

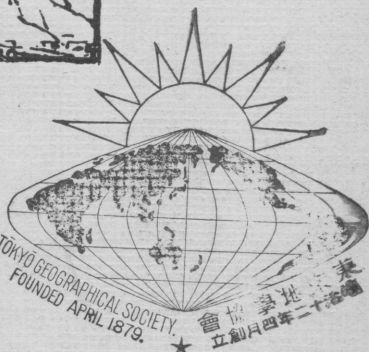
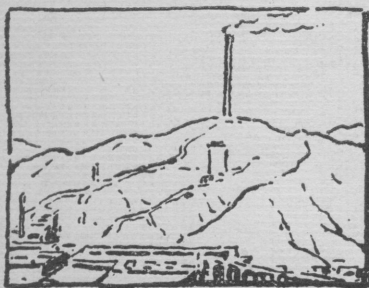
GUIDE-BOOK EXCURSION C-2

(Nov. 6th-7th)

會協學地京東

No.

THE HITACHI COPPER MINE



PAN-PACIFIC SCIENCE CONGRESS, 1926

JAPAN

THE HITACHI COPPER MINE

BY TOMIJI SUZUKI AND JIN-ICHIRO AKAOKA

1. SITE AND COMMUNICATIONS

The mine is situated on the northeast coast-line of the Government Railways about five miles northwest of the Sukegawa station. From Sukegawa an electric railway built by the mine runs two and a half miles to the smelters, which are connected with the mine itself by a wire-rope transmission system for bringing down the ore. A general plan of the mine and the works is given on the map attached hereto.

2. HISTORICAL NOTES

According to tradition, the mine was discovered about four hundred years ago, and worked at one time by the Sataké clan. From 1861 to 1863, Gengoemon Ōtsuka of Mito Province worked the mine under a grant from the Mito clan, and produced a small amount of rough copper until operations had to be abandoned owing to disturbances in the clan. After 1873 the mine changed hands several times until it came under the control of Mr. Shinroku Ōhashi of Tokyo, when it was known as the Akazawa Copper Mine. In December, 1905, Mr. Fusanosuké Kuhara purchased the mine from Mr. Ōhashi and called it the Hitachi Mine. At that time, it was considered a small copper mine and few people in the country knew of its existence. However, Mr. Kuhara has devoted himself to exploring the ore body, with the result that many rich ore deposits have been struck, and the mine itself has become more and more productive. Also improvements have been made in mining and smelting methods and indeed in every phase of the business, resulting in a largely increased output. To keep pace with the development of the mine, the smelting plant was removed from its old site to the present location, an electric refining plant was erected, and at the same time a hydro-electric power plant was added. About this time also the mine began custom-ore smelting by which the productivity of the mine was considerably supplemented in the output of gold and silver. Thus, as the concern's business was rapidly expanding, the Kuhara Mining Co., Ltd., was incorporated in September, 1912, and took over the mine and all the works.

The amount and value of the output since 1912 are shown in the following table.

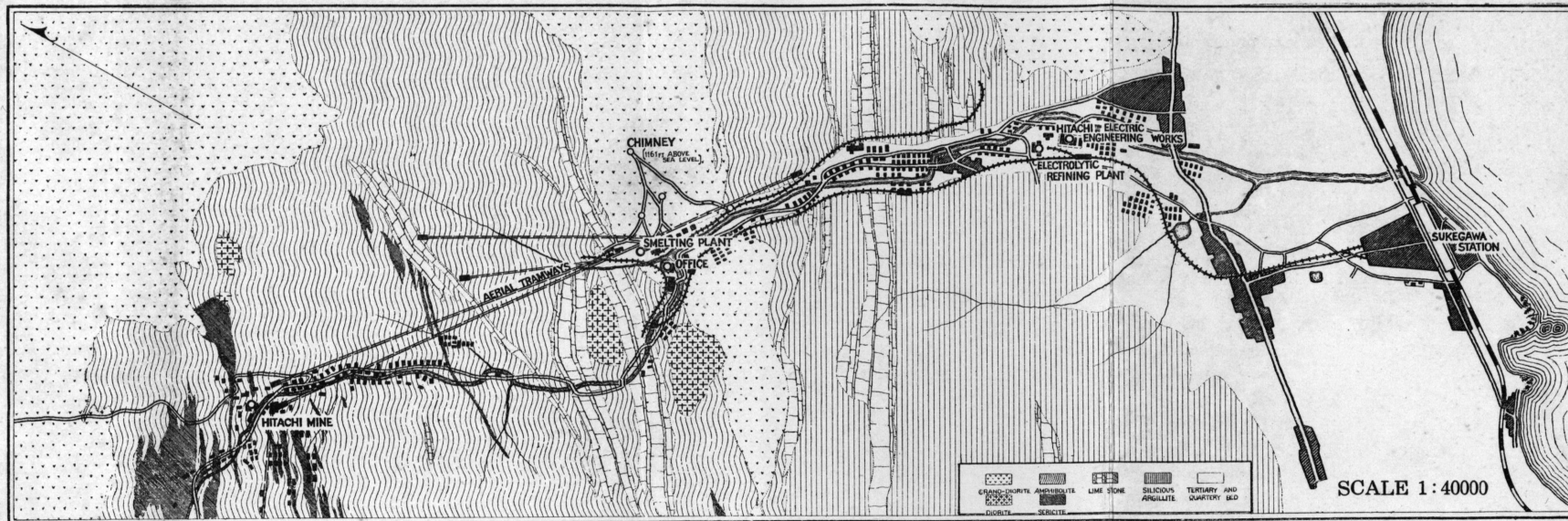
THE OUTPUT OF THE HITACHI MINE

	Gold	Silver	Copper	Copper Sulphate	Zinc	Lead	Nickel Sulphate	Total Value
	kgs.	kgs.	Metric ton	kgs.	kgs.	kgs.	kgs.	Yen
1912 (11 Mos.)	560	7,318	6,443					5,620,151
1913	1,370	14,702	10,208	779	—	—	—	9,312,846
1914	2,218	17,393	10,191	2,805	—	—	138	9,599,523
1915	3,348	39,090	13,698	3,694	—	—	190	16,857,989
1916	3,776	44,078	17,019	4,973	768	7	3	28,028,329
1917	4,100	62,750	25,193	4,454	513	15	75	38,810,145
1918	2,654	63,098	16,277	4,633	912	215	575	23,987,277
1919	2,083	42,990	13,387	3,080	1,344	97	755	18,142,182
1920	1,785	34,667	10,197	3,070	1,039	125	453	13,499,187
1921								
(11 Mos.)	1,530	28,166	6,470	2,315	469	26	40	7,868,635
1922	1,577	23,102	6,251	3,150	75	64	80	8,127,328
1923	1,523	21,158	7,919	2,419	—	3	121	9,549,346
1924	1,599	18,118	7,645	3,283	—	53	53	9,591,415
1925 (1st 6 Mos.)	933	10,179	4,957	1,690	—	—	3	6,504,890

3. GEOLOGY AND ORE DEPOSITS

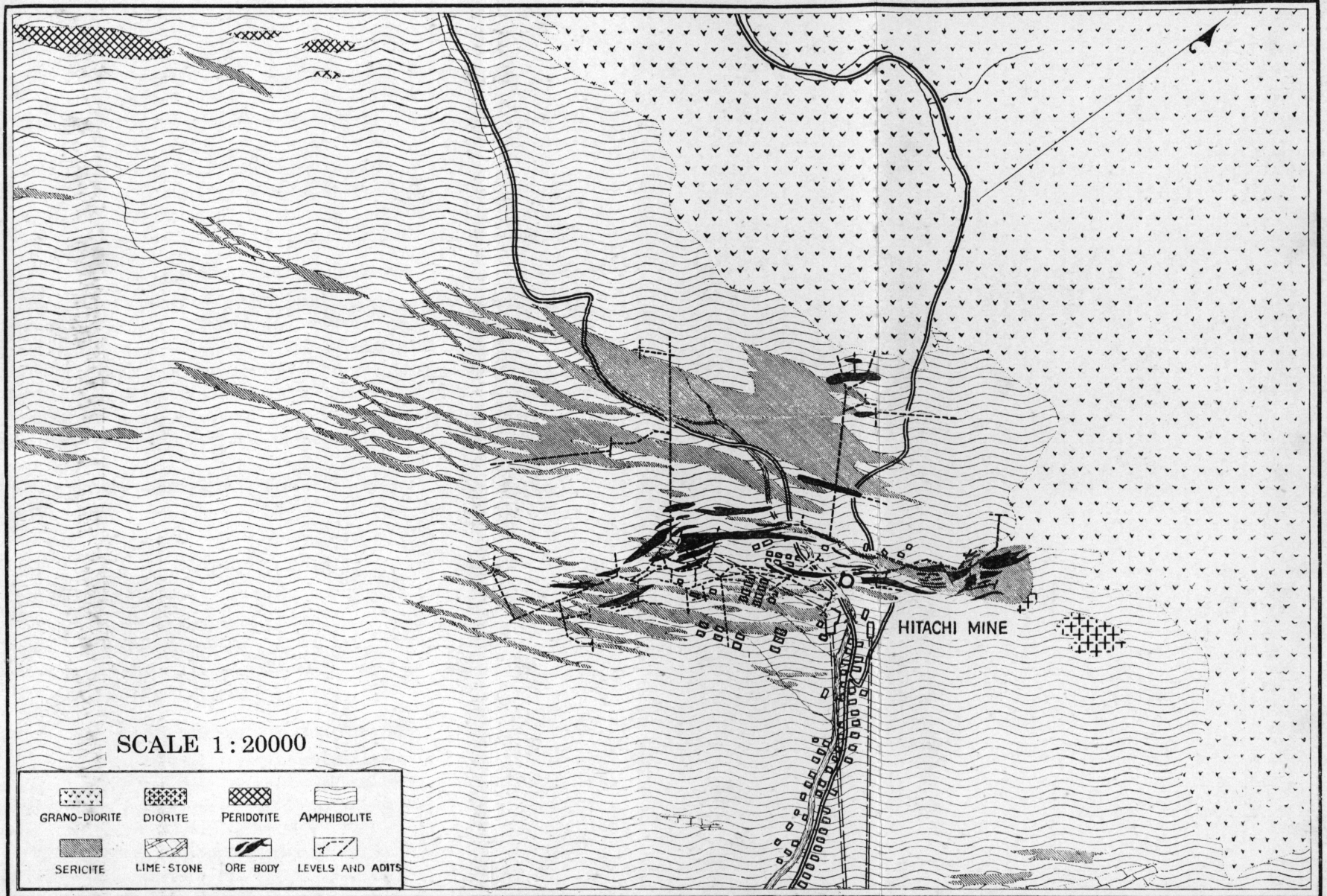
The mine and its environs are located at the southern end of the "Abukuma" plateau, which is built up of amphibolite, biotite-schist, sericite-schist, phyllite, clay-slate, limestone, etc. belonging to the Paleozoic Formation, together with intrusions of granodiorite and diorite. In the neighbourhood of the ore deposits, amphibolite and sericite-schist are extraordinarily developed, the rocks near the granodiorite being so metamorphosed by its eruption that andalusite, cordierite, etc., have been produced as contact minerals. The ore deposits occur among these schistose rocks, and are considered to have been formed by hydro-thermal metasomatism following the eruption of the granodiorite and diorite. The principal deposits are called Sasamé, Chūsei, Kamminé, Honkō, Akazawa, Takasuzu and Irishiken and strike generally N 45° E, i.e. parallel with the schistose plane of their country rocks, and dip 60°-70° N.W. The important ores are pyrite, pyrrhotite, chalcopyrite and rarely zinc-blende with small amounts of chlorite, quartz and barite as gangue minerals.

The average principal constituents of the ores are as shown in the following table.



GEOLOGICAL MAP OF THE ENVIRONS OF THE HITACHI MINE.

1926



	Au	Ag	Cu	Fe	Zn	S	SiO ₂	Al ₂ O ₃	CaO	MgO	Mn	BaSO ₄
	Oz. per metric ton		%	%	%	%	%	%	%	%	%	%
Sasamé ore	.0289	.2700	2.38	37.24	1.18	39.05	12.19	2.96	.56	2.70	.20	.31
Chūsei ore	.0386	.3665	3.77	35.28	1.55	37.31	13.75	3.58	.83	2.25	.19	.40
Kamminé ore	.0257	.3536	2.54	27.49	2.31	28.76	24.07	5.93	.81	4.07	.24	1.11
Honko ore	.0289	.3633	2.76	27.20	2.16	28.69	25.77	5.70	1.29	3.46	.24	1.14
Irishiken ore	.0289	.2539	4.40	36.10	1.38	38.63	9.51	2.09	.59	1.65	.24	.10
Akazawa ore	.0257	.3054	2.40	34.93	2.31	37.00	12.44	3.69	.80	2.76	.22	1.00
Takasuzu ore	.0257	.2990	2.21	36.21	2.79	38.71	10.23	3.07	.78	2.48	.28	1.60

4. THE MINE AND ITS EQUIPMENT

The ores are worked out by the overhand stoping method either by hand or by rock drill. The excavated space is filled in with earth from the surface and rubbish from first dressing, while the rillcut method is applied in some special cases. For preliminary prospecting diamond core drills are employed and for the excavation of adits and levels rock-drills are chiefly used. The gross extension of drilling made is about 80,000 ft. and that of the adits and levels already driven is nearly 300,000 ft.

The equipment for mining is as follows :

Rock Drills,

drifter	71
stoper	20
jack hammer	45

Air Compressors 6

Winding Machines (hoist) 4

Diamond Boring Machines 13

Drainage Pumps 9

Total H. P. applied at present is 1,300.

5. ORE DRESSING AND CONCENTRATION

The principal method of concentration is to treat the raw ore (cupriferous pyrite and massive pyrite) chiefly by spalling and hand sorting : and the smalls are subjected to concentrating machines such as jiggers and sand and slime tables.

The current slime from various parts of the mill is subjected to froth flotation machinery.

The preferential flotation method for the low grade cupriferous pyritic ore has been tried with success; and a new plant for it is to be realized soon.

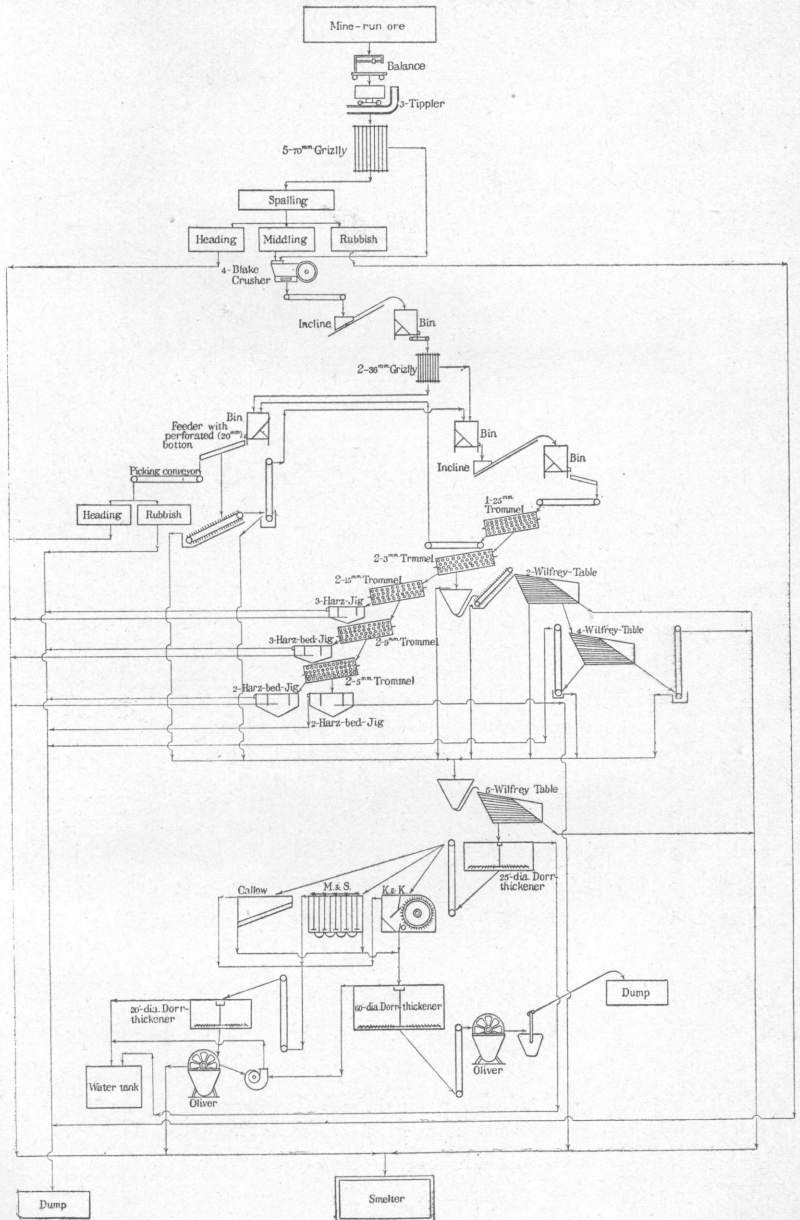
The equipment for the concentrating plant is as follows :

Grizzlies	15
Ore Breakers	7
(both the Blake and Dodge Types)	
Balanced Roll	1
Picking Conveyors	9
Trommels	10
Wilfley Tables	11
Jiggers	12
(Hancock, Hartz, and Bull)	
Flotators	3
Oliver Filters	2
(with accessories)	
Callow Cones	3
Dorr Thickeners	4
Circulating Pumps	2
Total H. P. applied at present is 390.	

6. SMELTING WORKS

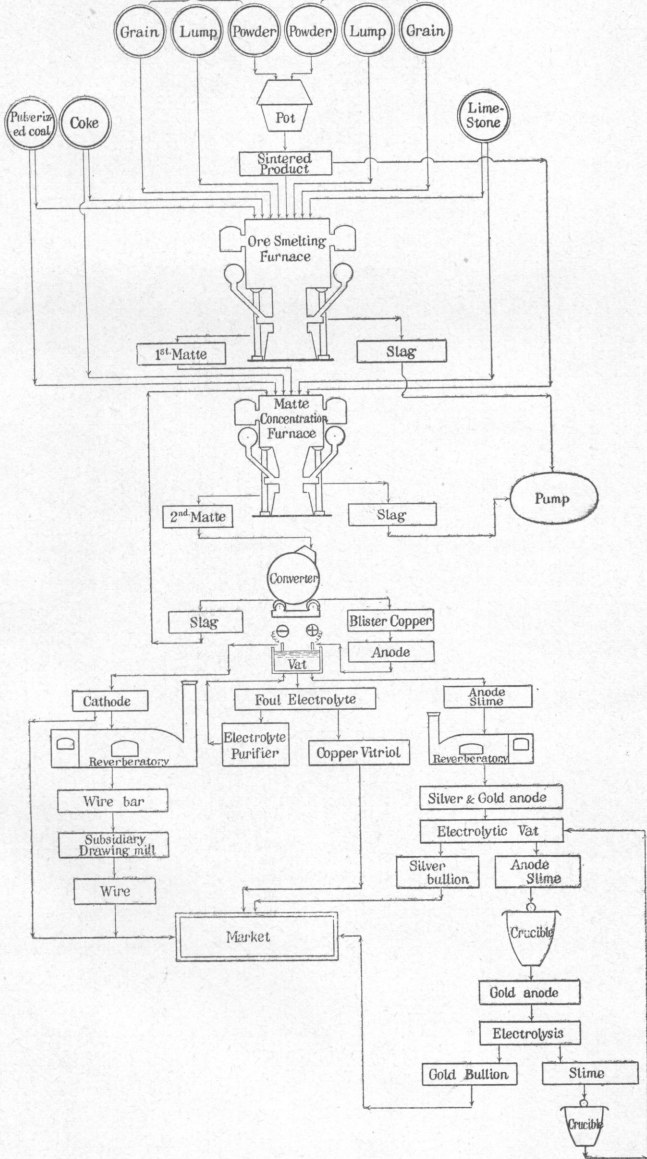
The smelting works are erected at Daioin two and a half miles distant from both the mine and Sukegawa station. They consist of the pot, blast furnace plant and converter plant. Lump ores are directly smelted in the blast furnace together with the fine ores, after having been sintered in pots and flux by the pyritic method, producing low grade matte. The blast furnace is of the long narrow shape and is equipped with tuyers which are specially designed to supply pulverized coal so as to make the operation easy and to increase the capacity of the furnace. The low grade matte is remelted in the matte concentration furnace of the same type to produce the concentrated matte. This is afterward subjected to the charge of a converter and blown into blister copper. The converter is of the barrel type, and is lined with refractory basic bricks, so that it can be supplied with siliceous material from overhead. The blister copper after being cast into an anode is sent over to the refining plant. The details of smelting and refining are set forth in the scheme attached hereto.

Scheme of Dressing at Hitachi Mine.



Flow Sheet of Hitachi Smeltery and Refinery

Custom Ore. Ore from The mine.



The equipment for the smelting works is as follows :

Blast Furnace Plant

Ore Blast Furnace

Length 40 ft. breadth 4 ft. at tuyer level	2
,, 20 ,, ,, ,, 	3
,, 15 ,, ,, ,, 	3

Matte Concentration Furnace

Length 24 ft. breadth 4 ft.	2
-------------------------------------	---

Sintering Pots

15 tons capacity	8
5 ,, ,,	27

Low Pressure Turbo Blowers	8
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Converter Plant

Converters, diameter 6.5 ft. length 8 ft.	6
High Pressure Turbo Blowers	5

Total H. P. applied at present 1,820.

Chimney and Dust Chambers

The chimney is built of reinforced concrete on the top of a hill 650 ft. above sea-level and is 511 ft. in height, 25 ft. in diameter at the top and 35 ft. at the base, in order to facilitate the diffusion of smoke from the blast and other furnaces. The accessories are as follows :

Dust Chambers . . . reinforced concrete . . .	5
Flue ,, . . .	7,960 ft.

7. REFINING WORKS

The refining works are erected at Shibauchi in a flat valley between the smelting works and Sukegawa station. The anode received from the smelting works is refined here into cathode, most of which is cast in bars to be drawn into wires by the mill erected near the refinery. This mill is the property of the Hitachi Engineering Works, Ltd., a branch of the Kuhara Mining Company. The anode slime is treated by the leading furnaces and later by the cupellation furnace to produce gold and silver bullion which is cast into another anode. The anode is electrolysed to separate the gold and silver which, after proper treatment, are cast into ingots ready for the market.

In the refinery are also manufactured electric copper sheet, copper sulphate, nickel sulphate, lead, selenium, etc. as by-products. The equipment for the refining works is as follows :

Refining Plant

Reverberatory Furnaces	4
Electrolytic Vats for refining, (lead-lined wooden tanks) . .	714
" " parting gold and silver, (earthenware)	28
Leading Furnace	1
Cupellation Furnace	1
Motor Generators, 400 K.W. 4 & 800 K.W.1.	5
Boilers for heating electrolyte	3
Chimneys for furnace and boilers, (reinforced concrete) . .	2
Flue	415 ft.
Total H. P. applied at present	1,690.

8. CUSTOM ORE SMELTING

In view of the fact that the mine's smelters are the central smelters in the eastern half of the country, there are smelted here not only ores extracted from the mine but also ores collected from other mines belonging to the same company as well as ores purchased from various outside mines. The mines that supply ores to the Hitachi smelters are at present thirty in all, though before the present world-wide depression set in they were computed to be more than three times the present number.

9. TRANSPORTATION AND EQUIPMENT

In order to facilitate the transportation of the ores and general supplies, aerial ropeways run between the mine and the smelters, as well as from the limestone quarries to the smelters, while an electric railway is laid between the smelters and the Sukegawa freight depot. Their extensions are as follows :

Aerial ropeways

No. 1 Double System (between mine and smelters) . . .	7,470 ft.
No. 2 " " " . . .	13,370
No. 3 Single System (between quarries and smelters) . .	4,500
No. 4 " " " . . .	2,812
Total H. P. applied at present	390

10. MOTIVE POWER

The motive power used in the mine is furnished by the four hydro-electric power plants mentioned below, the surplus power being supplied to the coal and other mines in the neighbouring district.

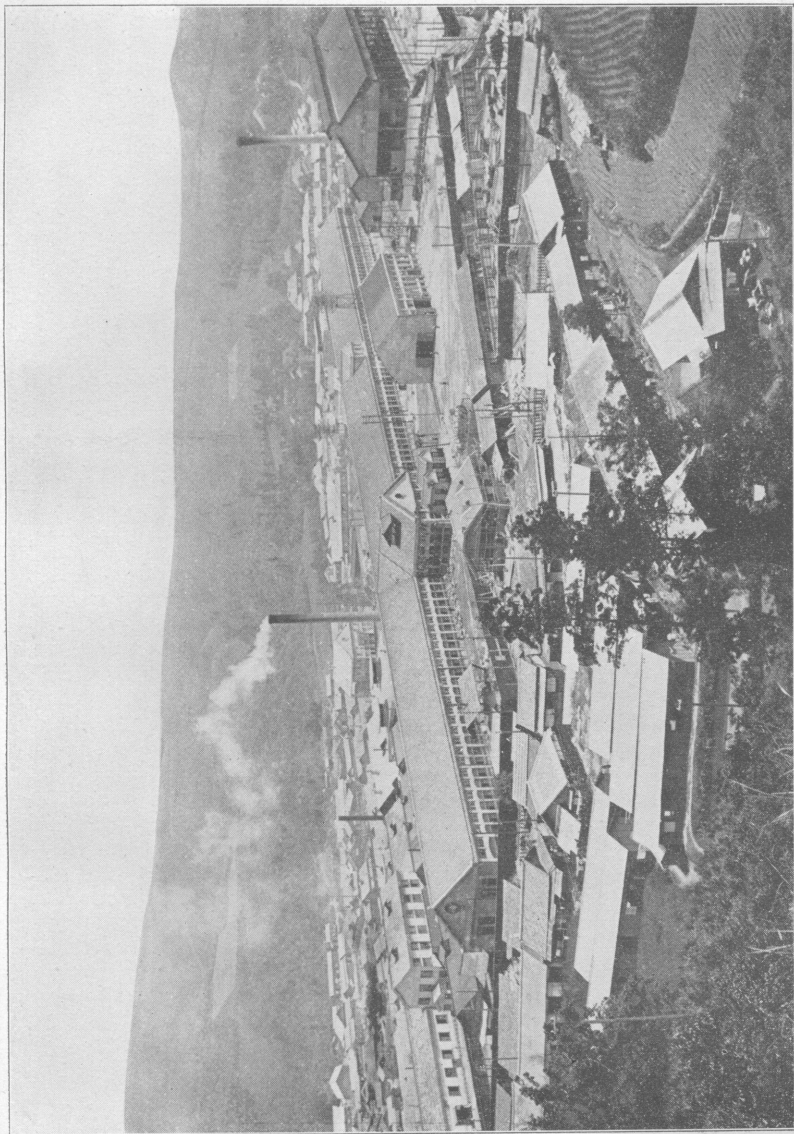
No. 1 Ishioka Power Plant	4,000 K.W.
No. 2 " " "	1,000
No. 1 Natsugawa " "	3,700
No. 2 " " "	3,200
Total	11,900



General View of Mining Works, Hitachi.



General View of Smelting Works, Hitachi.



General View of Electrolytic Refining Works.

大正十五年十二月二十日印行
大正十五年十二月二十五日發行

第三回汎太平洋學術會議

印刷者 木 下 憲
東京市日本橋區兜町二番地

印刷所 東京印刷株式會社
東京市日本橋區兜町二番地

發賣所 東京地學協會
東京市京橋區木挽町九丁目二十九番地

Executive Office: Rooms of the National Research Council,
Department of Education, Tokyo

CABLE ADDRESS:—KENKYU, TOKYO.