 metric tons of pig iron; this seems to indicate that Szechwan is almost self-sufficient in this respect.

E. Ore Dressing in Large Scale Mines

/Chart on Concentrate Grade by Ore Dressing, % Fe, at end of translation./

The January 1959 issue of Metallurgy has listed the following problematical points of ore dressing:

1. The metal withdrawal percentage by ore dressing for China during 1958 was under 70%. (Normally /should be/ 70-80%.) (Note: By the second half of 1959 it was over 70% as indicated in another chart.)
2. There is still room for increasing the capacity of crushers. The Nan-fen No. 4 Ore Dressing Plant has a high efficiency operating at 4.6 metric tons per hour m^3; the Ta-ku-shan Flotating Plant is operating at a low efficiency rate of three metric tons per hour m^3.
3. It is necessary to find some means to recover the copper and cobalt content from Ta-yeh iron ore.
4. Experiments are being conducted on the manufacture of soy bean oil-fatty acid-oxidized oil /direct translation of Daizuyushibō-san sankayu/, NM-11, pulp waste, rosin oxide, sodium alcoholate, and rosin sulphide-sodium alcoholate as by-products of flotation; however they are still insufficient.
5. We would like to establish the goal of 65% as the minimum grade of concentrate and 90% as the percentage of metal withdrawal from mechanical dressing.
6. Because we have not as yet sufficiently mastered the method of combining flotation with power selection (動力選), upon which we recently began operation, further research should be continued.
7. Research should be conducted on the use of lean hematite in flotation.
8. The degree of granulation by crushers should be raised, with 5 m/T per m^3 hour established as a goal.

China's model ore dressing plants seem to be those of Pen-ch'i and Nan-fen. The daily output is 10,000 metric tons with the concentrate grade reaching 64%. These plants are experimenting with the ore dressing method of combining magnetic separation with power selection, and they have been successful in raising the grade of lean ore to 64% with a maximum of 66-67%.

F. Pellet Ore

Evidently the Chinese have been successful in creating a new technique, viz., producing pellet ore. Details of this technique were published in Metallurgy under the authorship of Lin Yün-hsia of the An-shan Iron and Steel Works Sintering Plant. I have translated the entire article in the hope that it will serve as a reference and also because it is related to the question of importation of ore from the Soviet Union /(sic) more likely the author meant Communist China./

Pellet Ore

By Lin Yün-hsia, Sintering Plant,
An-shan Iron and Steel Works

Producing autolytic pellet ore by using finely pulverized ore is a progressive technique in ingot production. It is one of the items contained in our nation's 12 year scientific program. Last year (1958), under the stimuli of the Great Leap Forward and with the support of all workers, the ore briquette factory of our sintering plant was successful in achieving a foothold on this progressive technique through 30 experiments covering 45 grueling days. On 1 October the first pellet ore machine in our nation was completed and thrown into production. Since then half a year of positive achievements in production has gone by; presently the machine is engaged in the production battle for iron and steel. In 38 days our factory constructed the second pellet ore machine which has been producing since May.

1. The Advantages of Pellet Ore

There are advantages of using pellet ore. Iron content, machine intensity (chi-ch'i ch'iang-tu), and grit are all better than sintered ore. Alkalinity has only reached 0.67 because of the unsettled situation of the present limestone crushing facilities; however it is certain that the capability will be raised to exceed 1.2 in the future. Compared to the present manufactured products of open hearth angular ore (p'ing-lu chüeh-t'uan-k'uang) the iron content is a little lower; however pellet ore is not only produced much easier but also in large quantities. The production output capacity of this factory is already six times that of angular ore. The chart below will clearly show the superiority of pellet ore.

Type	Iron Content	Alkalinity	chuan-ku /sic/ (転鼓) under 5 m/m	FeO	Grit under 5 m/m	External Shape
Pellet Ore	56.45	0.67	11.9	6.81	--	spherical 10-25
Sintered Ore	50.14	1.195	22.36	18.37	9.58	amorphous 10-100
Angular Ore	61.03	0.122	4.35	3.67	--	angular ingots 170x170x60

Pellet ore was used in several blast furnaces at the Anshan Steel Works; the results were excellent. The coke ratio was reduced seven percent, and the output was increased seven percent as a result of 50% use of pellet ore in two blast furnaces during the month of April. The metallurgical intensity (yeh-lien ch'iang-tu) was increased to a high degree. Although the history of the production of pellet ore has been short, it is thought that after respective indexes concerning quality have been improved, the metallurgical intensity has been raised, the coke ratio has been lowered, and production output has been increased, pellet ore will further demonstrate its powerful capabilities in the future.

2. History of the New Technique

Pellet ore originated in the ore briquette factory of our plant. This factory had been producing brick-shaped angular ore;

however since its production necessitated large labor power, the production efficiency rate was low with each briquette machine producing only 200 tons daily. In addition, there was a large disparity in the quality of the products and reduction was poor, so our products were not welcomed by iron foundries.

Motivated with enthusiasm by the Movement for Technological Revolution, workers of the ore briquette factory of our plant have endeavored to rectify the backward nature of our angular ore production since the second half of last year (1958). Coincidentally the Soviet specialist, Mr. U-I-CHI-U-CHIN /Japanese romanization/, had just read reports on the production of pellet ore and on experiments conducted by the Chung-nan Metallurgical and Mining Institute. In response to this reading a coalition group comprised of cadre, technicians and workers of the plant organized an experimental unit. An old mill was remodelled using the method of "Rehabilitation through Self-strength," and a pellet producing machine was constructed. The workers made an experimental furnace by hand and were able to achieve initial success after 39 experiments. However there were still many difficulties in the work processes from the experimental laboratory to the industrial production stage. These problems were speedily resolved as a result of a total mobilization of workers and Party /members/ in the plant. For example, problems concerning furnace structure, raw material feeding equipment, and ore unloaders were all solved by the "Self-strength" of the masses. All electrical and mechanical workers at the Works were mobilized, and after 45 days of work on this project, one pellet ore machine was manufactured. This year we again designed and produced a second pellet ore machine. For the most part, old facilities of the angular ore type were utilized and remodelled to manufacture these two pellet ore machines, so the manufacture was easy and old /(sic) probable misprint for speedy/ to be accomplished. We have scheduled another pellet ore machine for August which would make the daily output 4,500 metric tons, which is enough to supply our blast furnaces.

3. Method of Manufacturing Pellet Ore

The chief raw materials for pellet ore will be obtained from this plant. This will be finely granulated ore with 63.5% Fe, water content under 10%, and grit at 0.074 m/m. Quicklime of 12% with grit from 0 to 5 is added as flux and also as binding material for the pellets. After the amounts are measured, the materials are put onto a conveyor belt which takes the material to the intermediate ore bucket located above the pellet ore machine; then two-thirds of the material from the two openings in the mill feeder is conveyed to the left side of the large partition of the pellet ore machine (i.e., the fei-tsao-ch'iu-ch'u -- non-pellet producing section); the /character missing/ is conveyed to the right top section of the pellet ore machine (i.e., tsao-ch'iu-ch'u -- pellet producing section.) This type of conveying speeds up pellet production.

It is necessary to convey the material evenly. If there is excessive material, the revolving time of the forms within the basin of the pellet ore machine will not be fast enough, and the pellets will be discharged before attaining their regulation grit. When there is insufficient material, the length of time for forming pellets in the basin of the pellet ore machine is extended, and the water content of the surface of the forming pellets is increased so as to produce coking properties between pellets.

Since the water content of the pellet production material determines the intensity and speed of the pellet formation, it must be strictly regulated. We have found through our experience that a water content of 11% ± 0.2% is just right for pellet formation. The general practice in the method of water feeding is to add appropriate quantities of water after the materials have been suitably mixed; however because this depends on the condition of the pellet ore machine, there are cases where more water is added. The proto-pellet (Mu-ch'iu -- mother pellet) is constantly revolving in the pellet ore machine. After the forming pellets attain a specified size, they are rotated out of the machine. At this stage, coke dust of 0-3 m/m grit or anthracite is added. We have even experimented with gas ash (wa-ssu-hui). Grit for over 96% of the formed pellets must be 10-25 m/m; water content must be 11.2 plus /or minus/ 0.2%, and the intensity of pressure resistance must be above seven Kg per. A drop test from a height of 500 centimeters must be conducted four times. The finished product is conveyed to a materials receptacle and loaded evenly onto a flat car. Presently the problem of uneven receiving has not been solved. Normally it is evened out by hand. The first pellet roasting machine had limitations in its suction capacity, and the thickness of the layer of material only reached 300 m/m; however 600 m/m is possible according to experimental data. The material is dried, preheated, fired, and cooled after being received. Mixed coal gas is used in the /first/ three stages mentioned. Drying temperature is 400-700° C; preheating temperature is 700-1,000° C; firing temperature is 1,200° C ± 20° C; and the exhaust temperature at the final stage of roasting is 250° C. The length of the roasting furnace is 32.5 meters; the blast amount during roasting is 138,000 m^3 per hour during the roasting process, and the water column blast pressure is 120-220 m/m. The flat cars' rate of speed is 0.7-0.8 meters per minute. Normally temperatures for drying and preheating could be a little higher without adding more fuel, but only to a point at which the pellets would not crumble.

We have found through several months of production experience which we have undergone that it is all right to dry and preheat simultaneously, and after the pellets are sufficiently dried, they are fired again. The usual practice is to allow 20 minutes for drying, nine minutes for preheating, six minutes for firing, and 35 minutes for roasting.

Pellet ore becomes a finished product after undergoing the above production processes.

Since the history of pellet ore production is very short, new problems will arise as we go along. We have yet to resolve the problems of disparity in quality, unevenness, and the degrees of alkali deficiency of the pellets.

Note: Metallurgical intensity = $\dfrac{\text{coke consumption of a given production period}}{\text{effective production by blast furnace x work}}$

A DETAILED CHART OF THE KEY IRON AND STEEL INDUSTRIES IN CHINA

Name of Enterprise	Pig Iron Manufacture	Steel Manufacture	Rolling Facilities	Source of Ore
1. An-shan Iron and Steel Works			#1 Blooming mill /#2?/ Blooming mill	Mines in the Vicinity:
	Blast Furnace #1 350 tons #2 400	They have up to a #24 open hearth furnace. #23 and #24 world's largest (over 500 tons?)	#1 Sheet mill #2 " " #1 Medium plate mill	Ta-ku-shan, Kung-chang-ling, Ying-t'ao-yüan,
	#3 500		#2 Medium plate mill	Tung-an-shan, Ch'i-tao-k'ou,
	#4 600 #5 700 #6 700 780 m^3 scheduled to be converted to 1,102 m^3		Large scale mill Medium scale mill Small scale mill	Ta-li-tzu Mines in other Provinces: Chin-ling, Li-kuo, Lung-yen
	#7 700 #8 700		Sheet rolling mill Seamless steel pipe mill	Manganese ore from Wa-fang-tzu. Lime-
	#9 700 944 m^3	Completed June 1956 Automatic high pressure	Welded tube mill	stone from Kan-ching-tzu
	#10 1,513 m^3 Daily output 2,000 M/T	Automatic high pressure	Rod mill	Nien-tu, Fu-chou, Yen-t'ai
2. Pen-ch'i Iron and Steel Works				Mines in the Vicinity: Wai-t'ou-shan, Miao-erh-pei /sic, probably

Name of Enterprise	Pig Iron Manufacture	Steel Manufacture	Rolling Facilities	Source of Ore
				typographical error for k'ou/ Nan-fen Nan-fen has ore dressing facilities
	#1 200 tons (335 m^3) #2 200 (335 m^3) #3 600	12 K/T converter Constructed in 1956 Converted to high pressure in June 1959	have	Welding plant /probably typographical error for sintering plant/ Two coke ovens
	#4 600 (By 1959 the production plan for #1 and 2 is scheduled to be 550,000 metric tons.)	Constructed in 1957 High pressure furnace		
3. Wu-han Iron and Steel Works	#1 Furnace 1,385 m^3 (High pressure) #2 1,436 m^3 (High pressure) #3 in the planning stage	Open hearth #1 250 tons #2 500 tons Completed October 1959 #3 500 tons Completed December 1959	Blooming mill under construction Large scale rolling mill under construction Seamless steel pipe mill under construction	Ta-yeh Iron Mines Ore dressing and sintering plants completed Coke ovens #1,2,3 completed

Name of Enterprise	Pig Iron Manufacture	Steel Manufacture	Rolling Facilities	Source of Ore
		Two others being planned		
4. Pao-t'ou Iron and Steel Works	#1 1,513 m^3 High pressure	#1 Open hearth completed	Two plants under construction	Pai-yün-o-po Mines Ore dressing plant completed. Coke oven completed
5. Shih-ching-shan Iron and Steel Works	Blast furnace #1 250 metric tons #2 380 " " #3 963 m^3 High pressure furnace #4 Under construction	Open hearth, electric furnace	Blooming mill Cast iron pipe mill	Lung-yen Iron Mines Sintering plant completed in 1959. Four coke ovens. Annual production for #4 plant 45 tons. Also a large scale coke oven is under construction.
5. Shanghai Iron and Steel Works	They have up to a #10 plant. The steel rolling enterprise is second to An-shan. Blast furnace 255 m^3 two furnaces	9 electric, 3 open hearth, 13 converters	Large, medium, small scale sheet, medium	Pig iron is supplied by the following:

Name of Enterprise	Pig Iron Manufacture	Steel Manufacture	Rolling Facilities	Source of Ore
		a. Planned steel output for 1959, 1,650,000 metric tons. b. Present capabilities, 2,500,000 metric tons.	plate, and rod mills	Anhwei, Kiangsi, Shantung, and Szechwan Provinces. Also supplied by the Anshan, Pen-ch'i, Shih-chingshan, and Wuhan Works.
7. Ta-lien Steel Works	none	Electric furnace	Rolling facilities	
8. T'ien-ching Iron and Steel Works (Four steel plants)	none	Open hearth furnace, converter	Rod mill rolling facilities	
9. T'ang-shan Steel Works	none	Electric furnace	Rolling facilities	
10. Heng-yang Steel Rolling Plant	none		Sheet mill, 20,000 metric ton /capacity/ Blooming mill, 50,000 metric ton /capacity/	
11. Ma-an-shan Iron and Steel Works		Planned 500,000 metric tons	Planned annual production, 150,000 metric tons	
	630 m^3 One furnace	Converter (3 ton)	500 m/m x 2 300 m/m x 2 } two new facilities	Mining, pig iron manufacture, and

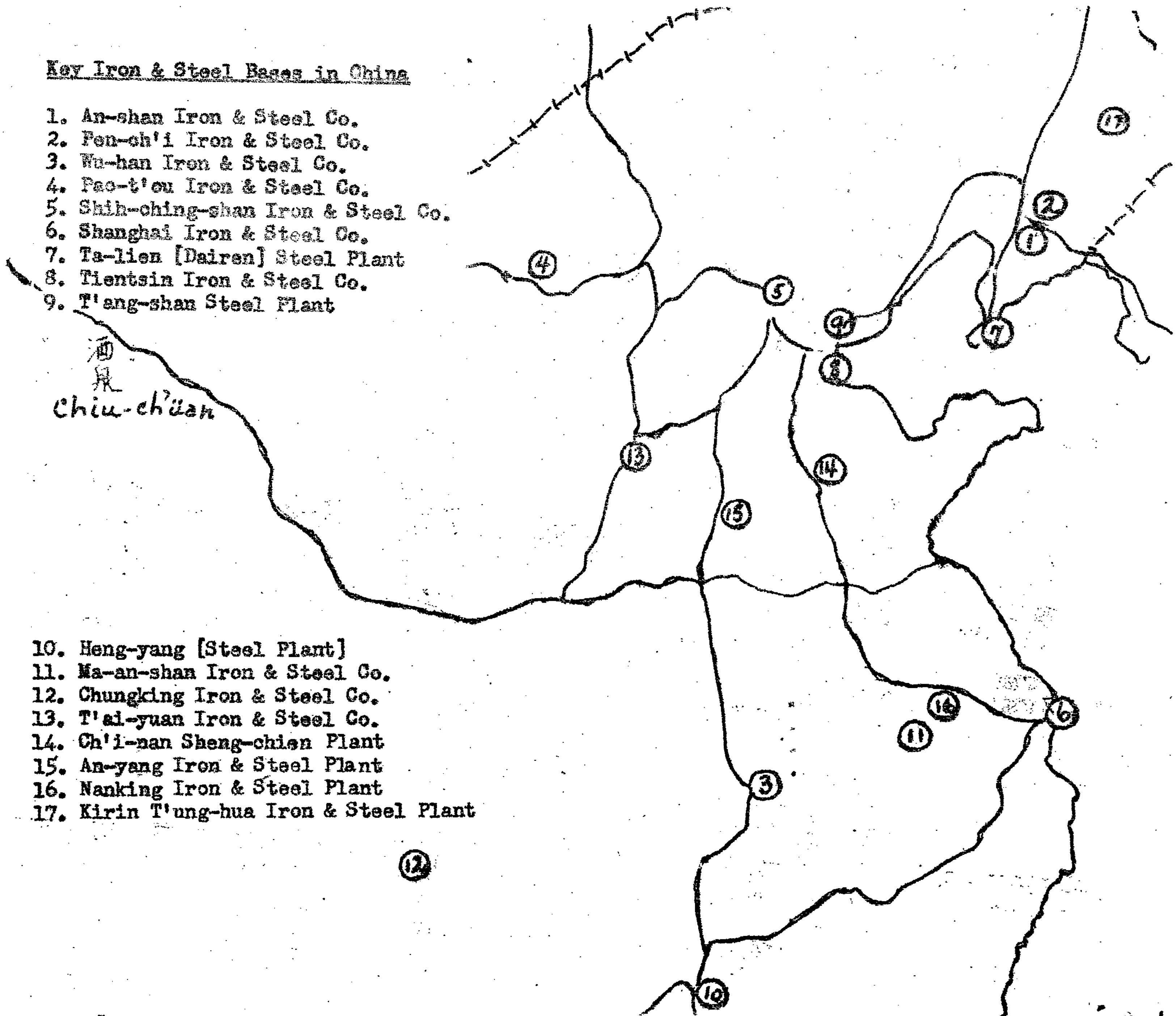
Name of Enterprise	Pig Iron Manufacture	Steel Manufacture	Rolling Facilities	Source of Ore
	630 m^3 One furnace under construction 30 metric tons, six furnaces		under construction 250 m/m in operation	steel rolling have become a cohesive amalgamated enterprise. Nan-shan and Yao-shan Iron Mines
12. Chungking Iron and Steel Works	have	Open hearth furnaces (large and small scale)	#3 medium scale rolling mill Large scale rolling mill (rails)	
13. T'ai-yüan Iron and Steel Works	301 m^3 One furnace, 151 m^3 One furnace; Daily output over 500 metric tons	Electric furnace, open hearth furnace	Sheet mill Blooming mill	
14. Ch'i-nan Iron Works	255 m^3 One furnace			Supplied by iron mines in Shantung Province
15. An-yang Iron and Steel Works	255 m^3 One furnace			
16. Nanking Iron and Steel Works	255 m^3 One furnace (Annual production 130,000 tons) Also one small scale furnace			Feng-huang-shan Iron Mines?
17. Kirin T'ung-hua Iron and Steel Works	255 m^3 Two furnaces			
18. Lung-yen Iron and Steel Works	255 m^3 One furnace 210 m^3 One furnace	none	none	Lung-yen

CONCENTRATE GRADE BY ORE DRESSING (% Fe)

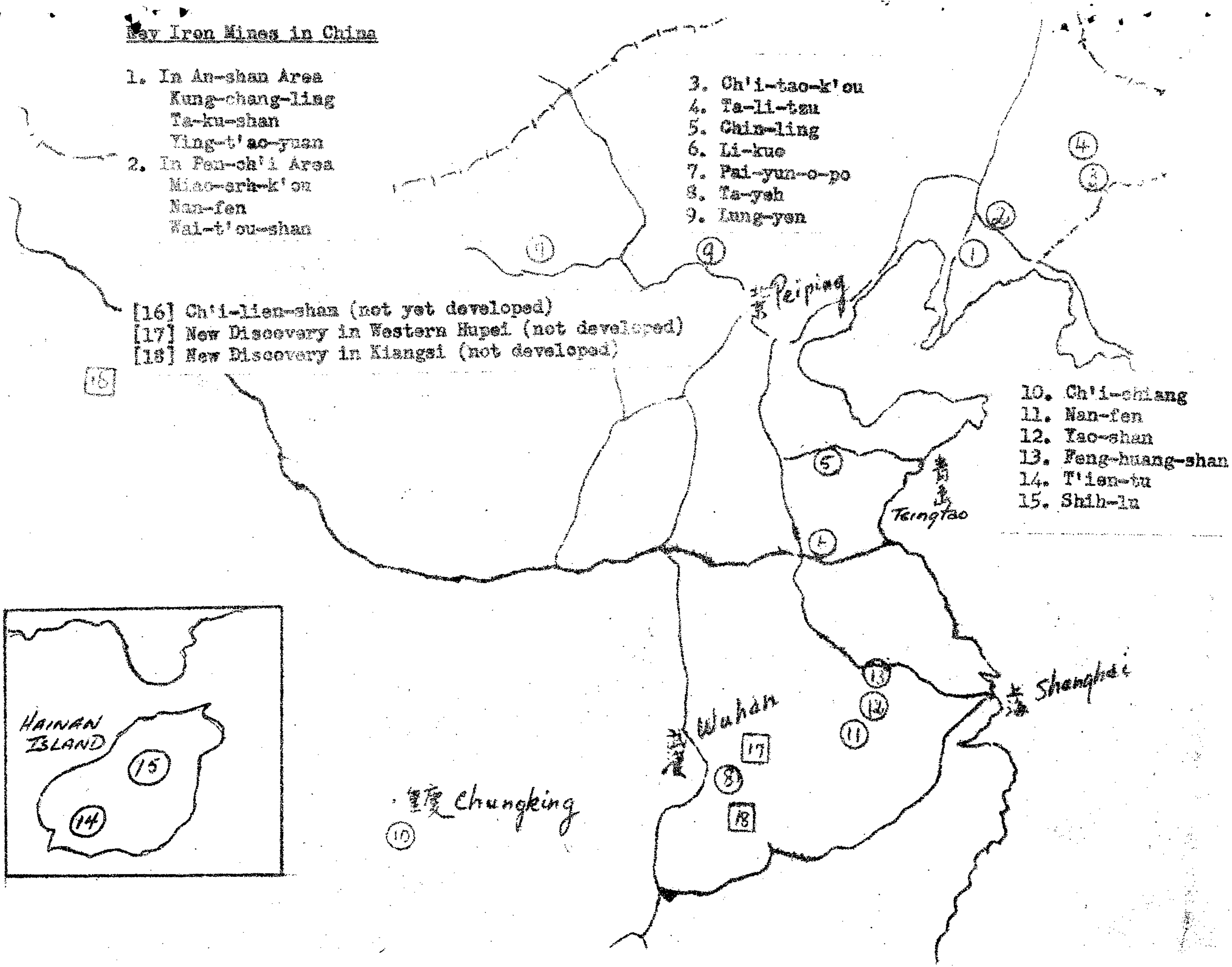
Ore Dressing Plants	Average for 1958	Maximum for 1958	Feb. 1959	Apr. 1959	June 1959	July 1959	Percent of metal withdrawal
Nan-fen (Pen-ch'i)	63.32		63.81	63.98	64.94	64.19	
" " No. 1	63.5	65.13					
" " No. 2	53.15	65.02					
" " No. 3	63.02	64.84					
" " No. 4	63.08	64.84					
Ta-ku-shan (An-shan)	62.3		61.99	62.22	62.87		
Magnetic separation	62.6	65.52				62.68	78.83
Flotation	59.8	60.95				59.73	69.58
An-shan	61.86		63.3	63.43	63.87		
No. 1	60.86	64.16				(magnetite)	
No. 2	63.69	65.48				63.74	78.58
No. 3	63.33	65.02					
Flotation	58.28	60.57				64.61	70.33
Tung-an-shan	60.57	61.29				62.96	77.61

Key Iron & Steel Bases in China

1. An-shan Iron & Steel Co.
2. Pen-ch'i Iron & Steel Co.
3. Wu-han Iron & Steel Co.
4. Pao-t'ou Iron & Steel Co.
5. Shih-ching-shan Iron & Steel Co.
6. Shanghai Iron & Steel Co.
7. Ta-lien [Dairen] Steel Plant
8. Tientsin Iron & Steel Co.
9. T'ang-shan Steel Plant
10. Heng-yang [Steel Plant]
11. Ma-an-shan Iron & Steel Co.
12. Chungking Iron & Steel Co.
13. T'ai-yuan Iron & Steel Co.
14. Ch'i-nan Sheng-chien Plant
15. An-yang Iron & Steel Plant
16. Nanking Iron & Steel Plant
17. Kirin T'ung-hua Iron & Steel Plant



Key Iron Mines in China



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