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CHAPTER IX

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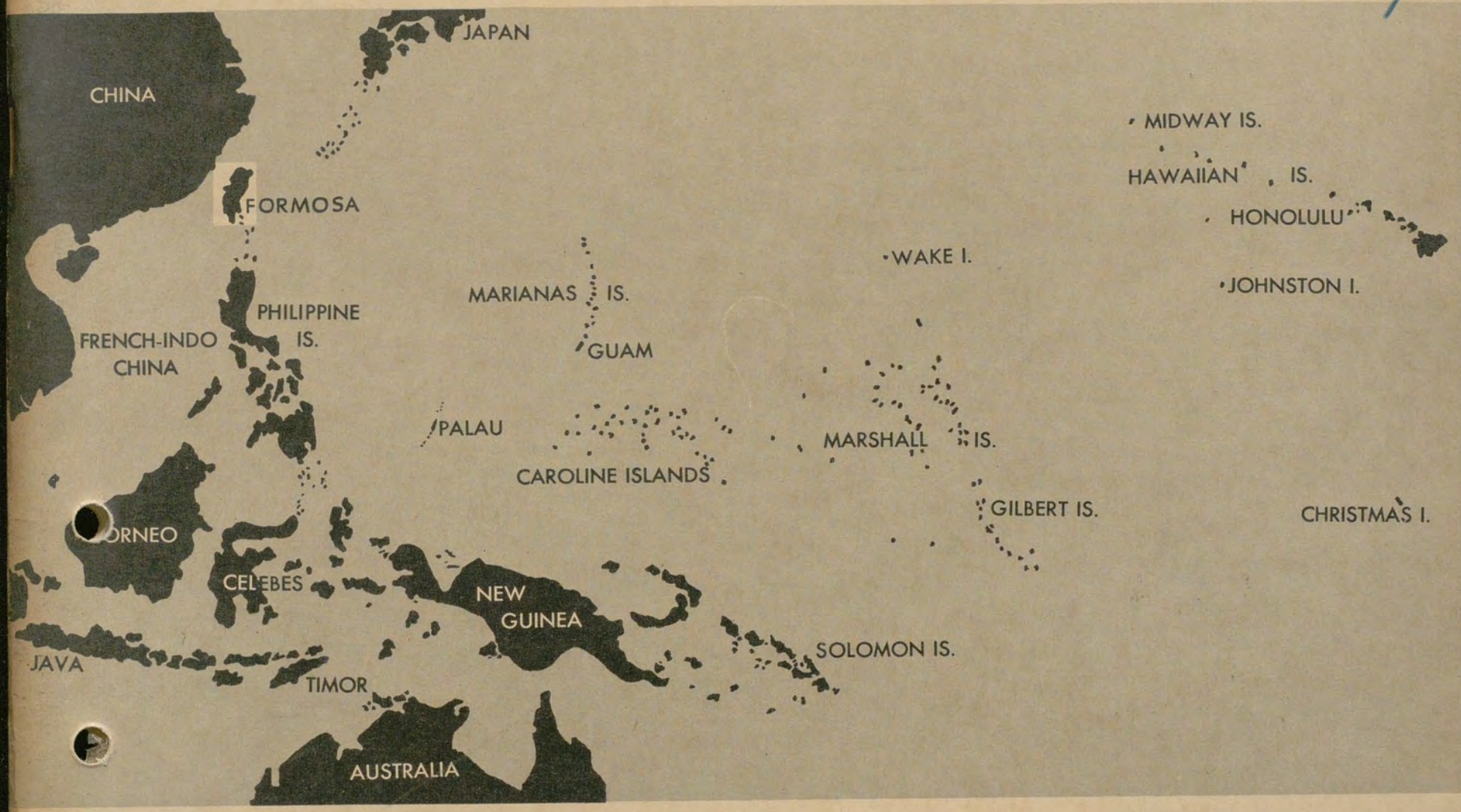

JOINT ARMY-NAVY INTELLIGENCE STUDY

OF

FORMOSA (TAIWAN)

RESOURCES AND TRADE

JUNE 1944

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RESOURCES AND TRADE

90. General Description

Agriculture is the basis of Formosa's economy and has been directed to complement the economy of Japan proper. The island is self-sufficient in basic foodstuffs, and is a prime producer of refined sugar, rice, bananas, and tea for the Japanese Empire. Formosa's non-food crops are relatively unimportant in quantity, and consist chiefly of tobacco, jute, hemp, and castor beans. Hogs are the principal source of meat and provide 95% of the island's raw hide production. Edible fish are abundant in Formosan waters; Japan proper supplies most of the dried and salted fish consumed on the island. All the island's larger communities have ice plants, but known cold storage and refrigeration facilities are inadequate. Warehousing facilities appear to be more extensive although capacity figures are not available.

Water supply is abundant. Some 40 communities have waterworks systems, and water supply for ships is generally available. Production of construction materials is minor, and consists principally of lumber, cement, brick, and tile. There are 83 sawmills on the island, and the Asano Cement Company factory at Takao is one of the largest cement plants in the Far East.

With the exception of coal, mineral production is unimportant. Formosan petroleum production covers only 10% of the island's needs and but 3% of the Japanese Empire's war requirements.

Industrialization in Formosa is comparatively recent. The Japanese are attempting, for strategic reasons, to transform the island into an important industrial base in the Japanese war economy. Some slight advances have been made, particularly in non-ferrous metals. Formosa produced an estimated 10% of alumina and 15% of aluminum for the Empire in 1943, and a smelter completed at the end of 1940 is reported to be producing about 10% of Japan's nickel requirements. Exact data on the island's aircraft assembly and repair facilities are available from reconnaissance made early in 1944, but the location and extent of munitions manufacture is unknown. A number of small chemical plants are producing fertilizers, sulphuric acid, cyanide, and nitrates.

The known power capacity of the island is 315,982 kilowatts, but it is expected that this figure will be doubled by the end of 1945 upon completion of 6 new hydroelectric plants. The heart of the Formosan power system is the Jitsugetsu-tan development in the west center of the island which transmits electric energy via 154,000-volt lines north to Taihoku and south to Takao. Aluminum and magnesium plants consume ½ the electric energy generated on the island.

Ninety per cent of Formosan commerce is with Japan, exports (chiefly sugar and rice) greatly exceeding imports. The island depends, however, upon imports for most of its manufactured commodities.

Formosan currency is based upon the Japanese *yen* and is issued by the Japanese-controlled Bank of Taiwan. Until 6 January 1942, the Formosan *yen* was linked to the U. S. dollar at the rate of 23 7/16 cents per *yen*. The Bank of Taiwan and 5 other banks operate an aggregate of 79 branches on the island.

91. Food Resources

A. Agriculture.

Almost 2,100,000 acres, or ¼ of the total surface area, was cultivated land in 1941, the highest percentage of cultivated land of any Japanese colony. Nearly ⅔ of the paddy fields are double-cropped, and a different third crop is sometimes grown annually on the same field. In 1941, 41% of the total of Formosa's production was farm produce. If the output of sugar refineries and pineapple canneries is added, about ¾ of Formosa's production is dependent upon agriculture. Pre-war Japanese official investigations reported that the ratio of land utilization (ratio of land under cultivation to total area of land fit for cultivation) was well over 90%. More than 90% of the agricultural production came from the relatively level provinces on the western side of the island.

The following Japanese standards of weights and measures are used in Topic 91:

ko equals 2.397 acres
koku equals 5.119 bushels
kin equals 1.32 pounds
kan equals 3.75 kilograms, or 8.25 pounds

The Japanese have worked since 1895 to improve the island's methods of agriculture through experiments to increase crop yields, the introduction of improved seeds, and the construction of irrigation systems. Modern sugar mills were built and the sugar industry developed until Formosa became Japan's chief source of sugar. Pineapple canning was introduced and pineapple production expanded until Formosa became the third largest producer of canned pineapple in the world, outranked only by Hawaii and Malaya. The Japanese also introduced a new type of rice, called *horai* rice, with a greater yield per acre and an appeal to the taste of consumers in Japan proper.

The island produces sufficient foodstuffs for its own needs and, in addition, has large surpluses of rice and sugar (together constituting 70% of the total value of agricultural production), as well as tea, pineapples, bananas, and oranges, which are exported mainly to Japan.

The surpluses now going to Japan would be sufficient in quantity to supply some of the food needs of a large occupying force. The quality of the food, however, is very questionable. It is necessary to bear in mind the possibility of gross crop contamination (so far as American consumption is concerned), caused by the unsanitary habits of the Formosan farming population. Such contamination, however, could be counteracted by proper cleansing and cooking. It is quite possible, also, that some of the local varieties of vegetables would not appeal to American tastes.

Rice, grown chiefly in paddy fields on the northern part of the western plains, is the most important crop. Sugar cane,

sweet potatoes, and tropical fruits, grown in the southern part, are other important crops. Tea, which is Formosa's leading export to foreign countries, is grown in the foothills of the north. Other products include peanuts, tobacco, ramie, hemp, jute, cotton, a wide variety of green vegetables, and limited quantities of some cereals. FIGURE IX - 74 shows the areas of major and secondary crops.

Livestock in Formosa includes water buffalo, used in the paddy fields; hogs, supplying the population with its principal source of meat; chickens; ducks, important as a source of feathers for export and for their eggs, which are relished by natives; and a limited number of cattle, horses, sheep, turkeys, and goats.

Area under cultivation was divided among the various major crops in 1938 as indicated in TABLE IX - 1.

TABLE IX - 1

FORMOSAN CROP AREAS IN 1938

CROP	PER CENT OF TOTAL AREA UNDER CULTIVATION
Rice	52%
Sweet potatoes	12%
Sugar cane	11%
Tea	4%
Others	21%

Of the cultivated rice area in 1941, 62% was paddy or wet fields and 38% upland or dry fields.

The latest available figures on food, crop acreage, production and value are for 1938, and are presented in TABLE IX - 3.

It is probable that crops have been adversely affected since 1938 by: a reduced supply of farm labor owing to war conscription; conversion of some farm land to sites for military installations; and reductions in imported fertilizers.

(1) *Food crops.*

(*a*) *Rice.* Rice is the most important crop in Formosa, accounting for over ½ of the total agricultural production and 52% of the cultivated land. About half of each year's crop is exported to Japan proper and other parts of the Empire. Rice exports increased from 2,220,000 *koku* in 1930, virtually all of which went to other parts of the Empire, to 4,201,000 *koku* in 1939, of which only 95,000 *koku* was exported out of the Empire. In recent years, a considerable proportion has been sent to Japanese military forces in China, and some has probably gone to the conquered people.

The average annual consumption of rice in Formosa in nearly 4 bushels per capita. Rice yield per *ko* (2.397 acres) has increased steadily. In 1938, it amounted to 13.62 *koku* per *ko*, or an average of about 29 bushels per acre.

Of the more than 1,500,000 acres of rice land under cultivation in Formosa, about 25% are in Taichū province, 22% in Shinchiku province, 20% in Tainan province, 15% in Taihoku province, and 14% in Takao province. Giran-gun (Taihoku-shū), Shoka-gun (Taichū-shū), and Heitō-gun (Takao-shū) are the best rice producing regions of the island. Rice production in Taitō and Karenkō prefectures is not important in proportion to total rice acreage, but rice land constitutes 50% of the total cultivated land in these 2 prefectures. No rice production is recorded for Bōko prefecture.

Two main types of rice are produced in Formosa. *Horai* rice is an improved grade introduced by the Japanese, and 70% of it is grown in paddy fields in the northern part of the island. About 75% of the *horai* crop is exported to Japan. *Zarai* or ordinary rice, practically all of which is consumed by the Formosan-Chinese, is grown largely in the area south of the Dakusui-kei (Taichū-shu). A relatively small quantity of glutinous rice, most of which is exported, is also produced in Formosa. An even smaller quantity of upland rice of inferior grade is grown in dry fields in the south, largely for consumption by the aborigines.

Sixty-two per cent of the paddy fields are double-cropped. In some cases, a third crop of sweet potatoes or wheat is also raised. The first rice crop is harvested from June to July, and the second crop, from October to November. Most of the cultivation is done by primitive means with crude plows and harrows drawn by water buffalo. Irrigation is often accomplished by human power turning crude water wheels. Threshing is done by hand in the fields and the rice carried away in wicker baskets.

Comparative production figures of various types of rice produced in Formosa from 1930–1939 are in TABLE IX - 2.

Rice and sugar cane are competitive crops in Formosa, since either can be grown with equal success in many areas. To counteract the preference of Formosan-Chinese farmers for raising rice and to promote the sugar industry (in which the government has a large investment), the Government-General stimulated sugar cane cultivation through irrigation controls, tax measures, price controls, and subsidies for sugar cane cultivators. In 1938, the Bureau of Productive Industries of the Government-General published a 10-year plan for crop diversification and expansion, but rice was to be kept at a rather constant level, increasing only 10% by 1948.

Since 1940, rice production has been lower than in previous years, and at the same time Japan has needed more and more rice for an ever-increasing army. Rice stocks in Formosa on 1 July 1939 totaled 1,720,000 *koku*, or 346,000 *koku* less than in the previous year. Rice production in Formosa since 1940 has shown the trend indicated in TABLE IX - 4.

TABLE IX - 2

RICE PRODUCTION IN FORMOSA, 1930–1939

(in thousand koku)

YEAR	HORAI RICE	% OF TOTAL	ZAIRAI RICE	% OF TOTAL	GLUTINOUS RICE	% OF TOTAL	OTHER KINDS	% OF TOTAL	TOTAL
1930	1,806.2	24	4,336.0	59	655.1	9	573.1	8	7,370.5
1932	2,942.7	33	4,428.4	49	876.8	10	701.2	8	8,949.2
1934	4,286.2	47	3,496.2	39	743.7	8	562.5	6	9,088.8
1936	4,639.2	48	3,501.4	37	861.6	9	556.0	6	9,558.3
1938	5,276.3	54	3,609.5	37	576.1	6	354.9	3	9,816.9
1939	4,796.7	53	3,318.1	36	665.4	7	371.4	4	9,151.7

TABLE IX - 3

AGRICULTURAL PRODUCTION IN FORMOSA IN 1938

CROPS	AREA IN ACRES	PRODUCTION*	VALUE IN YEN	PERCENTAGE OF TOTAL VALUE
Ordinary crops:				
Rice	1,545,569	9,816,899 koku	241,672,555 (1)	43.795 (1)
Sweet Potatoes	332,543	1,726,188 m.t.	33,315,181 (1)	6.037 (1)
Sugar cane used as a chewing sweet	3,787	93,478 m.t.	1,210,145	0.263
Soybeans	15,453	30,849 koku	709,636	0.154
Other beans	25,113	40,466 koku	731,425	0.159
Sweet corn	3,989	14,968 koku	283,783	0.062
Millet	13,802	21,515 koku	260,595	0.057
Wheat	2,689	10,342 koku	204,267	0.044
Barley	1,848	5,284 koku	57,149	0.012
Buckwheat	74	63 koku	722	0.000
Special crops:				
Sugar cane (for refining)	321,697	9,060,660 m.t.	117,665,244 (1)	21.323 (1)
Tea (crude)	109,668	71,392 m.t.	15,324,698 (1)	2.777 (1)
Peanuts	76,824	556,244 koku	7,135,719 (1)	1.293 (1)
Cassava	16,187	88,511 m.t.	1,203,273	0.262
Sesame	7,299	10,974 koku	360,870	0.078
Jasmine & other perfume flowers for tea	671	714 m.t.	262,806	0.057
Coffee	1,026	46 m.t.	52,467	0.011
Rapeseed	1,050	1,446 koku	35,414	0.008
Arrowroot	117	451 m.t.	7,697	0.002
Nursery Plants	204,351		34,398,013	7.474
Fruits:				
Bananas	51,500	201,651 m.t.	12,688,887 (1)	2.299 (1)
Pineapples	23,737	116,133,501 pieces	5,089,314 (1)	0.977 (1)
Oranges & other citrus fruits	11,321	36,209 m.t.	3,008,425	0.610
Longans	6,851	14,118 m.t.	797,500	0.163
Damson plums	2,371	6,446 m.t.	288,697	0.063
Pomegrantes	2,718	5,294 m.t.	219,712	0.048
Betelnuts	1,285	2,620 m.t.	148,242	0.032
Persimmons	1,007	2,886 m.t.	124,496	0.027
Peaches	590	1,480 m.t.	112,497	0.024
Mangos	1,433	1,173 m.t.	101,358	0.022
Papayas	427	2,168 m.t.	76,499	0.017
Renmu (or rembu)	326	1,185 m.t.	60,115	0.013
Loquats	235	437 m.t.	26,971	0.006
Grapes	53	71 m.t.	15,657	0.003
Vegetables:				
Daikon (radish)	19,284	76,616 m.t.	2,712,909 (1)	0.492 (1)
Cabbage	6,386	39,847 m.t.	1,889,246 (1)	0.342 (1)
Formosa rape	8,387	50,504 m.t.	1,309,853	0.285
Garlic	4,449	17,063 m.t.	1,300,224 (1)	0.235 (1)
Taro	4,859	15,647 m.t.	1,143,087 (1)	0.207 (1)
Onions	4,538	16,633 m.t.	1,063,296 (1)	0.193 (1)
Melons	4,243	17,086 m.t.	732,878	0.159
Snake gourds	5,038	22,239 m.t.	670,551	0.146
Celery	2,771	15,699 m.t.	651,489	0.141
Rape	3,224	15,771 m.t.	611,701	0.133
Cucumbers	2,241	10,351 m.t.	576,770	0.125
Peas	7,086	7,607 m.t.	542,841	0.118
Egg plants	2,958	11,321 m.t.	516,426	0.112
Leek	2,265	9,359 m.t.	458,204	0.100
Ginger	2,512	7,640 m.t.	424,783	0.092
String beans	3,658	8,645 m.t.	407,831	0.089
Cabbage lettuce	2,421	13,167 m.t.	311,605	0.068
Gourd-melons	1,714	9,190 m.t.	273,185	0.059
Pumpkins	2,148	8,945 m.t.	268,274	0.058
White potatoes	276	1,021 m.t.	69,094	0.015
Others	9,993	37,733 m.t.	1,596,058	0.347
Livestock & Products:				
Hogs (butchery) (2)		1,199,017 head	54,002,911 (1)	9.803 (1)
Chickens		7,094,698 head	8,955,466 (1)	1.623 (1)
Buffalo (2)		20,232 head	2,220,700 (1)	0.402 (1)
Ducks		2,022,535 head	2,198,622 (1)	0.398 (1)
Milk		537,154 gal.	851,178	0.185
Geese		394,191 head	572,505	0.124
Cattle (2)		3,789 head	338,602	0.074
Honey		126 m.t.	94,743	0.020
Other animals (sheep, turkeys, goats, deer, etc.)		56,764 head	531,413	0.116

*Koku equals 5.119 bushels
(1) Figures are for 1939
(2) Presumably number slaughtered

TABLE IX - 4
RICE PRODUCTION IN FORMOSA, 1940–1943
(in thousand *koku*)

YEAR	FIRST CROP	SECOND CROP	TOTAL
1940	4,224	3,678	7,902
1941	4,201	4,209	8,410
1942	3,450*	4,550	8,000
1943	3,820	3,990	7,810

*Estimate.

The Japanese Government began to encourage greater rice cultivation at the end of 1942, partly through subsidy. *Domei*, the official Japanese news agency, reported on 15 September 1942 that the Government-General was planning a 10-year program for increasing the rice crop by nearly 40%. It estimated that the 1942 crop would be 41,000,000 bushels, while a crop of 57,000,000 bushels was planned for 1952. However, in 1943, the Foodstuffs Control Bureau of the Government-General announced that the second crop in 1943 was not up to average, being only 20,424,810 bushels.

Despite large rice crops, Japanese demands have kept rice consumption in Formosa at low levels (now estimated to be 4 bushels per capita). During the period of poor rice crops, daily official rationing was imposed in some parts of Formosa. In 1940, for example, farmers in Taihoku province were allowed only ⅗ to ¾ *kin* (13 to 16 ounces) of rice each day.

(*b*) *Sugar cane*. In 1939, sugar cane accounted for about 20% of the total value of agricultural production, and in 1938 about 17%. Its 2 major industrial products, alcohol and refined sugar, make Formosan sugar cane production one of the most vital industries to the Japanese. In 1938–39[1] a record crop of nearly 13,000,000 short tons of sugar cane was produced, although the average for recent years has been about 8,000,000 short tons.

The Javanese varieties of sugar cane are now used exclusively, as they have been found more suitable for the island than the Hawaiian varieties and produce cane with a higher sugar content.

During the year 1938–39, over 167,000 *ko* (about 400,800 acres) of sugar land was harvested, an increase of almost 35,000 *ko* over the previous year and an average 20% acreage increase for the preceding 4 years. About 47% of total sugar acreage in Formosa is in Tainan province and 22% is in Taichū province. The principal centers of sugar cane production are around Kagi-shi, Tainan-shi, Taichū-shi, and Heitō-shi. One-sixth of the cane-producing acreage is owned by sugar corporations and worked by hired labor. Cane farmers work the rest of the land, some as owners, others as tenants. On the larger plantations, modern, motorized equipment is used (FIGURE IX - 1). Planting occurs from June to November, and harvesting and grinding are done 12 to 18 months later, from November through May.

(*c*) *Sweet potatoes*. Sweet potatoes are, by actual quantity, the second largest crop in Formosa. In 1938 they constituted about 6½% of the total value of agricultural production, exceeded only by rice and sugar cane. The sweet potato crops supply a large part of the island population's food needs. They are also used, to an increasing extent, for the manufacture of industrial alcohol and to some extent for animal fodder. Most of the crop is consumed in Formosa, but some

[1]All annual figures in this section are for sugar years beginning 1 November and ending the following 31 October.

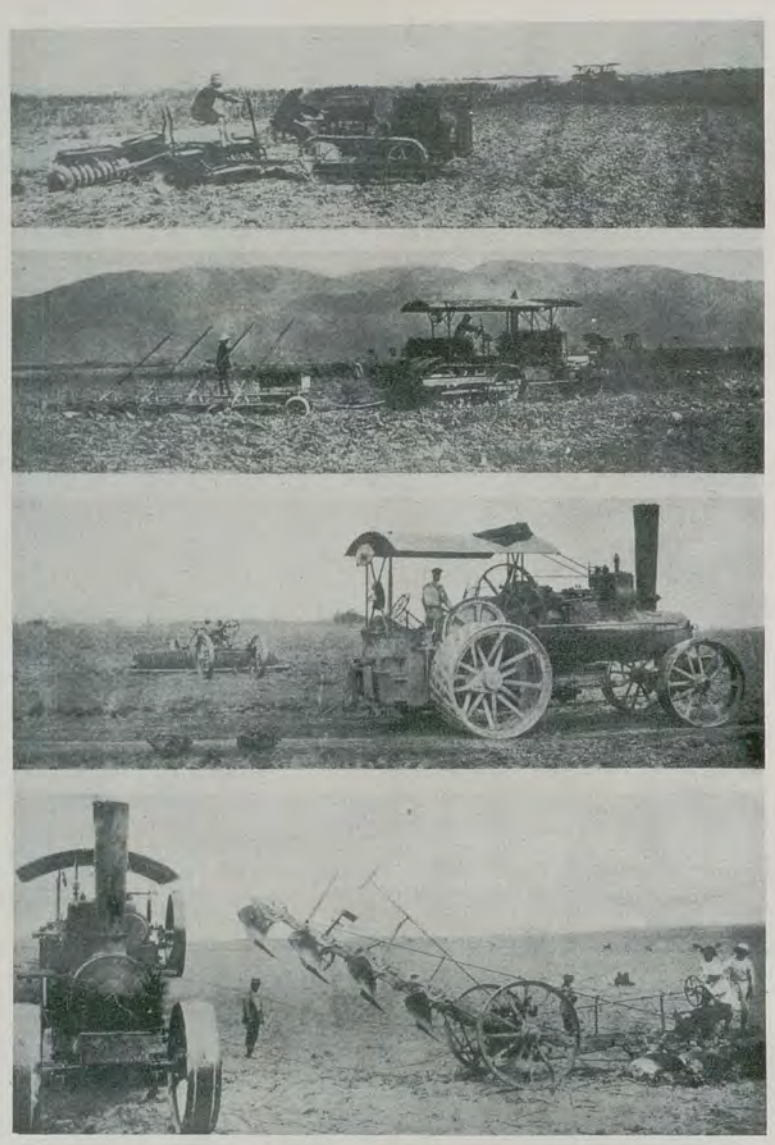


FIGURE IX - 1. *Formosa*.
Types of machinery used on Japanese-owned sugar plantations.

of it is dried and shipped to Japan for industrial use. The 11,000 metric tons exported in 1939 were a sharp decrease from the record export of 70,000 metric tons in 1938.

Nearly everywhere on the island are fields of sweet potatoes which produce all year long. Almost 33,000 acres of sweet potatoes were under cultivation from 1937 to 1939. Tainan province, with Kagi as the center of sweet potato production, had 41% of the total sweet potato acreage. Takao, Shinchiku, and Taichū provinces each had 15% acreage of this crop, and in Bōko prefecture almost ¼ of the total cultivated acreage is devoted to sweet potato production. TABLE IX - 5 shows the trend in Formosan sweet potato production from 1927–1939:

TABLE IX - 5
SWEET POTATO PRODUCTION IN FORMOSA

YEAR	LAND UNDER PRODUCTION (IN THOUSAND *ko*)	AMOUNT OF PRODUCTION (IN MILLION *kin*)	VALUE OF PRODUCTION (IN THOUSAND *yen*)
1927	128.7	2,125.0	21,372.8
1932	134.7	2,388.8	19,373.0
1935	142.5	2,706.8	25,432.0
1936	144.5	2,868.9	28,321.2
1937	143.3	2,949.9	26,655.9
1938	138.7	2,876.9	29,545.2
1939	130.3	2,131.6	33,315.1

(*d*) *Tea*. Until 1938, when it was exceeded by sugar, tea held first place in Formosa's exports to foreign countries. It is still one of the island's principal exports, ranking fourth in

importance and comprising 22% of Formosa's total 1939 exports to countries outside the Japanese Empire. Until 1941, 7,000,000 pounds of Formosa *oolong* tea and slightly less than 2,000,000 pounds of black tea were exported to the U. S. each year.

There are about 110,000 acres of tea plantations in Formosa. Ninety-nine per cent of the total acreage devoted to tea production is located in the northern foothills of Shinchiku and Taihoku provinces (FIGURE IX - 2). Tea is picked from May to December.

FIGURE IX - 2. *Formosa.*
Typical tea plantation.

In 1939 over 23,000,000 *kin* (about 30,360,000 pounds) of tea were grown in Formosa. Of this total, about ½ was black tea (dried slowly to permit oxygenation of the leaves); ¼ *pouchong* tea (wrapped tea similar to *oolong* and flavored with jasmine and gardenia flowers during curing); slightly less than ¼ *oolong* (partially fermented, usually classified as green tea); and the remainder was green tea (dried rapidly without oxygenation), including both powdered and stem varieties. Mitsui Gomei Kaisha (Mitsui Company) is the largest producer of tea. The Taiwan Kocha K.K. (Formosa Black Tea Company) with 8 modern factories also produces a large proportion of the total. Most of the industry is in Japanese hands. (Tea-processing companies are listed in Topic 91, D, (2).)

Of the total tea production in 1939, 82%, or almost 19,000,000 *kin* were exported, leaving Formosan consumption at about 4,000,000 *kin* each year. TABLE IX - 6 shows the types and quantities of tea exported in 1939.

TABLE IX - 6

FORMOSAN TEA EXPORTS IN 1939

TYPE OF TEA	QUANTITY (IN THOUSAND *kin*)	VALUE (IN THOUSAND *yen*)
Oolong	4,100.4	4,306.9
Pouchong	6,504.6	8,334.4
Black	7,163.4	5,476.4
Powdered	1,184.8	543.5
Stem	16.6	4.6

The United States was Formosa's most important single tea market, taking about 50% of Formosa's tea exports each year. Japan was probably able to offset partially the loss of the American tea market after 1941, at least in *oolong* and *pouchong* tea, but the effect of the war has been to curtail tea production in Formosa.

There are indications today that some tea is still being exported from time to time as shipping opportunities arise. In January 1943, it was reported that Thailand had contracted to import 400,000 pounds of Formosan tea and that negotiations were under way for exporting tea to Malaya.

(*e*) *Bananas.* Bananas are the third most important export of Formosa, ⅔ of the crop being exported in normal times. In 1939, there were 48,221 acres of cultivated banana trees, yielding a total crop of 303,270,000 *kin* valued at over 12½ million *yen*. Over 38,000,000 *kin* were exported in that year to areas outside the Japanese Empire, and over 200,000,000 *kin* were shipped within the Empire. The Taiwan Kudamono K.K. (Formosa Fruit Company) handles sales of bananas to Japan proper.

Several varieties of bananas are produced in Formosa, of which the long-stemmed, the short-stemmed, and the so-called "hermit's bananas" are the most valuable for trade purposes. They have an excellent flavor and can be preserved for long periods of time while being transported. There are 2 other varieties, the sour "apple-banana" and the "ice-cream banana," which are produced in much smaller quantities and cannot be exported because they spoil quickly.

Formosan bananas are grown in the mountains and on the plains. Plain areas generally produce twice as much as mountain areas, but owing to reduced production costs for bananas in mountain areas, most of Formosa's bananas are grown in the uplands, mainly in Taichū province, which has 65% of Formosa's banana acreage.

Daiton-gun, Nantō-gun, and Tōsei-gun are the centers of production in Taichū province. Takao province, noted for the plains banana, has over 20% of the total banana acreage. Chōshū-gun, Heitō-gun, Kisan-gun, and Tōkō-gun are the centers of banana production in Takao province. In Taichū province the fruit ripens all year around, and in Takao, it ripens from April to July.

(*f*) *Pineapples.* After the pineapple-canning industry was introduced by the Japanese in 1923, Formosan pineapple production increased rapidly. In 1921, only 1,300 *ko* (3,120 acres) were under pineapple cultivation, but by 1939 there were 10,700 *ko* (25,680 acres), producing a crop of 145,000,000 pineapples. It is estimated that more than 20,000 *ko* can be used in Formosa for raising pineapples. Today, Formosa is producing about 1,000,000 cases annually and is the third largest producer of canned pineapple in the world.

Over 51% of the total Formosan pineapple acreage is found in Taichū province. Takao province has 31% of the pineapple acreage (FIGURE IX - 3). The pineapple-growing areas in these provinces are found on the slopes of the foothills, and the crop is raised on large plantations, chiefly Japanese-owned.

FIGURE IX - 3. *Formosa.*
Pineapple gathering and crating.

Canned pineapple exports in 1939 amounted to $3,465,000, of which $2,910,000 represented exports to Japan proper, Korea, Karafuto, and the Japanese Mandated Islands, the remainder going to "foreign countries." Exports of canned pineapple to the United States in 1939 were valued at $145,000.

The chief canning season in Formosa is from July through September. A government monopoly over pineapple production is exercised by the Taiwan Godo Hori K.K. (Formosa Consolidated Pineapple Company).

(*g*) *Citrus fruits*. Eight varieties of oranges are grown in Formosa but lemon and grapefruit cultivation is minor. The annual citrus fruit crop usually amounts to about 3,000,000 *yen*.

Oranges are 1 of the important winter crops. The annual orange crop is about 55,000,000 pounds. Some of the oranges of Formosa are very sweet and have a delicious flavor, particularly the *ponkan* and *tankan* varieties. *Ponkan* oranges account for 55% of the total orange yield and their production is concentrated in Shinchiku and Taichū provinces. They ripen in November and December and may be kept until the following March or April. The *tankans*, grown mostly in Taihoku and Shinchiku provinces, ripen in March. The *Buntan* variety, produced principally in Tainan province, is put on the market in September. The *Zabon* (or *Zamboo*) variety, similar to grapefruit, was first cultivated in Tainan province, and its production is now concentrated there and in Shinchiku province. This variety ripens between January and April. Snow oranges and *kakuyu* oranges are grown mostly in Tainan Province. *Onshu* sweet oranges are grown only in Taihoku province. Valencia oranges are grown in Taichū, Tainan, and Taihoku provinces.

Lemons graduated from the experimental stage about 7 years ago in Formosa but less than 30 *ko* were under cultivation in 1939. Grapefruit acreage is less than 5 *ko*.

(*h*) *Other fruits*. About 49,000,000 pounds of other fruits are produced annually. These include plums, peaches, papayas, longans, pomegranates, persimmons, grapes, watermelons, and mangoes, all produced in lesser quantities than oranges (Table IX - 3).

(*i*) *Vegetables*. About 70 different kinds of green vegetables are grown all year round, although they are more plentiful in winter than in summer. About 42,000 *ko* are devoted to vegetable cultivation in Formosa. About 20% each of the acreage of Taihoku, Shinchiku, Taichū, and Tainan provinces is devoted to vegetable production. Radishes (daikon), cabbages, and Formosa *rape* are the 3 largest vegetable crops. (Table IX - 3).

(*j*) *Minor grains*. Other grains, aside from rice, are raised in unimportant quantities. Some corn is grown in scattered regions; a little wheat in Taichū province; millet in Bōko and Taitō prefectures, and Shinchiku province; barley principally in Tainan province; and buckwheat in Taitō prefecture. Table IX - 7 shows 1938 production.

Table IX - 7

MINOR GRAINS IN FORMOSA, 1938

Crop	Production in Bushels	Area in Acres
Corn (maize)	76,622	3,991
Indian millet	60,988	8,557
Wheat	52,941	2,689
Millet	49,148	5,245
Barley	27,049	1,850
Buckwheat	322	74

(*k*) *Peanuts*. Peanuts, used principally as a source of food and oil, and as a nitrogen-fixing alternate, are grown in all the lowlands. The main producing district is in Tainan province, where 44% of all peanut-growing land is located. In 1938, over 72,000 acres were devoted to peanut cultivation in Formosa. Almost 550,000 *koku* (2,816,000 bushels) were produced in that year. From 1,500,000 to 1,750,000 kilograms of peanut oil are produced each year in Formosa. Most of the peanut oil production serves as food, although some is used to flavor tobacco. About 500 tons of peanut oil residue is produced annually and constitutes an important fertilizer.

(*l*) *Other food crops*. Recently planted coffee plantations were reported on the east coast, half-way between Karenkō-shi and Taitō-shi. Cocoa plantations in the southwestern part of Formosa are owned by the Hoshi Seiyaku K.K. Cocaine and other narcotic by-products are also obtained from the Hoshi plantations.

(2) *Livestock.*

(*a*) *Cattle*. In 1939, there were 324,000 head of cattle in Formosa. Of the 5 types—water buffalo, yellow cow, Indian cow, sheep-cattle, and domestic hybrids—about 80% were water buffalo. The water buffalo is the most valuable of the island's domestic animals, and is used for farm work; as a source of natural fertilizer; and occasionally as a source of food. Its meat is not very palatable. There is an average of 1 water buffalo per farm household, and about 20,000 of the animals are produced and slaughtered each year. Slaughtering in 1939 amounted to 4½ million *kin* (nearly 6,000,000 pounds).

The yellow cow is used for food and as a draft animal. It is not so strong nor well adapted to paddy fields as the buffalo, but it provides more edible meat. In 1939, there were 46,600 yellow cows in Formosa. About 4,000 are produced each year, and about 6,500 are slaughtered. There were less than 700 Indian cows, about 550 sheep-cattle, and almost 11,000 hybrid cattle in Formosa in 1939; less than 200 Indian cows and sheep-cattle were produced in the same year. The island has few milch cows and no dairy industry.

(*b*) *Hogs*. Hogs furnish the principal source of meat for the Formosan population, consumption per capita being 30 to 35 pounds per year. Hogs on the island average more than 4 head per farming family, but the army is believed to have requisitioned some of them. In 1939, Formosa had 1,650,000 hogs. The average annual hog production is less than 1,500,000 head, and the average annual hog slaughter is over 1,000,000 head. The 1939 slaughtering was valued at over 54,000,000 *yen* (Figure IX - 4).

Figure IX - 4. *Taihoku.*
Hog slaughtering.

The Japanese introduced Berkshire hogs in a 5-year plan, instituted in 1926, for the improvement of the breed.

(*c*) *Horses*. Very few horses are used in Formosa, except by the army. In order to supply the army with horses, the Japanese in Formosa worked out, in 1937, a 10-year plan to raise 9,000 horses, and a 30-year plan to raise 110,000 horses. The slight development attained to date would indicate that these plans were impracticable. In 1937, Formosa had only 927 horses and in that year production amounted to only 55. A horse-breeding station is run by the Government-General at Karenkō.

(*d*) *Poultry*. In 1939, there were over 6,500,000 chickens, nearly 2,000,000 ducks, about 400,000 geese, and 40,000 turkeys in Formosa. Each Formosan farming family had an average of about 20 fowl. Formosan-Chinese farmers prefer duck eggs to chicken eggs, and duck feathers are one of the island's exports.

(*e*) *Other livestock*. In 1939, there were 64,000 goats and only 180 sheep in Formosa; more than 50% of each were in Tainan province. About 30,000 goats are produced annually (of which about 20,000 are slaughtered) and about 40 sheep a year are produced.

(3) *Non-food agricultural products.*

The 1938 production of certain non-food crops in Formosa is shown in Table IX - 8:

TABLE IX - 8
NON-FOOD AGRICULTURAL PRODUCTION IN FORMOSA IN 1938

Crops	Area in Acres	Production	Value in *Yen*	Percentage of Total Value
Tobacco	4,089	2,896 m. t.	2,600,265	0.565
Jute	20,669	14,047 m. t.	2,525,102	0.549
Ramie	3,902	776 m. t.	516,457	0.112
Sisal hemp	3,430	793 m. t.	360,021	0.078
Castor beans	14,298	1,645 m. t.	324,014	0.070
Cotton	11,697	1,090 m. t.	313,825	0.068
Rushes (Shichito)	920	923 m. t.	107,826	0.024
Rushes (Taiko)	34	72 m. t.	19,855	0.004
Silk worm cocoons	—	6,096 bushels	41,493	0.009
Raw hides	—	607,251 pieces	2,251,680 (1)	0.408 (1)

(1) Figures are for 1939.

(*a*) *Camphor*. Since 1899, the Government-General has had a world-wide monopoly on natural camphor production. Formosan production was delegated to an independent corporation until 1934, when the Government-General bought out the corporation and set about increasing camphor production. It was estimated that 2,500 acres should be planted in camphor trees each year in order to maintain a reserve. A long-range program is necessary because it takes 60 years for camphor trees to grow to a size practicable for camphor production. It was also planned that *hosho* camphor trees, having a greater oil yield, be planted in addition to the ordinary variety and that experiments be undertaken on the by-products of camphor refining.

The annual yield of camphor averages about 3,000 metric tons, obtained from trees having a circumference of between 25 and 36 feet, which are located in tropical and subtropical forests in the foothills and lower mountain slopes of the central and eastern parts of the island. The trees do not flourish at elevations above 3,500 or 4,000 feet.

Crude camphor, camphor oil, celluloid, and chemicals are manufactured at a Monopoly Bureau plant in Taihoku-shi. Refined camphor and camphor oil are shipped from the plant by 2 firms licensed by the Monopoly Bureau (Figure IX - 5).

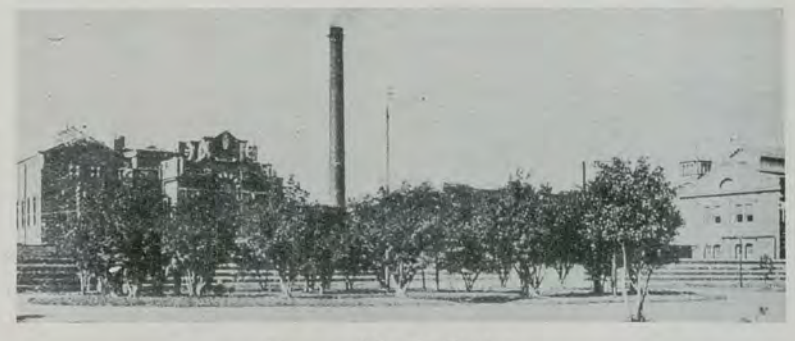


Figure IX - 5. *Taihoku*.
Camphor-opium monopoly buildings.

Natural camphor has been an important Formosan export, direct to foreign countries in the past, but the demand for it has decreased because of the development of cheaper synthetic camphor in recent years in other parts of the world. Before the war, the U. S. was the largest purchaser, receiving $426,000 worth of the $514,000 total camphor exports in 1939. French purchases in 1939 were valued at $34,000 and Great Britain's at $54,000.

(*b*) *Quinine*. Quinine is obtained from the bark of cinchona trees found in Taitō and Takao provinces. Tree nurseries were established in 1922 at Raisha, Chōshū-gun in Takao province and at Chimoto, Taitō prefecture. After several years of development, interest in cinchona plantations waned, but was revived in 1933 with a plan to plant 28,000 acres. In the middle 1930's, Formosan quinine production was only 225 tons annually. The Hoshi Seiyaku K.K. (Hoshi Drug Manufacturing Company) was reported to have grown 1,500 saplings from the 1934 seeds, and anticipated a yield of 7,000 tons of cinchona bark by 1944. The world total yield of cinchona bark in 1939 was about 16,000 tons.

No late production figures are available, but from recent information it would appear that Japan intends to transfer her attention concerning quinine to Java. This is based on a statement by a Japanese source to the effect that sufficient supplies of quinine are being obtained in Java and that it may not be necessary to increase production in Formosa.

(*c*) *Rubber*. Large areas formerly planted to sugar cane and bananas are reported to have been converted to rubber production several years ago. This unconfirmed report states that there were "great quantities" of rubber trees producing in 1941 and located mostly "on the east coast between Tokas (sic) and Tianon (sic) on the flat coastal plain." Rubber refining plants are reported to be located on the east coast. Trips to the eastern area of Formosa where rubber was being produced were greatly restricted after the alleged rubber production was begun, and no further information on this subject is available.

It has been the experience of rubber technicians that areas lying north of 18° north cannot produce rubber cheaply enough to compete in world markets with equatorial rubber. Since Formosa lies between 21° and 25° north, the future of its rubber industry under competitive conditions does not appear promising. However, under Japan's closed economy, a higher cost of production would not deter the promotion of rubber cultivation in Formosa for the Japanese war machine or in order to save shipping from Malaya and the East Indies.

(*d*) *Cotton*. Cotton is still an unimportant part of For-

mosa's economy, despite governmental efforts to increase production. Cotton planting on a commercial scale began in 1937, mostly in Tainan province. In 1939, there were 3,270 *ko* under cotton cultivation, a decrease of more than 1,600 *ko* under 1938. The 1939 crop amounted to 1,480,000 *kin* (1,953,600 pounds), 350,000 *kin* less than 1938.

Whatever cotton can be produced is sorely needed by the Empire. Seeds from Formosa have been used for growing cotton in other parts of the Empire more favorable to cotton cultivation. Large gins, with capacities greater than Formosa's production, have been built, perhaps with the intention of ginning cotton grown in other areas.

(*e*) *Jute and hemp*. Production of jute and hemp is also encouraged by the government, as they are a necessary source of airplane cloth for military use and of burlap bags. Hemp and jute production rose from 10,000 metric tons in 1937 to 25,000 metric tons in 1939, but this increase was 10,000 tons below the peak the government had anticipated. In 1938, when the local crop was 15,000 metric tons, it was necessary to import 22,000,000 burlap bags for sugar and rice exports.

Hemp is grown in Tainan, Taichū, Takao, and Shinchiku provinces. Manufacturing plans are located at Tainan-shi, and at Toyohara-gai (Taichū-shu).

Jute production is concentrated in Tainan province, where about 60% of all Formosan jute-growing land is located. Taichū province ranks second. Total jute acreage in Formosa grew from 2,500 *ko* (6,000 acres) in 1931 to almost 24,000 *ko* (57,600 acres) in 1939. Jute production in 1939 amounted to almost 40,000,000 *kin* (52,800,000 pounds).

(*f*) *Ramie*. In 1939, ramie (a fibrous plant) cultivation in Formosa was spread over an area of more than 1,800 *ko*, which represented a decrease from the 1936 high of over 2,000 *ko* (4,800 acres). Production declined to 1,300,000 *kin* (1,716,000 pounds) in 1939 from 2,300,000 *kin* (3,036,000 pounds) in 1936. The decrease may be due in part to increased cotton production under government encouragement, cotton yielding better fiber than ramie. Production of ramie is concentrated in the area around Giran-gun (Taihoku-shū) and Taiko-gun (Shinchiku-shū).

(*g*) *Sericulture*. With the shortage of fibers prevalent in the Japanese Empire during the war, more intensive sericulture is being encouraged in Formosa. In 1938, 1,400 households were engaged in sericulture, cultivating 275 *ko* (660 acres) of mulberry and producing about 5,000 bushels of cocoons. A central nursery at Taihoku has been distributing egg-sheets and conducting experiments with fertilizers for mulberry trees. Raw silk has been produced from cocoons at a factory of the Taiwan Sanshi K.K. (Formosa Silk Thread Company) in Taihoku. The value of raw silk production declined from 74,000 *yen* in 1933 to 50,000 *yen* in 1937.

(*h*) *Tobacco*. Over 4,000 metric tons of tobacco were produced in 1939 in Formosa, and a reliable 1941 Japanese source estimated that in 1942 over 5,500 *ko* would be devoted to tobacco cultivation. Under a Government-General Monopoly established in 1905, 3 varieties of tobacco—American yellow leaf, Chinese, and cigar—are raised in Formosa, chiefly in Tainan and Taichū provinces and in Karenkō prefecture. It is generally of an inferior quality.

Tobacco products are made by the Taihoku factory of the Monopoly Bureau and dealers in tobacco products must obtain a license from that Bureau.

In 1937, Formosa imported over 1,000,000,000 cigarettes valued at $2,278,000, which amounted to more than ⅓ of the total consumption of cigarettes on the island. After 1937, however, tobacco imports declined and by 1939 Formosa was exporting almost 750,000 *yen* worth of tobacco products, of which 97% was sent to South China. In 1941 this had risen to over 1,100,000 *yen*. In the same year, raw tobacco exports amounted to almost 1,500,000 kilograms, valued at over 1,500,000 *yen*.

(*i*) *Oil-bearing seeds*. Castor beans, sesame, and perilla are 3 unimportant oil-bearing seeds produced in Formosa. The Japanese Government's efforts to promote castor bean production have been more successful than its efforts on cotton. The Formosa climate is suitable and, because of the value of castor oil as an aviation lubricant, it has become a profitable crop. Production has increased substantially in recent years. In 1939, 1,886 metric tons were produced. According to a 10-year plan announced in 1938, the government hopes to increase acreage to 28,800 acres with an output of between 11,000 and 12,000 tons by 1948. This would necessitate increasing the yield per acre from its present level of 215 pounds to 830 pounds. Present indications are that the plan will be partially successful. A castor bean factory in Takao province is reported to be satisfactorily supplying castor oil to the armed services.

In 1939, there were over 9,000 *ko* devoted to sesame production in Tainan and Takao provinces. In 1934, the government began encouraging the planting of perilla in rice fields with seeds distributed through a government nursery. In 1937, about 2,500 acres were reported to be planted with perilla and oil was being produced from the seed at the Sugihara plant.

(4) *Food deficiencies.*

Wheat and wheat flour, condensed milk, soy beans, and bran are produced in only negligible quantities in Formosa, nor are there adequate food substitutes. With the occupation of Formosa by the United Nations forces, Formosa's suppliers of these commodities will be cut off. During 1939, the following foods were imported:

Wheat—9,300 metric tons were shipped from other parts of the Japanese Empire and 780 metric tons were imported from foreign countries.

Wheat flour—29,000 metric tons of wheat flour were imported from other parts of the Empire.

Condensed milk—400,000 dozen cans were imported from the Empire.

Sake and beer—Almost 1,500,000 gallons of sake and 260,000 cases of beer were imported from other parts of the Empire.

Soy beans—42,000 metric tons of soy beans and 175,000 metric tons of soy bean cake were imported from Manchuria and Kwantung Leased Territory.

Bran—15,000 metric tons of bran were imported from China and Kwantung Leased Territory.

(5) *Fertilizer requirements.*

Much of the increased yield per acre of land in Formosa that has occurred under Japanese management has been due to experiments with and improvements in fertilizers. Prior to 1939, most of the artificial fertilizers used in Formosa had been imported, including 200,000 tons of ammonium sulfate annually. Lower crop yields since 1940 can be attributed in part to fertilizer shortages due to the lack of shipping facilities during the war.

In 1939, 269,000 metric tons of fertilizer were produced in Formosa, an increase of 135,000 metric tons over 1938 production. This amount was divided among 4 different types of

fertilizers in the following quantities: animal fertilizer—1,000 metric tons; vegetable fertilizer—25,000 metric tons; chemical or mineral fertilizer—30,000 metric tons; and mixed fertilizer—213,000 metric tons.

The chemical fertilizers used in Formosa in 1939 were superphosphate of lime—21,000 metric tons, lime nitrate—7,000 metric tons, and melted guano phosphate—2,000 metric tons.

Since domestic fertilizer production has never been sufficient to meet Formosan needs, large quantities have always been imported. TABLE IX - 9 shows the types imported in 1939.

TABLE IX - 9
FORMOSAN FERTILIZER IMPORTS, 1939
(in metric tons)

TYPE	FROM FOREIGN COUNTRIES		FROM JAPANESE EMPIRE
Animal	—		1,700
Vegetable	175,500		4,500
Chemical			
Ammonium sulfate	12,250		167,200
Potassium chloride	1,000		85
Potassium sulfate	9,500		1,655
Lime nitrate	—		3,500
Chilean saltpeter	—		360
Superphosphate of lime	—		59,300
Artificial fertilizer	—		29,300
Mixed fertilizer	—		68,400
Total	198,250		335,000
Total imports		534,250	

B. Fisheries.

An abundance of fish, including sardine, shark (together constituting the largest part of the catch), tunny, swordfish, "tai" (favorite of the Japanese), bonito, and shell-fish, is found in the waters surrounding Formosa, the Spratly Islands, and Bōko-tō (Pescadores). Despite fairly large exports of fresh fish, Formosa depends upon Japan for larger imports of dried and canned fish. The average annual Formosan consumption of fish is estimated to be 25 pounds per capita.

In 1939, 75% of the Formosan fishing catch resulted from deep sea fishing, the remainder from coastal fishing. The total catch in 1939 weighed 4,860,000 *kan*, or about 40,000,000 pounds, and was valued at over 25,000,000 *yen*. The area of the hatcheries all over the island is about 30,000 *ko* (72,000 acres).

(1) *Types of fish.*

Bonito, tunny, shark, swordfish, and sea-bream are found in the northern sea area; bonito and tunny in the eastern sea area; grey mullet, yellow-tail, shark, scombremours niponium (a mackerel-like fish), and red sea-bream in the western sea area; and tunny, bonito, shark and sea-bream in the southern waters. Bonito angling, and trawling for tunny and swordfish are done chiefly from Takao, Kiirun, Suō, and Bōko-tō. From Daibanrachi, at the southern tip of Formosa, 20 to 50 whales are caught annually by 2 whaling vessels (FIGURE IX - 6).

In addition to the salt water catch, hatcheries on 70,000 acres of land are devoted to fish culture. *Sabahi*, grey mullet and crustaceans such as crabs, lobsters, and oysters are bred. *Sabahi*, a favorite fish of the Chinese, is the most important of these. It is cultivated largely on the coast of Tainan province, especially at Ampin. Grey mullet is raised in fish ponds in Takao province, and oysters and lobsters chiefly along the coasts of Tainan, Taichū, and Takao provinces. Carp, grey mullet and other fresh water fish are raised also in Taichū, Tainan, and Shinchiku provinces.

On the flat banks, extending far out to sea from Ampin (Tainan-shū), oysters are raised (FIGURE IX - 7). Oyster shells are placed on bamboo sticks stuck into the muddy bottom of the flats. These shells attract immature oysters carried in by the tide, and these young oysters, nourished by the tides, grow to a large size in 1 year.

Renkodai, bonito, sharks, and sardines are the most important fish caught off Kiirun.

Dragnet fishing from motorboats yielded catches valued at 3,180,000 *yen*. In 1934, 29 boats were engaged in bonito fishing. Sea-bream fishing has lately been declining. Fishing for tunny, spear, and shark has proved very profitable, engaging 450 boats in 1935, which had catches valued at over 2,000,000 *yen*.

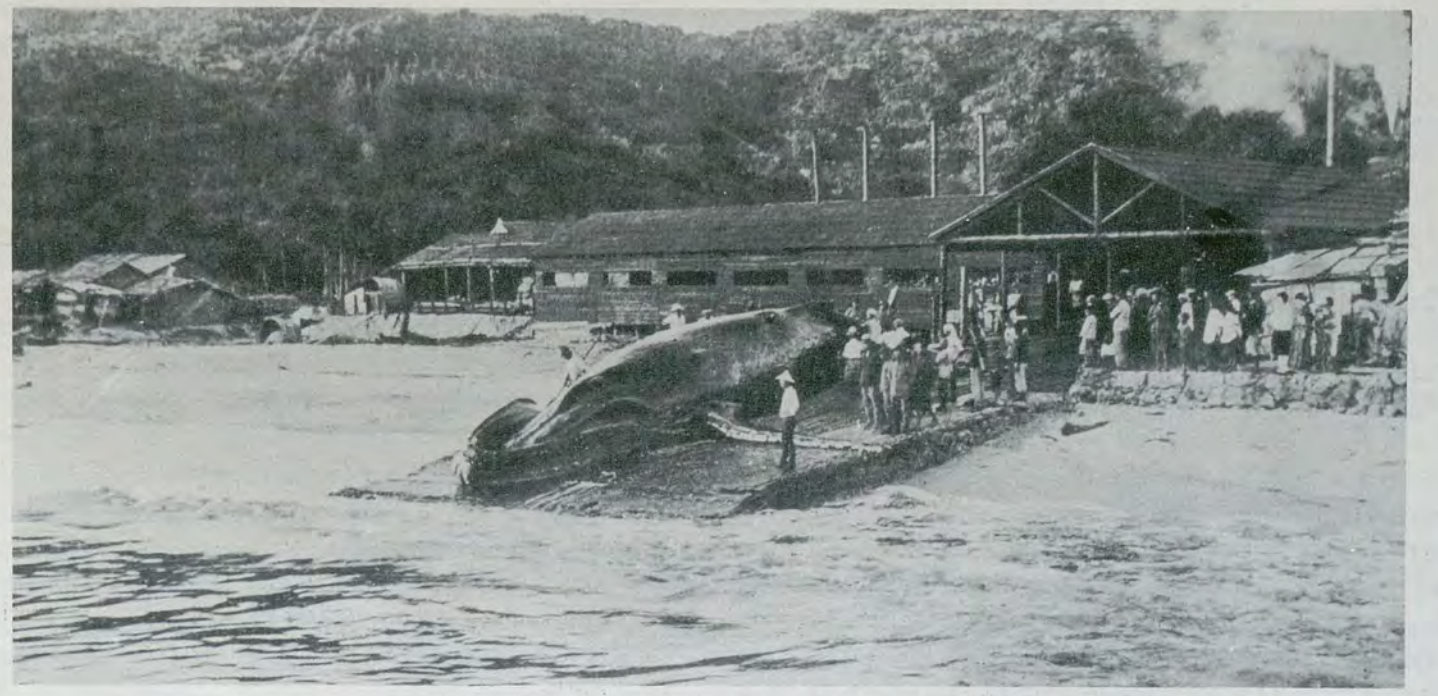


FIGURE IX - 6. *Garan-bi*.
Whale caught off southern coast.

FIGURE IX - 7. *Rokko.*
Oyster beds.

The results of aquatic catches in Formosan waters from 1932–1938 are presented in TABLE IX - 10.

TABLE IX - 10
AQUATIC CATCHES IN FORMOSA, 1932–1938
(in thousand *kan*)

TYPE OF FISH	1932	1934	1936	1938
Sardine	1,512	2,834	2,898	2,094
Bonito	969	1,572	1,284	264
Tai	328	430	483	307
Shark	1,603	1,854	2,031	1,626
Tunny	808	857	1,348	971
Swordfish	868	1,190	1,054	669
Shellfish	16	53	409	206
Shrimps	106	129	151	199
Cuttlefish	146	186	306	193
Coral	2.6	1.2	5.3	1.5
Weeds	136	83	97	145

(2) *The fishing industry.*

About 130,000 persons are engaged in the Formosan fishing industry. Only about 6,000 of these are Japanese, the remainder being Formosan-Chinese. Of this number, about 100,000 are fishermen, 60% of them part-time.

In 1938, there were reported to be 10,000 fishing boats in operation in Formosan waters. Of these, only 1,000 were power vessels. However, the proportion of power vessels is believed to be steadily increasing. Based on Kiirun, Takao, and Suō are 200 to 300 sea-going fishing vessels powered with kerosene motors which can carry equipment and 70 to 100 men. Owing to the war, the Japanese have confiscated a number of fishing boats for military purposes, 811 Formosan fishing boats being expropriated between 1937 and 1942.

(3) *Fishing ports.*

The 2 most important Formosan fishing ports are Takao and Kiirun. Takao is a base for deep-sea fishing in an area extending from the straits of Basi◦ to waters near the Philippines (FIGURE IX - 8). Fishing vessels embarking from Takao sometimes remain at sea from 25 to 35 days.

Fishing is one of the most important industries in Kiirun, and the 1939 catch from that port was valued at 6,000,000 *yen*. Other important fishing ports are Suō, Shinkō, and Makō.

(4) *Imports and exports.*

Formosa is not at present self-sufficient in fish but could become so. Each year Formosa imports more fish than she exports, the chief source of imports being Japan proper. Formosa exports fresh fish to Japan, and imports dried and salted fish from Japan. Total imports of dried and salted fish from Japan amounted to over 35,000,000 *kin* (46,667,000 pounds) in 1939; imports of the same items from foreign countries in the same year totaled 1,740,000 *kin* (2,320,000 pounds).

TABLE IX - 11 lists the amounts of different types of fish imported and exported by Formosa in 1937.

The following measures have been considered necessary in order to make Formosa self-sufficient in fish: deep-sea fishing must be further developed; improved and increased storage and refrigeration facilities must be provided; subsidies to fishing companies should be continued; fishing equipment and additional sites for boat repairs should be provided; increases in labor supply in the fishing industry should be attempted through shifts within the Formosan economy, rather than through the importation of labor from other Far Eastern areas.

FIGURE IX - 8. *Takao.*
Fishing wharf.

TABLE IX - 11

QUANTITY OF FISH IMPORTS AND EXPORTS, 1937

(in thousand *kin*)

TYPE OF FISH	IMPORTS FOREIGN COUNTRIES	IMPORTS JAPANESE EMPIRE	EXPORTS FOREIGN COUNTRIES	EXPORTS JAPANESE EMPIRE
herring, salted	3,924.3	2,211.2	—	—
trout, salted	3,190.1	19,509.7	81.5	—
mackeral, salted	—	2,191.1	46.6	—
sardine, salted	—	551.3	71.8	—
fresh fish and shell fish	—	7,664.2	609.3	11,184.8
hairtail, salted	—	3,114.6	—	—
salmon, salted	—	1,521.1	—	—
cod, dried	—	1,277.0	629.6	—
small fish, dried	—	6,131.9	373.5	—
cuttle, dried	—	1,428.4	103.7	—
shrimp and prawns, dried or salted	9.0	2,485.5	236.5	—
other salted fish	32.6	125.2	84.9	—
other dried fish	.7	1,703.0	62.9	—
other shell fish, dried	—	—	165.8	—
shark's fins	—	—	161.9	—
Konbu (Laminaria)	—	403.6	214.8	—
Other fish and aquatic products	38.5	—	74.7	—
sea blubbers, salted	210.7	—	—	—
whale meat	—	—	—	111.2
Katuobusi	—	144.9	—	271.4

C. Refrigeration and storage.

(1) *Ice manufacturing.*

Over 160,000 metric tons of ice were manufactured in Formosa in 1938. All of the larger cities and towns have ice-making plants. The distilled water-can system is used largely, although there are some systems using raw water. Ice made from raw water in Formosa must not be used in preparing food or drink.

There are known to be 18 ice manufacturers operating in Formosa. A Formosa Ice Manufacturers' Guild, with headquarters in Taihoku-shi, is maintained by these manufacturers. The 18 plants are listed in TABLE IX - 12.

TABLE IX - 12

ICE MANUFACTURING PLANTS IN FORMOSA

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION
Inrin Seihyo K.K.	113,650	1926	Inrin-gai (Taichū-shu)
Taizan Seihyo K.K.	100,000	1931	Takao-shi
Chuo Seihyo K.K.	300,000	1928	Taichū-shi
Toko Seihyo K.K.	100,000	1930	Tōkō-gai (Takao-shū)
Nishi Taiwan Suisan K.K.	1,000,000	1939	Makō-gai (Bōko-chō)
Heitō Seihyo K.K.	100,000	1921	Heitō-shi (Takao-shū)
Fukusen Seihyo K.K.	200,000	1927	Taihoku-shi
Yamato Seihyo K.K.	300,000	1926	Taihoku-shi
Nantō Seihyo K.K.	120,000	1931	Nantō-gai (Taichū-shū)
Toyohara Seihyo K.K.	300,000	1920	Toyohara-gai (Taichū-shū)
Toho Seihyo K.K.	125,000	1930	Ishioka-shō (Taichū-shū)
Takao Seihyo K.K.	500,000	1925	Takao-shi
Taiwan Seihyo Reizo K.K.	100,000	1929	Taihoku-shi
Tainan Seihyo K.K.	200,000	1927	Tainan-shi
Taichū Seihyo K.K.	200,000	1911	Taichū-shi
Kiyomizu Seihyo K.K.	140,000	1929	Kiyomizu-gai (Taichū-shū)
Kizan Seihyo K.K.	—	—	Kizan-gai (Takao-shū)
Taihoku Chuo Shijo K.K.	—	—	Taihoku-shi

(2) *Cold storage facilities.*

Facilities for cold storage and refrigeration appear to be inadequate. No recent figures for refrigeration facilities in Formosa are available, but the steady increase in exports to Japan of perishable goods seems to indicate that these facilities have recently been improved.

Many industrial firms maintain cold storage plants in connection with their own commodities. The Tobu Suisan K.K. (Eastern Marine Products Company) operates cold-storage enterprises in Kiirun-shi and Suō-gai, both in Taihoku province, in Shinko-shō (Taitō prefecture), and other towns.

Five general cold storage plants are known to be in operation in Formosa. These are listed in TABLE IX - 13 on the following page.

FIGURE IX - 9. *Kiirun.*
Warehouses at harbor.

TABLE IX - 13
COLD STORAGE PLANTS IN FORMOSA

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION
Nishi Taiwan Suisan K.K.	1,000,000	1939	Makō-gai (Bōko-chō)
Taiwan Reito Kogyo K.K.	500,000	1935	Takao-shi
Chuo Seihyo K.K.	300,000	1928	Taichū-shi
Kiirun Reizo K.K.	300,000	1930	Kiirun-shi (Taihoku-shū)
Taiwan Seihyo Reizo K.K.	100,000	1929	Taihoku-shū

(3) *Warehousing facilities.*

Warehousing facilities exist in all Formosan cities and large towns. All harbor facilities include warehouses on the waterfront (FIGURE IX - 9). In Karenkō there are 10 warehouses, each with floor space capacity of 6,500 square feet; Gosei (Niitaka) has 6 warehouses; 118 warehouse-type buildings have been reported at Tōshien, 115 in the Takao harbor area, and 251 in the Reigaryō industrial suburb of Takao. Five warehouse areas in Taichū have been reported, with about 40 warehouses. Tainan has 20 warehouses.

TABLE IX - 14
GENERAL WAREHOUSING FACILITIES IN FORMOSA

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION
Karenko Niyaku Soko KK	400,000	1938	Karenko-shi
Kyujo Godo Unyu KK....	100,000	1939	Saei-shō (Takao-shū)
Kiirun Godo Unsu KK....	150,000	—	Kiirun-shi (Taihoku-shū)
Karenko Kinkai Unyu KK.	180,000	1939	Karenko-shi
Asahi Kumi KK.....	250,000	1922	Karenkō-shi
Arisan Godo Unso KK....	80,000	1939	Kagi-shi (Tainan-shū)
Mato Godo Unso KK.....	50,000	1939	Matō-gai (Tainan-shū)
Kokusai Unyuso KK.....	250,000	1929	Takao-shi
Taiwan Soko KK.....	2,000,000	1916	Kiirun-shi (Taihoku-shū)
Nisshin Shippo Gomei Kaisha.....	150,000	1924	Taihoku-shi
Nitto Shosenso KK.....	1,000,000	1918	Takao-shi
Manei Kumi KK.....	200,000	1930	Kiirun-shi (Taihoku-shū)
Rato Unyu KK.....	100,000	1939	Ratō-gai (Taihoku-shū)
Nippon Shokuryo Kogyo KK.....	—	—	(1) Taihoku-shi (2) Kiirun-shi (Taihoku-shū)
Osaka Shosen KK.....	—	—	Taihoku-shi
Ryumon Kogyo Goshi Kaisha.....	—	—	Taihoku-shi
Yamato Unso KK.....	—	—	Taihoku-shi
Nanyo Storage Company..	—	—	Taihoku-shi

Warehouses are operated by 4 different groups of owners: the government, industrial firms, agricultural or industrial associations, and warehousing companies. The Government-General and the provincial governments operate a number of warehouses. At Takao there are 5 government owned warehouses of galvanized iron with steel frames, each with a capacity of 5,000 tons, used largely for rice and sugar storage. Warehouses are maintained by individual industrial firms for the storage of their materials. In 1937, there were 21 warehouses managed by agricultural associations and 15 by industrial associations. Warehousing companies are known to operate 19 warehouses, not including cold storage plants. (See TABLE IX-14).

D. Processing.

(1) *Sugar refining.*

(*a*) *General.* Refined sugar is Formosa's most important export, 90% of Formosa's total sugar production being sold abroad and supplying 90% of the sugar needs of the Japanese Empire (FIGURE IX - 10). From 1933–1937, it averaged 43% of the total value of exports. Before 1939, Formosa supplied China with only a small part of its sugar requirements, but in 1939, 43% of China's recorded sugar imports came from Formosa, and in 1940, 28%. Before the present war, sugar was the main source of revenue to the Government-General. A protective tariff was placed on imported refined sugar in 1903, and was steadily raised from the initial tariff of .8 *sen* per *kin* until by 1932 it was 7.15 *sen* per *kin*, making importation of foreign sugar prohibitive.

(*b*) *Production.* Formosan refined sugar production reached its peak in 1938–39. TABLE IX - 15 shows production trends between 1931–43.

TABLE IX - 15
REFINED SUGAR PRODUCTION IN FORMOSA, 1931–1943
(in million pounds)

1931–32	2,181	1937–38	2,182
1932–33	1,397	1938–39	3,127
1933–34	1,426	1939–40	2,497
1934–35	2,129	1940–41	1,771
1935–36	1,989	1941–42	not available
1936–37	2,221	1942–43	2,347

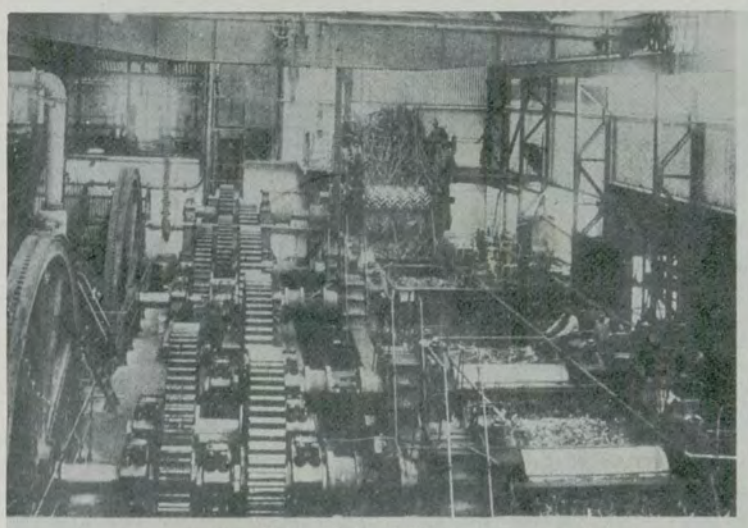
(*c*) *Sugar refineries.* Five Japanese-controlled sugar companies, each having a capitalization of over 1,000,000 *yen*, produce 95% of all Formosan refined sugar.

TABLE IX - 16 lists the sugar refineries in operation in Formosa. (FIGURES IX - 11 to IX - 25).

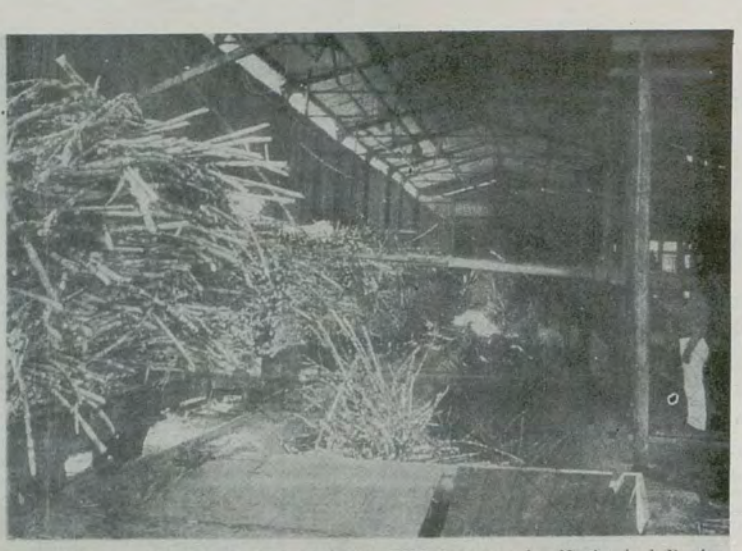
TABLE IX - 16
FORMOSAN SUGAR REFINERIES*

FACTORY NAME	LOCATION	DATE OF CONSTRUCTION	DAILY CAPACITY	MOLASSES PRODUCTION 1938–39 (IN MILLION KIN)
		1. Taiwan Seito K.K.		
Kyoshito No. 1	Nanshi-shō (Takao-shū)	1902	650 long tons	13.12
Kyoshito No. 2	Nanshi-shō (Takao-shū)	1908	400 short tons	
Kohekirin	Kominato-shō (Takao-shū)	1909	1,000 short tons	8.69
Ako	Heitō-shi (Takao-shū)	1909	3,000 short tons	35.63
Toko	Rinken-shō (Takao-shū)	1921	700 short tons	11.27
Sharoken	Jintoku-shō (Tainan-shū)	1911	1,200 short tons	12.80
Wanri No. 1	Zenka-gai (Tainan-shū)	1906	180 long tons	19.39
Wanri No. 2	Zenka-gai (Tainan-shū)	1929	1,000 short tons	
Sankanten	Einei-shō (Tainan-shū)	1909	850 long tons	9.82
Horisha	Hori-gai (Taichū-shū)	1912	300 long tons	2.38
Taihoku	Taihoku-shi	1912	500 long tons	2.97
Kibi	Kizan-gai (Takao-shū)	1911	1,200 long tons	12.36
Koshun	Kōshun-gai (Takao-shū)	1927	350 long tons	3.15
		2. Shinko Seito K.K.		
Sansdicho	Tairyō-shō (Takao-shū)	1905	850 long tons	9.25
		3. Meiji Seito K.K.		
Soya	Matō-gai (Tainan-shū)	1912	1,000 short tons	9.10
Shoro	Kari-gai (Tainan-shū)	1909	750 long tons	9.31
Ujurin	Kōheki-shō (Tainan-shū)	1911	750 long tons	9.07
Nansei	Mizukami-shō (Tainan-shū)	1909	2,000 long tons	14.87
Santo	Rokkyaku-shō (Tainan-shū)	1911	2,200 short tons	25.40
Nanto	Nantō-gai (Taichū-shū)	1912	750 long tons	12.48
Keiko	Keiko-shō (Tainan-shū)	1921	1,500 long tons	25.40
		4. Ensuiko Seito K.K.		
Shinei No. 1	Shinei-gai (Tainan-shū)	1909	1,000 long tons	13.57
Shinei No. 2	Shinei-gai (Tainan-shū)	1937	1,200 long tons	14.37
Gannai No. 1	Ensui-gai (Tainan-shū)	1905	550 long tons	18.05
Gannai No. 2	Ensui-gai (Tainan-shū)	1912	700 long tons	
Karenko-Kotobuki	Kotobuki-shō (Karenkō-chō)	1914	500 long tons	6.56
Karenko-Yamato	Mizuho-shō (Karenkō-chō)	1922	550 long tons	8.03
Keishu	Keishū-shō (Taichū-shū)	1909	1,950 long tons	24.85
		5. Dai Nippon Seito K.K.		
Kobi No. 1	Kobi-gai (Tainan-shū)	1909	2,200 long tons	28.34
Kobi No. 2	Kobi-gai (Tainan-shū)	1912	1,000 long tons	10.53
Ryugan	Bōko-shō (Tainan-shū)	1936	1,100 short tons	12.17
Hokko	Hokkō-gai (Tainan-shū)	1912	2,000 long tons	14.37
Tairin	Tairin-shō (Tainan-shū)	1913	1,200 long tons	13.58
Toroku	Toroku-gai (Tainan-shū)	1912	500 long tons	6.32
Shoka	Wabi-shō (Taichū-shū)	1911	750 long tons	14.83
Ujitsu	Ujitsu-shō (Taichū-shū)	1922	450 long tons	8.91
Getsubi	Naiho-shō (Taichū-shū)	1914	750 short tons	9.60
		6. Teikoku Seito K.K.		
Taichu No. 1	Taichū-shi (Taichū-shū)	1912	750 short tons	12.36
Taichu No. 2	Taichū-shi (Taichū-shū)	1914	300 short tons	3.98
Tanshi	Tanshi-shō (Taichū-shū)	1918	750 long tons	12.92
Chikunan	Chikunan-gai (Shinchiku-shū)	1913	550 long tons	6.47
Shinchiku	Shinchiku-shi (Shinchiku-shū)	1915	650 long tons	5.94
Kanshikyaku	Shinchiku-shū (exact location unknown)	1939	750 long tons	3.23
		7. Showa Seito K.K.		
Giran No. 1	Giran-gai (Taihoku-shū)	1917	400 long tons	—
Giran No. 2	Giran-gai (Taihoku-shū)	1920	750 long tons	—
Tamai	Tamai-shō (Tainan-shū)	1913	900 long tons	6.96
Byoritsu	Byōritsu-gai (Shinchiku-shū)	1920	900 long tons	7.24
Sharoku	Sharoki-shō (Taichū-shū)	1922	300 long tons	4.29
		8. Taitō Seito K.K.		
Taito No. 1	Hinan-shō (Taitō-chō)	1916	350 long tons	4.74
Taito No. 2	Hinan-shō (Taitō-chō)	under construction, 1940	150 long tons	—
		9. Sango Kansu K.K.		
Gensei	Nirin-gai (Taichū-shū)	1934	350 long tons	2.47

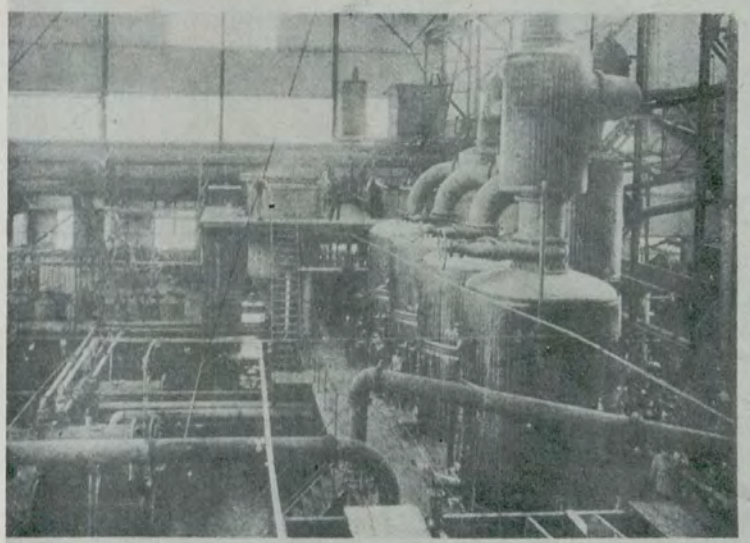
*The Shinkō Sugar Co. was merged with the Formosa Sugar Co. in 1941. The Teikoku Sugar Co. and the Showa Sugar Co. were merged with the Japan Sugar Co. in 1941 and 1940, respectively.

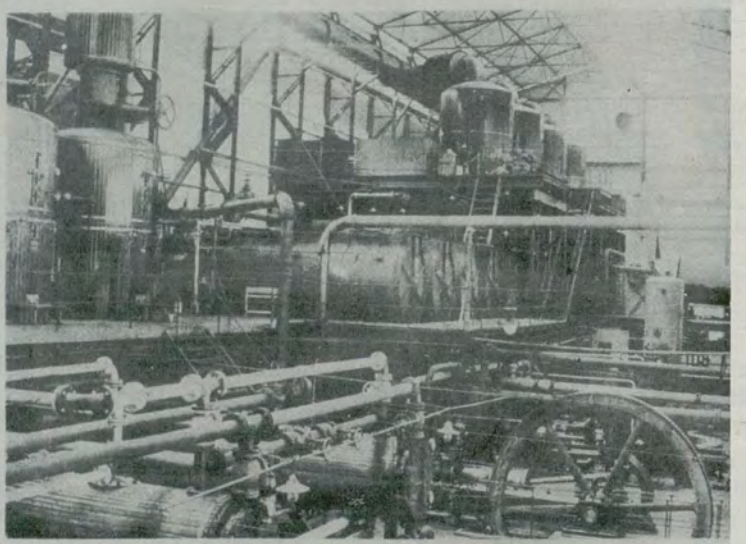


Nine Roller Mill and Crusher



Showing Cars being Unloaded into Mill Conveyor by Mechanical Device





Sugar Boiling Floor: Showing Clarifiers and Quadruple Evaporator on Left and Vacuum Pans and Crystallizers on Right, Vacuum Pumps on Lower Level

FIGURE IX - 10. *Formosa.*
Interior views showing equipment in Sugar Mill No. 1, Japan Sugar ~~Manufacturing~~ Co., ~~Ltd~~. 1930.

GREAT

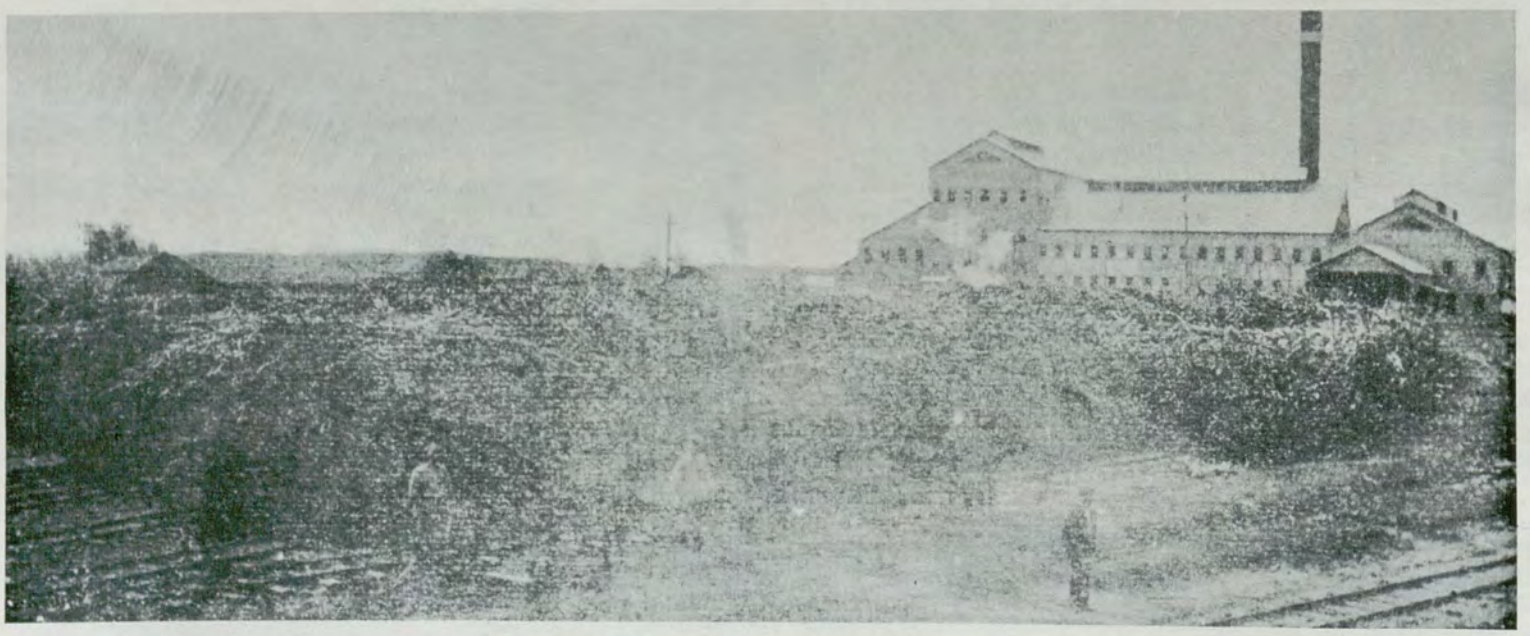


FIGURE IX - 11. *Takao-shū.*
Kohekirin mill of Formosa Sugar Co.

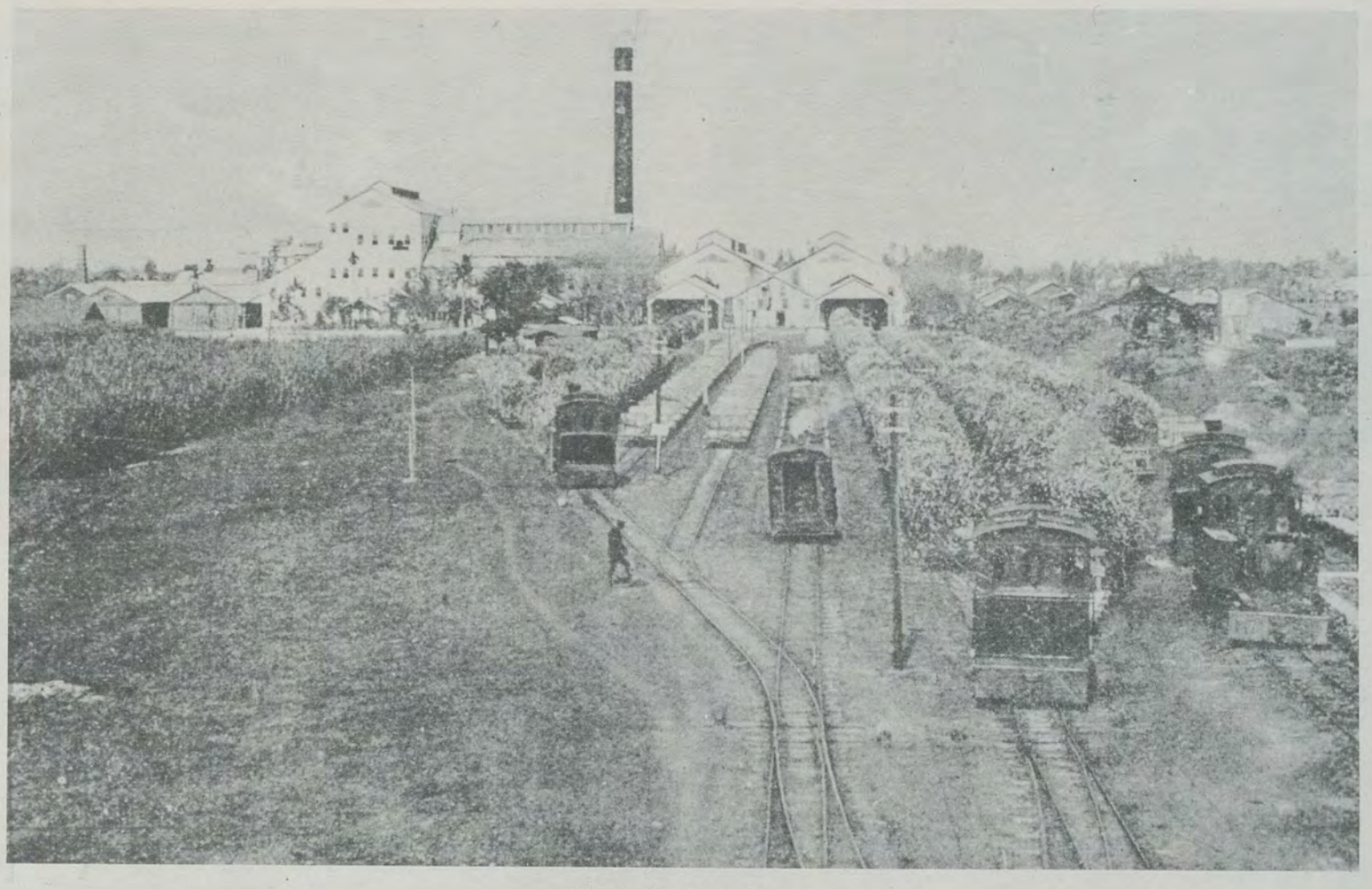


FIGURE IX - 12. *Heitō.*
Ako mill of Formosa Sugar Co.

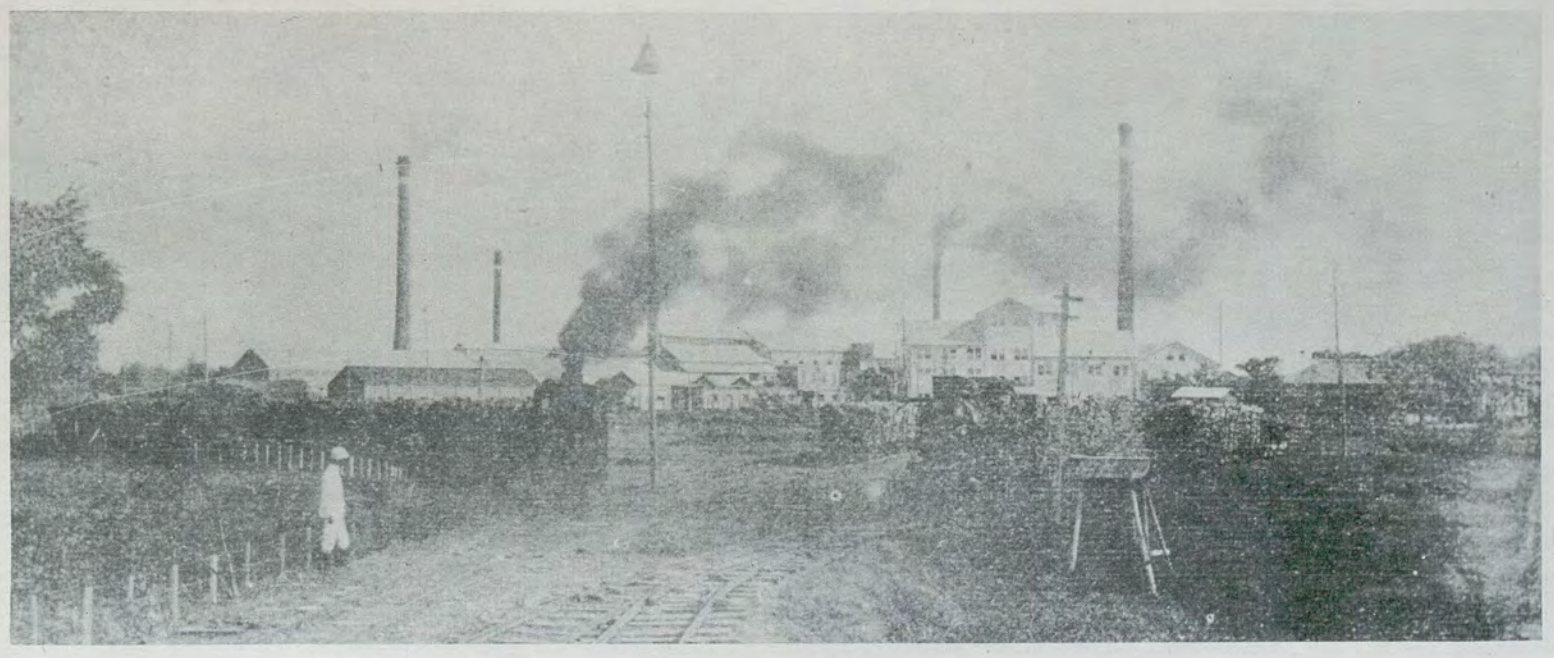


FIGURE IX - 13. *Nanshi.*
Kyoshito mills of Formosa Sugar Co.

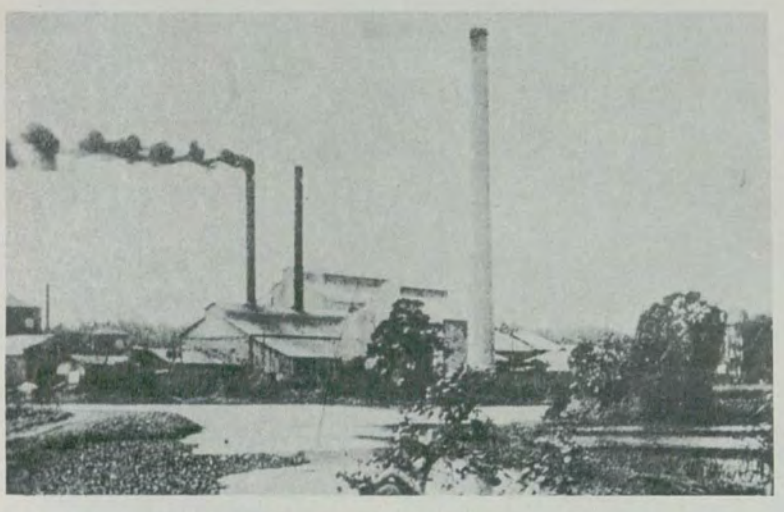


FIGURE IX - 14. *Heito.*
Sansaicho mill of Shinko Sugar Co.

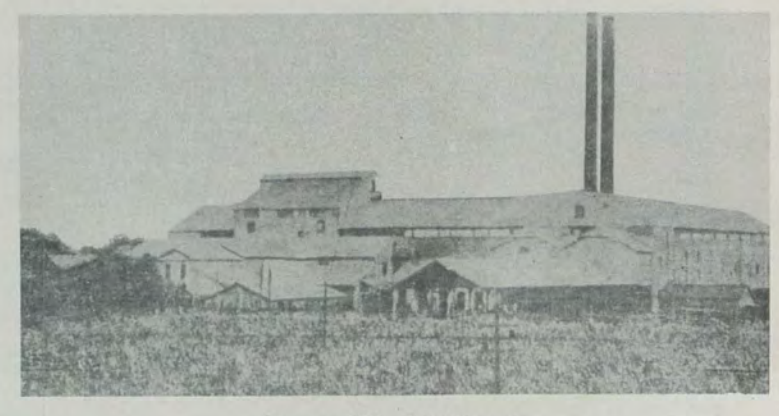


FIGURE IX - 15. *Nansei.*
Nansei mill of Oriental Sugar Co.

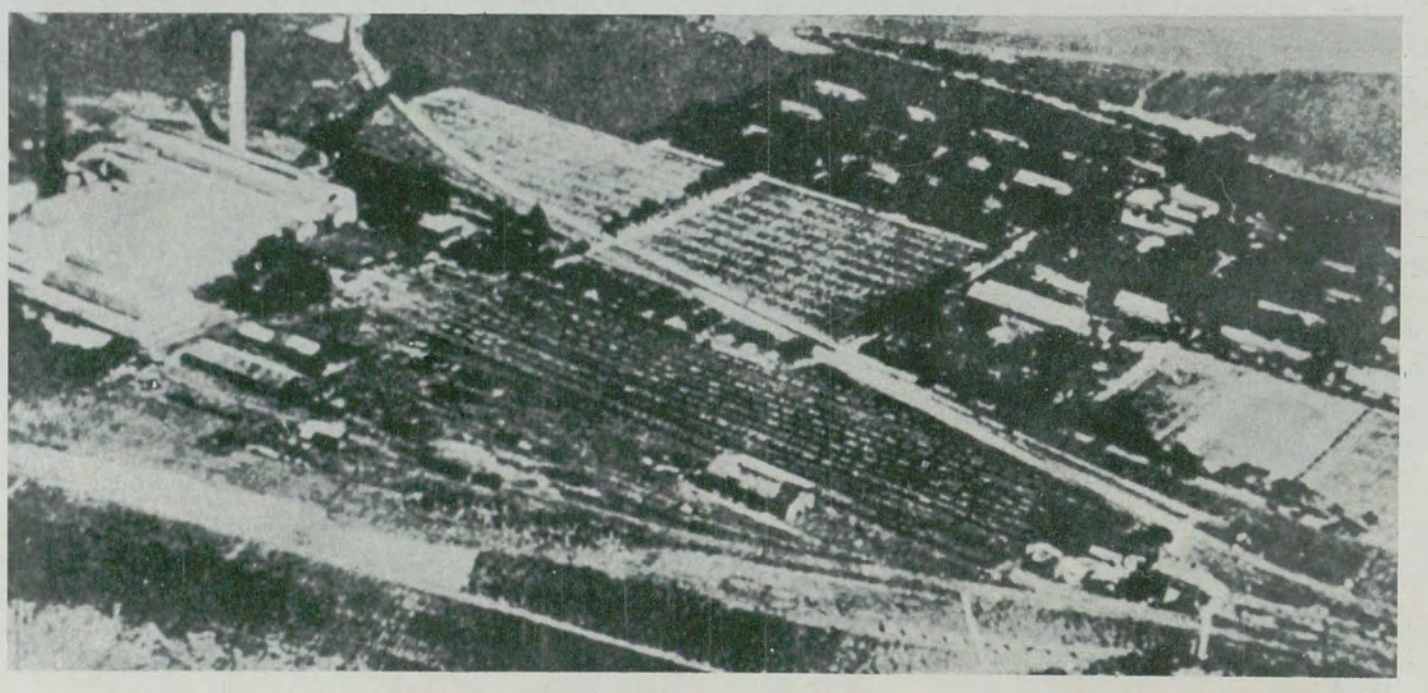


FIGURE IX - 16. *Rokukyaku.*
Santo mill of Oriental Sugar Co.

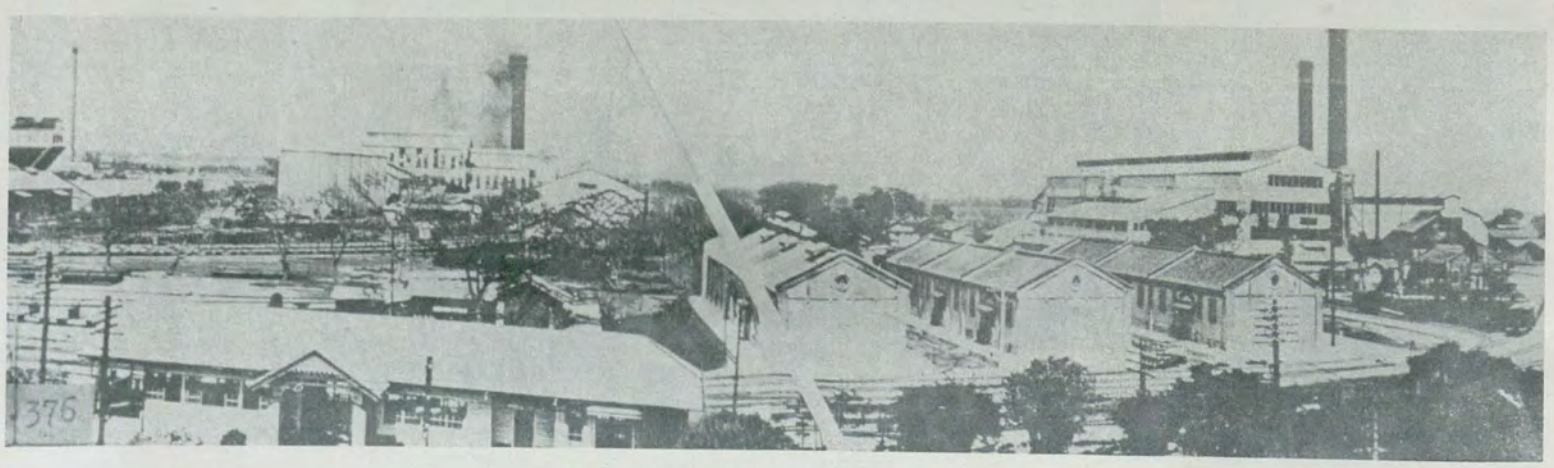


FIGURE IX - 17. *Kobi.*
Kobi mill of the Japan Sugar Co.

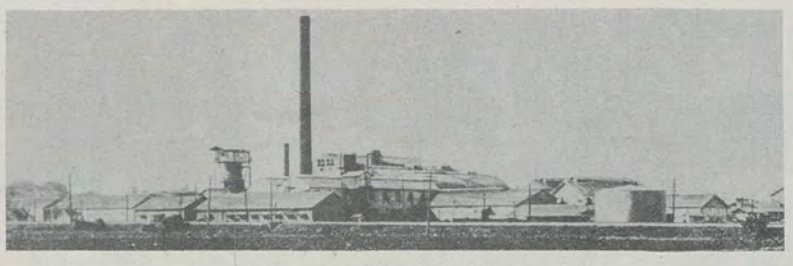


FIGURE IX - 18. *Shinei.*
Shinei No. 1 mill of Ensuiko Sugar Co.

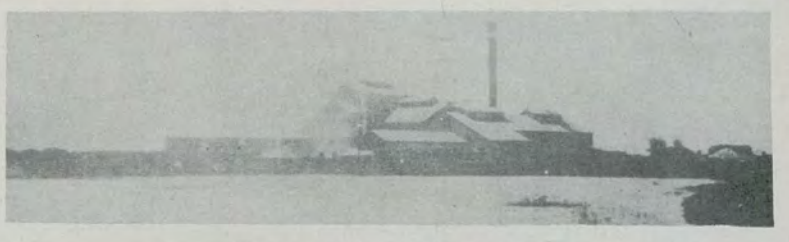


FIGURE IX - 19. *Tainan-shu.*
Sharoken mill of Formosa Sugar Co.

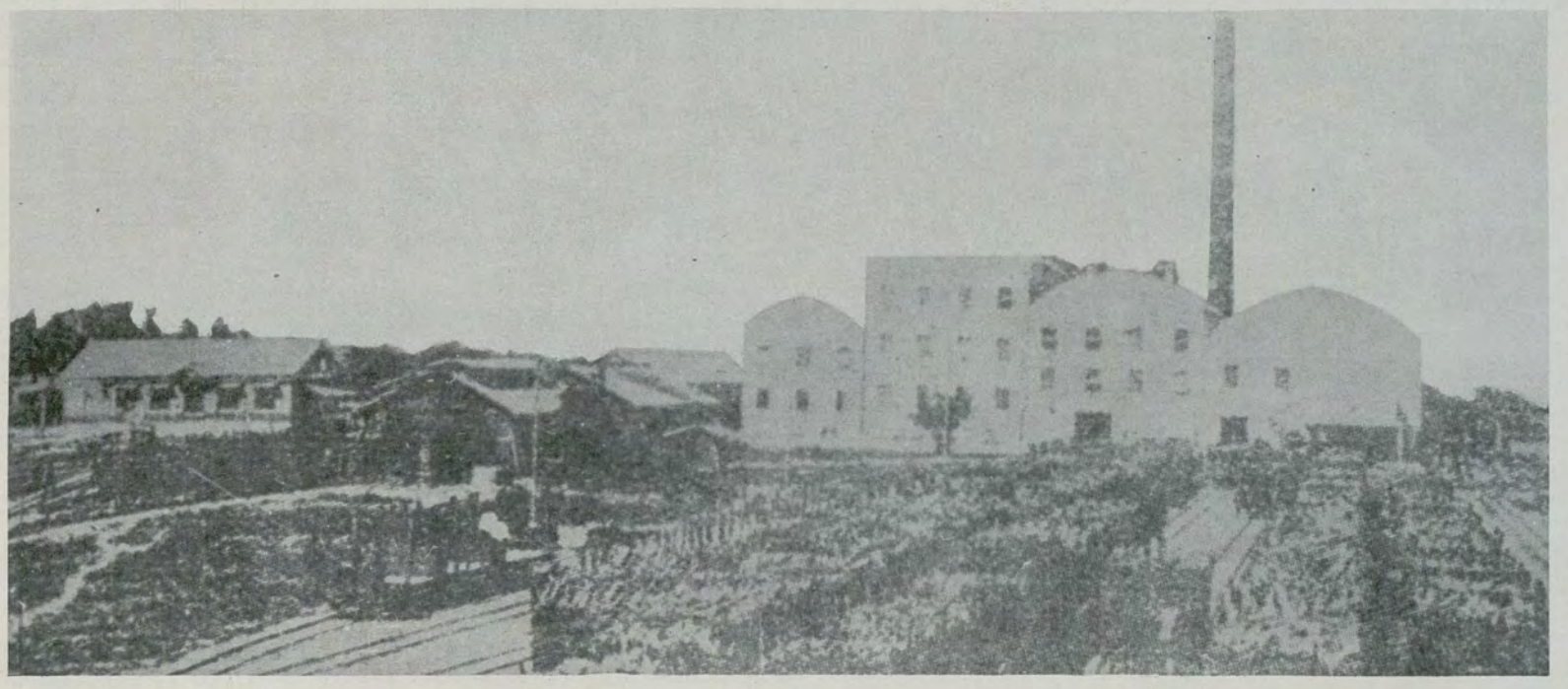


FIGURE IX - 20. *Mato.*
Soya (No. 1) mill of Oriental Sugar Co.

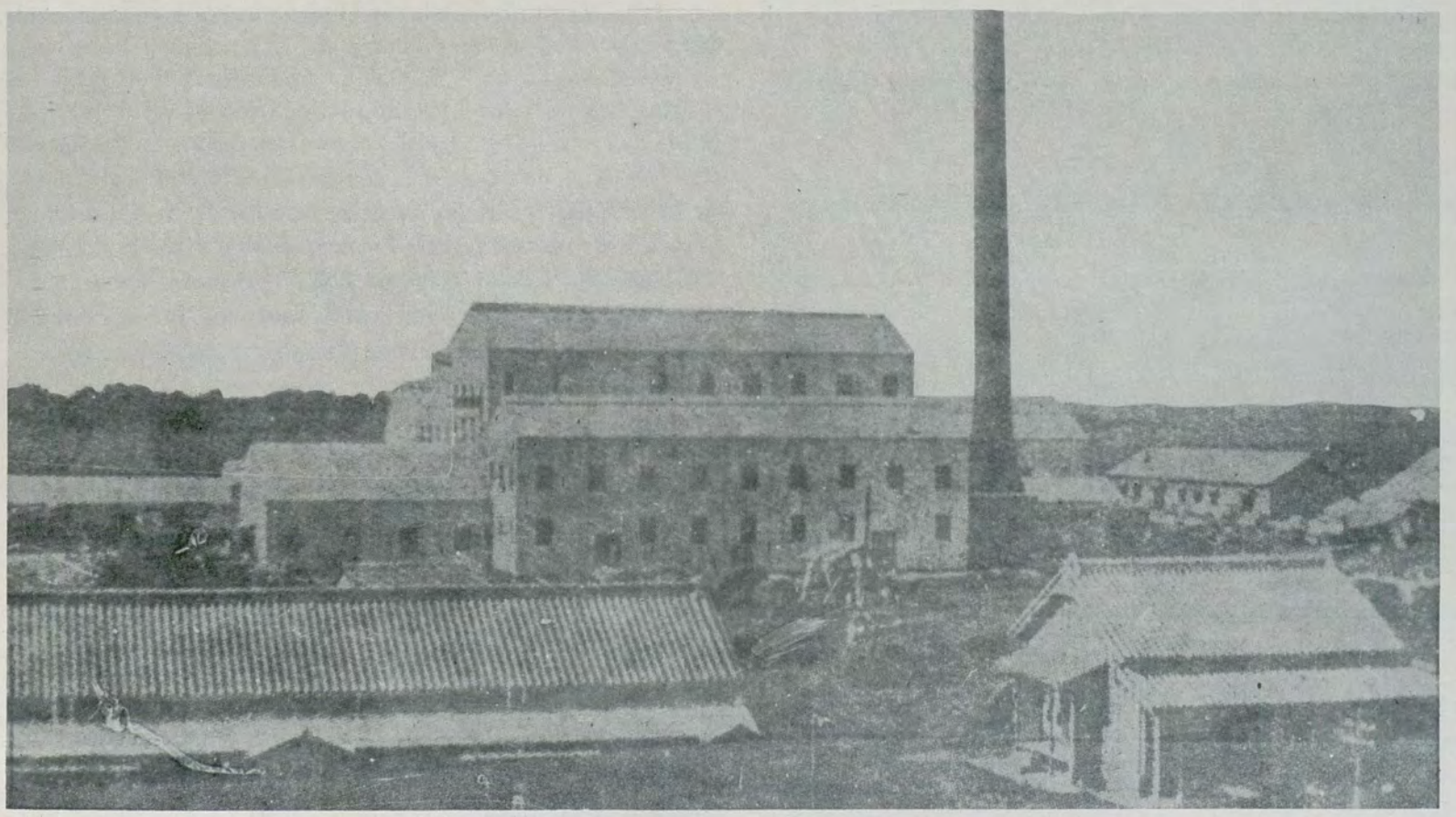


FIGURE IX - 21. *Shinei.*
Shinei No. 2 mill of Ensuiko Sugar Co.

FIGURE IX - 22. *Nantō.*
Nantō mill of Oriental Sugar Co.

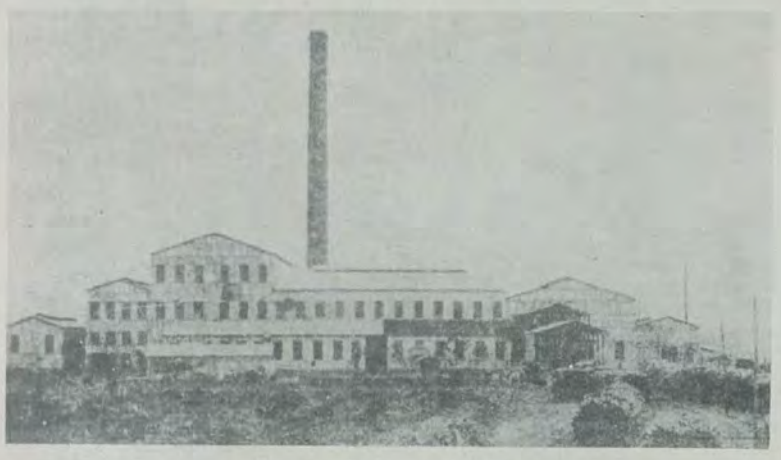


FIGURE IX - 23. *Hokkō.*
Hokkō mill of the Japan Sugar Co.

(2) *Tea processing.*

There are 12 Formosan tea-processing companies known to be in operation. TABLE IX - 17 lists these companies and the location of their factories (FIGURE IX - 26). In addition to these, the Japanese-chartered Mitsui Gomei Kaisha is considered to be the largest tea producer in Formosa (TOPIC 91, A, (2), (d)).

TABLE IX - 17

FORMOSAN TEA-PROCESSING COMPANIES

COMPANY	CAPITALIZATION (IN YEN)	DATE FOUNDED	LOCATION
Giwa Chaho K.K.	2,000,000	1935	Taihoku-shi
Kinki Seich K.K.	500,000	1932	Taihoku-shi
Sanjo Kyoei Chagyo K.K.	200,000	1938	Taihoku-shi
Taikei Chagyo K.K.	300,000	1939	Taikei-gai (Shinchiku-shū)
Taiwan Kocha K.K.	150,000	1937	Taihoku-shi
Taiwan Seicha K.K.	190,000	1939	Taihoku-shi
Taiwan Chagyo K.K.	500,000	1937	Chūreki-gai (Shinchiku-shū)
Bunzan Seicha K.K.	100,000	1938	Taihoku-shi
Mokusatsu Chagyo Korei K.K.	130,000	1928	Shinkō-shō (Taihoku-shū)
Yamato Chagyo K.K.	100,000	1940	Ryūtan-shō (Shinchiku-shū)
Eiyu Chako K.K.	600,000	1922	Taihoku-shi
Ryūtan Chagyo K.K.	180,000	1940	Ryūtan-shō (Shinchiku-shū)

(3) *Pineapple canning.*

The largest pineapple canning company is the Taiwan Godo Hori K.K. (Formosa Consolidated Pineapple Company) established in June 1935, with a capital of 7,200,000 *yen*. This company operates 77 canneries throughout Formosa, the main office being in Takao-shi. It is believed that the

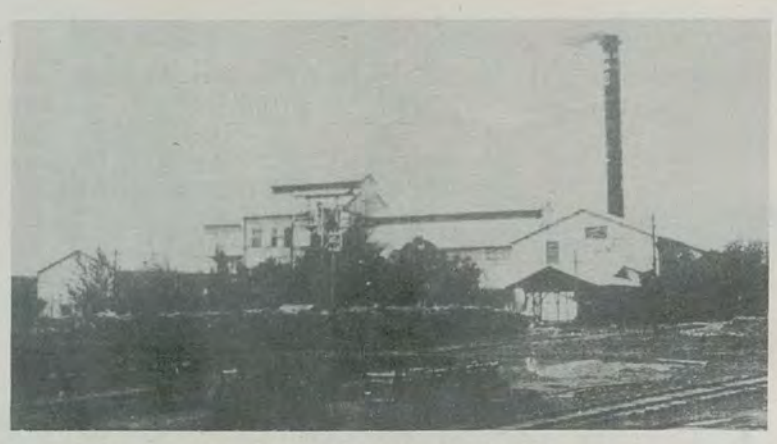


FIGURE IX - 24. *Taichū.*
Taichū mill of Taikoku Sugar Co.

FIGURE IX - 25. *Karenkō.*
Yamato mill of Ensuiko Sugar Co.

Taiwan Godo Hori K.K. exercises a monopoly over the pineapple industry. It is not known whether the Taiko Pineapple Canning Company, reported to be operating 2 large factories at Nantō and Toyohara in Taichū province at the end of 1935, is still operating independently.

(4) *Livestock products.*

(*a*) *Hides.* Production of hides in Formosa has made great advances in recent years. In 1937, 39,500 hides were produced, weighing 2,380,000 *kin* and valued at 420,000 *yen*. Within 2 years, total hide production had increased to 1,200,000 hides weighing 12,100,000 *kin*, and valued at 2,250,000 *yen*. Pig skins made up 95% of all hides in 1939. The Taiwan Seikaku K.K. (Formosa Tanning Company) in Taihoku-shi is believed to be the largest dealer in animal hides in Formosa. The Taiwan Seikaku Kogyo K.K. (Formosa Tanning Industries Company) in Taihoku-shi with the Taiwan Hikaku Hambai K.K. (Formosa Hide Tanning Sales Company) are the 2 leading dealers in leather goods, including shoes.

(*b*) *Milk.* Milk production has increased gradually in Formosa, but has not yet reached important proportions. In 1939, slightly less than 12,000 *koku* (572,400 gallons) of milk were produced, valued at 800,000 *yen*. This represented production from only 1,445 head of milk-producing animals. The Heito Kogyo K.K. in Heito-shi (Takao-shu) is believed to be the leading dealer in milk in Formosa.

(*c*) *Honey.* The production of honey in Formosa has gradually declined in recent years. In 1939, only 138,000 *kin* (184,000 pounds) of honey were produced, a decline of 320,000 *kin* from 1937 production.

(5) *Fish products.*

In 1938, 1,270,000 *kan* (10,477,500 pounds) of dried and salted fish were produced in Formosa. TABLE IX - 18 shows the distribution of this production by type of fish.

FIGURE IX - 26. *Formosa.*
Tea refinery in northern area.

TABLE IX - 18
DRIED AND SALTED FISH IN FORMOSA, 1938

TYPE	QUANTITY (in kan)
Dried bonito	17,000
Dried fish	149,000
Salted and dried fish	20,000
Boiled and dried fish	1,052,000
Salted fish	33,000

92. *Water Supply*

A. Natural availability.

(1) Surface water.

An abundant rainfall, and numerous rivers, streams, springs, and wells provide Formosa with a large natural water supply (FIGURE IX - 75). Rivers and streams, although generally polluted, are the principal sources. The large streams are perennial, but the smaller streams in the piedmont plateau and in the foothills disappear during the dry season (October-April in the north and April-September in the south). There are very few lakes, but many of the mountain streams have been dammed to provide reservoirs from which water is piped to the cities.

(2) Ground water.

Ground water is plentiful in all parts of Formosa except in the mountainous regions, where springs and shallow stream gravels are the principal sources. Most of the perennial mountain springs yield only 1,500 to 3,000 gallons per day, but at least 20 have a daily flow of more than 10,000 gallons. Although many of the springs are thermal and strongly mineralized, their water is potable. Springs contribute only minor supplies in lowland areas.

B. Developed sources.

(1) Number of waterworks.

In 1935 there were 90 water supply systems serving 1,192,100 people, and at least 28 new systems were planned underground supplies are replenished by heavy rainfall during June and July. Makō is the only city in the island group with a municipal waterworks (FIGURE IX - 27).

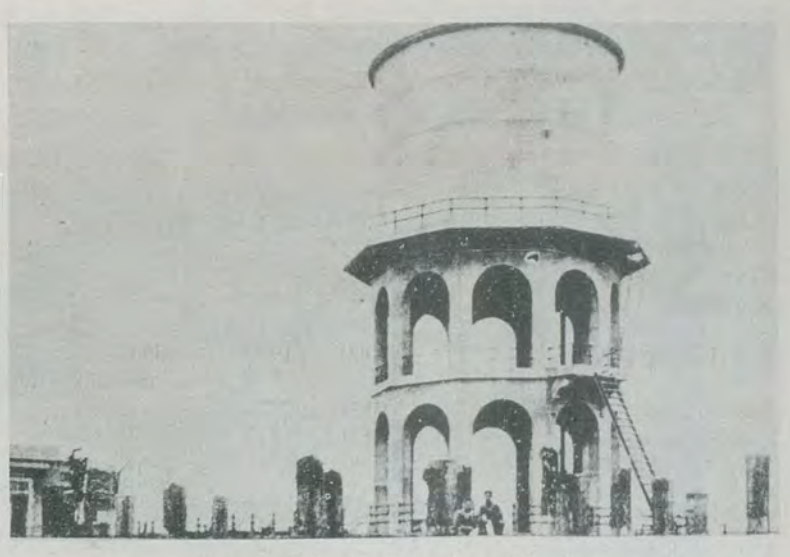


FIGURE IX - 27. *Pescadores Islands.*
Gravity-type water tower at Makō.

21. Shinchiku	26. Shōka	31. Taiko	36. Tansui
22. Shinka	27. Seira	32. Tainan	37. Tōen
23. Shinjō	28. Taichū	33. Taitō	38. Tōkō
24. Shiodome	29. Taihoku	34. Takao	39. Toroku
25. Shirin	30. Taikei	35. Tamari	40. Tōsei

(*a*) *Heitō*. A 35-acre water purification plant is located about 1 mile east of the railroad yards. Its dimensions are 1,350′ x 1,100′, and its component parts are:

1 pump house 70′ x 25′
1 building 140′ x 70′
2 large aeration ponds 15′ in diameter
2 filter basins 150′ x 90′
1 water tower 60′ in diameter
5 buildings on the south edge of the plant

The pump house is located on the bank of a small canal, 1,750′ east of the plant.

(*b*) *Kagi*. The Kagi reservoir is situated about 1½ miles east of the town and about ¾ mile south of the railroad which leads to Takezaki and Ari-san.

(*c*) *Karenkō*. Karenkō obtains its supply from the Sabato-kei about 4 miles west of the town. The system was built in 1922.

(*d*) *Kiirun*. The original waterworks at Kiirun, planned for a population of 50,000, were completed in 1902. It was estimated that the normal daily use would be about 3 cubic feet (20 gallons) per capita with a maximum per capita use of 6 cubic feet. Sento and Denryoka are supplied in addition to Kiirun.

The water is impounded in a reservoir behind a dam 50′ long and 8′ high, on the Seisei-kei, a tributary of the Kiirun-kei. From the reservoir the water flows by gravity to shaft No. 1. Here there are 3 valves, one of which controls the water flowing to shafts No. 2 and No. 3, while the other 2 are outlets for water flowing to the settling basin.

The settling basin measures 121′ x 79′ x 15′ and has the capacity to supply a population of 30,000 for 1½ days with normal water consumption (provided the basin was being drained).

There are 2 filters, each with a capacity of about 430,000 gallons. Enough water is filtered in one day to furnish 30 gallons per capita for 30,000 people. The filtered water goes to shaft No. 3 from which point it is sent to the city in 14″ pipes. These pipes pass over the railroad bridge and through the tunnel at Hatto. Near the tunnel the main pipe divides into 10″ lines at a water meter. Mains of smaller diameter handle distribution. There are 56 public hydrants throughout the city.

Since 1934, when the waterworks were enlarged, good water has been abundant. Conduits have been built to supply ships with water at 25 places on the quays and 7 on the landing stages. Two of the conduits at the landing stages can each supply 6,720 gallons of water per hour. The other conduits can each supply 1,568 gallons per hour.

To prevent a possible water shortage a second reservoir-dam has been built in the stream not far below its confluence with the Tosei-kei. From that point a steam pump can deliver water either directly to the city, or to shaft No. 1.

(*e*) *Shōka*. A concrete dam has been built on bed rock across a stream about 8/10 mile east of the city. The water is led to a reservoir through 2 iron pipes, whence it flows to the city by gravity in 8- , 6- , and 4-inch iron mains, the dam being 75 feet higher than the city. The surrounding hills have been planted with trees to control run-off.

(*f*) *Suō*. Three springs behind Suō provide plenty of water of good quality. At one, a reservoir has been constructed. Water from the Shuto-kei is used for drinking and bottling, but in the winter rainy season the water becomes muddy. The water in a stream which empties at the west end of the head of Suō-wan is turbid and impure, but good for general purposes. It is used for drinking purposes by the natives. Facilities for pumping 2,240 gallons of water per hour are provided at the wharf.

(*g*) *Taihoku*. Deep wells in the district of Taihoku are inadequate to meet the needs of the city without seriously lowering the water table, thus endangering supply. Supplementary supplies are taken from the Shinten-kei, at a point about 2¼ miles southeast of the city (Figure IX - 28). The

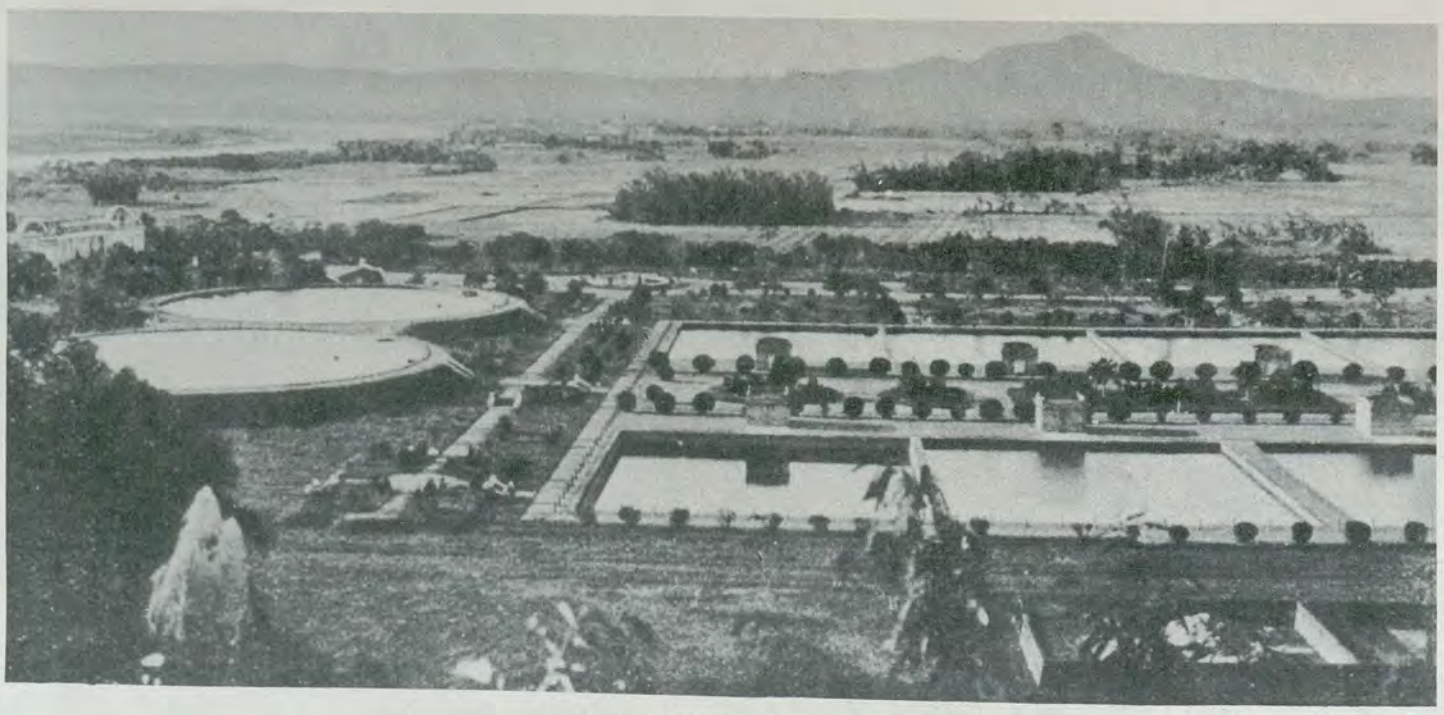


Figure IX - 28. *Taihoku*.
Waterworks before 1931, looking E. ~~Settling ponds in foreground, filtering wells to left.~~
Slow sand filters in foreground, sedimentation basins to left.

or under construction. Forty of the 90 established systems were located in the following cities and towns:

1. Ampin	11. Karenkō	21. Shinchiku	31. Taikō
2. Bokushi	12. Kiirun	22. Shinka	32. Tainan
3. Byōritsu	13. Kimpori	23. Shinjō	33. Taitō
4. Ensui	14. Kizan	24. Shiodome	34. Takao
5. Giran	15. Kōshun	25. Shirin	35. Tamari
6. Heitō	16. Makō	26. Shōka	36. Tansui
7. Hokutō	17. Matō	27. Seira	37. Tōen
8. Hori	18. Nantō	28. Taichū	38. Tōkō
9. Hōzan	19. Rokko	29. Taihoku	39. Toroku
10. Kagi	20. Sansei	30. Taikei	40. Tōsei

(2) *Sources of water.*

(*a*) *Rivers.* The principal supplies are drawn from rivers and streams, which are generally contaminated. Numerous cities and towns obtain their water from the mountains, where it is stored in dam-contained reservoirs and piped to the cities through mains. Kagi, Kiirun, Sansei, Shōka, Taihoku, Taikō, Tainan, Takao, and Tamari are some of the larger cities which depend upon river supplies.

(*b*) *Ground water.* Many of the municipal systems draw their water from springs, and from dug and drilled wells. The water from such sources is generally distributed without treatment. Hokutō, Shirin, and Tansui are among the cities which obtain their supplies from springs, while Kimpori, Taichū, and parts of Taihoku depend upon drilled wells. Artesian wells are particularly numerous in the Tainan-Kagi district and in the area around Taihoku.

Dug wells are rare in upland areas, but supply a large part of the water used in rural lowlands. These wells, mostly less than 50 feet deep, are equipped with hand pumps, buckets being forbidden for sanitary reasons.

(3) *Installations.*

Dams are constructed of concrete or stone, and are generally less than 10 feet high. The dam in the Kiirun system, with a length of 100 feet, is one of the largest in Formosa. The reservoirs are small.

Intakes are generally brick or concrete structures ranging in size from about 7 feet square to 17 x 14 feet. The intake at Taihoku, however, consists of a 26-inch perforated iron pipe buried below the bed of the Shintenkei. Water is filtered as it enters the pipe.

In several systems the water must be pumped from the source installations to the purification facilities or to the clear-water reservoirs. Distribution to the consumer, however, is always by gravity flow.

(4) *Treatment.*

Urban supplies drawn from rivers are settled and often filtered, but are not known to be treated chemically. Although purification facilities have been improved and expanded in recent years, all water should be boiled or chlorinated before drinking. These precautions apply to bathing water as well, because of the prevalence of flukes.

(5) *Per capita supply.*

The per capita supply varies between 22 and 168 gallons per day. The majority of the systems have low capacities.

FIGURE IX - 29. *Taichū.*
Artesian well N of railroad station, before 1931. Water pumped to top of building and distributed by gravity.

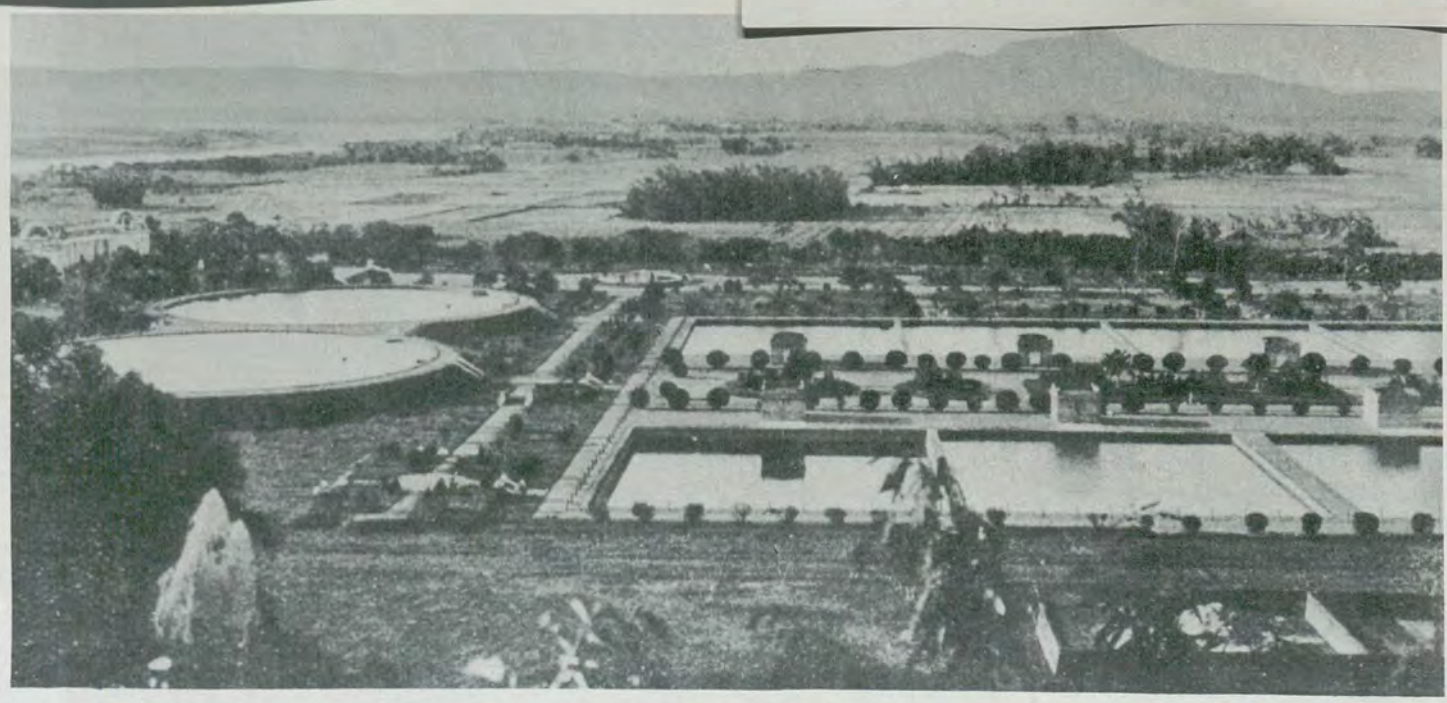


FIGURE IX - 28. *Taihoku.*
Waterworks before 1931, looking E. ~~Settling ponds in foreground, filtering wells to left.~~ SLOW SAND FILTERS IN FOREGROUND, SEDIMENTATION BASINS TO LEFT.

(6) *Table of waterworks.*

Most of the information contained in the table of waterworks is as of 1927 or 1937. The 1944 information has been derived from aerial photographs. Table IX - 19 presents details on 23 of the 90 waterworks reported to be in existence in 1935.

TABLE IX - 19
WATERWORKS OF FORMOSA

City and Population (1939)	Date of Information	Population Served	Per Cap. (gpd)	Source	Source Installations H: Height L: Length D: Depth T: Thickness	Purification Facilities	Clear Water Reservoirs	Remarks
Heitō 54,766	1937	9,792	168	Takao System (1927) New waterworks.	Pump house 70′ x 25′	2 settling ponds each 150′ in diameter and 2 slow sand filters 150′ x 90′ (1944). See remarks.	1 tank 60′ in diameter (1944). A recorded depth of 11.5′ (1927) may apply to this feature.	Maximum capacity of system 2,642,000 gallons per day. System includes 27 miles of pipe. Air photo (1943) shows the purification plant on east side of city.
Hokutō	1927	4,000 (estimated)	22	Spring waters of Horisentaku and Hentōsen.	Intake structure L: 7½′ W: 5′ H: 2¼′.	Apparently none. Water led from intake to water tank by 4-inch pipe.	Water tank.	Gravity system.
Hōzan	1944					Settling pond, 160′ in diameter. 4 filters.		Plant under construction several miles E. of town. Other installations measuring 1350′ x 720′ are shown in the same area.
Kagi 92,428	1937	47,293	56	Gyuchukei	2 dam-contained reservoirs connected by elevated concrete pipe. (1927). See remarks.	Settling pond, 125′ x 125′ x 15′.	Reservoir, 84′ x 73½′ x 11¼′. See remarks.	Gravity system. Maximum capacity 2,939,000 gallons per day. System includes 29 miles of pipe. A water-distribution building is mapped (1930) in NW quadrant of the city. A reservoir is plotted on a map (1943) 1½ miles E of city. An air photo (1944) shows 12 circular and 2 rectangular storage ponds 4 miles SW. of the center of the city; 2 dam-contained reservoirs 1 mile S; and an aqueduct. The relation of these installations to the water supply is unknown.
Karenkō	1927	10,000 (estimated)	33 (est.)	Hokitan Gulch of Shabashikei, at Basekkusha.	Concrete well, inside diameter 15′, depth 22′.	Settling pond, 100′ x 60′ x 11′.	Reservoir, 53′ x 44′ x 11½′.	Gravity system. A map (1937) shows a large reservoir on the NE side of the city.
Kiirun 100,511	1936	52,114	58	Seiseikei	Concrete dam L: 100′ H: 10′.	Settling pond, 125′ x 80′ x 15′. 2 filters.	Reservoir, 97′ x 86′ x 12′.	Maximum capacity of system 5,073,000 gallons per day. Water pumped between intake and settling pond. Elsewhere the flow is by gravity (1927). System includes 39 miles of pipe.
Kimpori	1927	4,300 (estimated)	22	Artesian well 75 feet deep, west side of Kimpori.	Water tank, 10′ square, 13′ high. 4-inch water pipe.	No settling pond. No information on other purification facilities is available.	None.	Gravity system.
Kōshun Stock farm	1927			Springs on side of Kinshisan	Small concrete dam.	No settling pond. No information on other purification facilities is available.	None.	Gravity system.
Makō	1944						Water tower in NE. section of Makō.	Pump house 2 miles E of town.
Matō	1944							Reservoir 3 miles long in the vicinity of Matō. Unknown relation to water supply.
Rokko	1944				Dam L: 2600′. Reservoir L: 3¼ mi. W: 2½ miles.	4 basins 50′ x 95′. 2 basins 30′ x 30′. 1 basin 30′ x 50′. 1 basin 30′ x 95′.		2 tanks each 80′ in diameter. Water works installations 2 miles SSE of town, dimensions 500′ x 550′.
Sansei	1927			Kanshi-kei	Concrete dam H: 3′. L: 30′. T: 2′.	No settling pond. No information on other purification facilities is available.	None.	Gravity system.

water moves to the pump shaft through a reinforced concrete pipe and a masonry waterway.

Three electrically driven pumps lift the water from the pump shaft into a second shaft connected by 14″ pipes to settling ponds. Each pump is capable of lifting 1,650 gallons per minute to a height of 50 feet.

Two circular, reinforced, concrete settling ponds, 170 feet in diameter and 15 feet deep, have been installed. The side walls are 1 foot thick at the top and 3 feet at the bottom. The combined capacity of the 2 ponds is about 3,700,000 gallons. Settling takes about 1½ days. A third pond may have been constructed in recent years. Daily consumption is about 20 gallons per capita.

The water leaves the settling ponds through 3 circular brick wells, 9′ deep and 15′ in diameter, which are connected with the filtering ponds by 14″ iron pipes.

Filtering is taken care of in 8 concrete ponds, each 125′ long, 100′ wide, and 10′ deep. The water passes through 2 layers of closely packed bricks overlain by 1½ feet of gravel, topped by 3 feet of sand. At each corner of the filtering pond, 6″ overflow pipes permit floating particles to flow out with the excess water. The probable maximum capacity of the 8 filters is about 5,700,000 gallons per day.

The filtered water is pumped to 2 ventilated concrete reservoirs each 90′ long, 86′ wide, and about 14′ deep. The north—south walls are 3′ thick and the east—west walls, 4′. Over 2 feet of soil and 1 of sand cover the concrete roofs.

The water is kept constantly on the move, and to ensure effective circulation each reservoir is provided with 5 stream guide brick walls. These walls and additional square brick pillars also support the reinforced concrete beams of the roof.

The water flows from the reservoirs into an intake well through 14″ pipes. This well, 12′ deep, 10′ wide (inner dimensions), is covered by a house 13′ x 15′. From the intake well the water is delivered to the city by gravity through two 20″ cast iron mains, 12,000 feet long. The fall is 101 feet. Valves are installed along the mains at distances ranging from 1,100 to 1,800 feet, with hydrants at every 475 feet. The water supplied to the city is not considered sufficiently pure for drinking, and boiling is necessary.

(*h*) *Tainan*. One water conduit is available at Tainan and Ampin, but is not accessible to ships in the outer anchorage.

(*i*) *Takao*. Water is taken from the Shimo Tansui-kei at Chikushiryo and pumped to Shoheicho reservoir 200 feet above the river. From there it passes through settling and filtering ponds whence it goes to an aeration pond about 12 miles to the southwest and 120 feet lower. Gravity flow is utilized.

The brick intake is 15′ long, 12′ wide, and 20′ deep. Two 20″ pipes connect this with an elliptical pumping well measuring 20′ x 14′ and 23′ deep, from which the water is pumped to Shoheicho reservoir through a 12″ iron pipe. There it passes through 2 settling ponds and a purification pond en route to the distribution mains by 14″ mains. Provision is made for by-passing the settling ponds.

Ships may obtain excellent water from the city system at the dock, and from 21 water boats at the mooring, one at the small Niihama dock, and one at the south coast mooring, each capable of delivering approximately 5,000 gallons per hour. Ships in the offing receive water from the Hagiware Ship Yard.

(*j*) *Tansui*. Tansui receives its water supply from a large spring at Soshunto which yields 1,768,800 gallons per day. The flow does not vary with weather conditions, insuring a constant supply. Temperature varies between 70 and 75 degrees F. With protracted rain showers the water becomes cloudy, but purity is not affected.

The water passes through a cement conduit into a stone reservoir approximately 12′ x 6′ x 9′, from which it is led to Tansui by a 10″ iron pipe. The distributing system is made up of pipes with diameters ranging from 10 to 3½ inches. Fifteen hydrants are available for public use.

There are no regular water boats at the dock, but water can be taken on from junks or sampans. A valve which can pass 300 gallons of water per hour is located about 260 feet south-southeast of the high range light.

(2) *Small sources of supply.*

Kashō-tō, Shinkō-hakuchi, Ryūkyū-sho, Taichū (Figure IX - 29), and Tokotsukutsu all obtain their water supplies from wells and springs.

Tables IX - 19 through IX - 26 give further details on Formosan water supply systems.

Table IX - 19
CONSTRUCTION DATES AND SOURCES OF WATER FOR WATERWORKS

Name of System	Source of Water	Date of Construction
Heitō	Pumping water at branch wells at Takao Reservoir	July 1914—Unknown
Hokutō	Hori	Mar. 1911—June 1911
Kagi	Gyuchu-kei	July 1911—Mar. 1915
Karenkō	Heki-tan, Shabatei-kei at Basekku-sha (shrine)	April 1917—Unknown
Kiirun	Toseki-kei and Seisei-kei of the upper course of the Kiirun-gawa	Mar. 1898—Mar. 1902
Kimpori	75′ well at west end of Kimpori	May 1910—July 1910
Kōshun	Springs on side of Kinshi-san	Feb. 1912—Mar. 1912
Sansei	Kanshi-kei	Dec. 1913—Mar. 1914
Shinka	Branch of Tainan Aqueduct	Feb. 1918—Unknown
Shirin	Springs on mountain in Sokei-shō	Mar. 1911—May 1911 but Maruyama Sept. 1912
Shōka	Unnamed streams on Koshinai and Hakke Mts.	May 1906—Mar. 1908
Taichū	Underground artesian well 43′ deep, 20′ diameter	Dec. 1914—Mar. 1917
Taihoku	Shinten-kei	Apr. 1907—June 1909
Taiko	Streams in Santyoku-shō	Oct. 1911—June 1912
Tainan	Sobun-kei	Apr. 1912—Unknown
Takao	Lower Tansui-kei	June 1910—Dec. 1913
Tamari	Imafuku-kei	Aug. 1911—May 1912
Tansui	No. 3 & 4 springs at Soshunto	Sept. 1896—Mar. 1898
Toroku	Underground streams in Keishitei	Jan. 1912—Dec. 1912

TABLE IX - 20

CAPACITY OF WATERWORKS

NAME OF SYSTEM	AREA SUPPLIED	DAILY	CAPACITY IN GALLONS PER CAPITA AV. PER DAY	CAPACITY IN GALLONS PER CAPITA MAX. PER DAY	HEAD
Heitō	Whole city	198,000	20	40	About 200 feet
Hokutō	Bathing place and station	No details	20	40	236 feet
Kagi	Whole city	891,000	20	No details	153 feet
Karenkō	Whole city	297,000	No details	40	200 feet
Kiirun	Whole city	1,551,000	20	40	80 feet
Kimpori	Whole city	No details	20	40	Weak water pressure
Kōshun	Stock farm	No details	No details	No details	174 feet
Sansei	Whole village	No details	No details	No details	No details
Shinka	Whole city	No details	No details	43	No details
Shirin	City and Maruyama	148,500	No details	No details	58 feet
Shōka	Whole city	No details	20	No details	58 feet
			40	80	90 feet
			20	40	117 feet
			20	No details	54 feet
			20	40	200 feet
			No details	33	127 feet
			No details	No details	No details
			20	45	No details
			20	40	About 170 feet

IX - 21

DS OF DISTRIBUTION

		METHOD OF DISTRIBUTION
	E	By natural gravitation.
	ke is 7½′ long, 5′ wide, and 2¼′	By natural gravitation.
	ower dams, diameter 1½′ to 2′.	By natural gravitation.
	ep.	By natural gravitation.
Kiirun	A dam 150′ long. Each intake 10′ high.	Natural gravitation flow from intake dam to settling pond.
Kimpori	Water tank, 10′ square, 13′ high. Forwarding pipe 4″.	By natural gravitation.
Kōshun	Rock-pile dam.	By natural gravitation.
Sansei	Concrete reinforced dam, 30′ long, 2′ wide, and 3′ high, 4″ pipe to intake well.	By natural gravitation.
Shinka	Branch lines at about every 8,100 yards on the main pipe line.	By natural gravitation.
Shirin	A pile of rocks around the intake and a shack on top of it 17′ long, 14′ wide. Covered ditch leads to distributing well.	A pump is used at Jinja and the rest is by natural flow of gravitation.
Shōka	Intake submerged. Brick dam is 9′ high.	By natural gravitation. There is a conservation forest.
Taichū	Water is raised by volution pump and underground filtered water is sent immediately to intake assembly well.	By natural gravitation.
Taikō	Concrete intake at a depth of 8′.	By natural gravitation.
Tainan	Concrete intake 15′ long, 12′ wide, and 11′ deep.	Water is pumped to storage basin and then flows by natural gravitation.
Taihoku	Intake is 8 yards from shore of the river at a depth of 28⅘′. Its inner dimensions are 10½′.	Natural gravitation flow from intake to purifying pond.
Takao	Concrete intake 15′ long, 12′ wide, and 20′ deep. Inner diameter of assembly well is 15′, and 9′ deep.	Water is raised by a gate to storage basin and then flows by natural gravitation.
Tamari	Rock-piled closed gate.	By natural gravitation.
Tansui	Covered reservoir made of rock.	By natural gravitation.
Toroku	Conduit, 2′ wide, 2′ deep.	By natural gravitation.

TABLE IX - 19 (*Continued*)

CITY AND POPULATION (1939)	DATE OF INFORMATION	POPULATION SERVED	PER CAP. (GPD)	SOURCE	SOURCE INSTALLATIONS H: HEIGHT L: LENGTH D: DEPTH T: THICKNESS	PURIFICATION FACILITIES	CLEAR WATER RESERVOIRS	REMARKS
Shinchiku 59,139	1937	21,325	51			1 basin 80′ x 160′. 1 basin 50′ x 50′. 2 basins 80′ x 130′. 6 basins 80′ x 110′.	Probably underground storage tank 65′ x 100′.	A possible purification plant consisting of 5 ponds, 110′ x 75′ is shown in an aerial photograph (1944). System includes 17 miles of pipe. Waterworks installations 570′ x 800′, 1½ miles ENE of town (1944). 2 reservoirs 4000′ ENE of town, dimensions are 65′ x 160′, and 150′ x 500′ (1944).
Shinka	1927	6,500 (estimated)		Tainan water supply system.				Gravity system. No individual treatment for Shinka.
Shirin	1927	5,000 (estimated)	33 (est.)	Springs on mountain in Sokei-shō.	Stone intake structure 17′ long and 14′ wide.	Apparently none. Water conducted by a covered ditch from intake to distribution reservoir.	Reservoir.	
Shōka	1927	20,000 (estimated)	22	Unnamed river at Kōshinai.	Concrete intake weir 9′ deep. Brick intake well 12′ in diameter and 8′ deep.	No settling pond. 2 basins each 70′ x 280′ (1944).	Reservoir 62′ x 60′ x 9′.	Gravity system. Waterworks installations 320′ x 400′, 2100′ E. of town (1944). Tank, 125′ in diameter and probable covered reservoir, 80′ in diameter (1944).
Taichū	1937	28,940	56	Artesian well 43 feet deep, 20 feet in diameter.	Pump. Sends water from artesian well to reservoir (1927).	Apparently none (1927).	Reservoir 70′ square (1927).	Maximum capacity of system 2,206,000 gallons per day. Gravity system from reservoir.
Taihoku 326,407	1936	181,918	42	Shinten-kei. Also drilled wells (Cf.p.3, (b)).	26-inch iron pipe buried 29 feet below the river bed, and leading to an intake structure 10½′ in diameter (1927).	2 circular concrete settling ponds, 170′ in diameter, 15′ deep, and with a combined capacity exceeding 4,200,000 gallons (1927). 8 slow sand filters 125′ x 100′ x 10′ each (1944).	2 adjoining reservoirs, each 90′ x 86½′ x 14′ (1927).	Maximum capacity of system 14,030,000 gallons per day. Gravity system after purification. Waterworks installations 600′ x 750′, 2 miles SE of town, and probable covered reservoir 210′ x 240′, 3 miles N of town (1944). 2 tanks 90′ in diameter (1944).
Taikō	1927	5,000 (estimated)	22	Streams in Sankyaku-shō.	Raw-water reservoir at intake, depth 8′.	Settling pond, 66′ x 66′ x 14′.	Reservoir, 38′ x 14½′ x 9′.	Gravity system.
Tainan 142,133	1937	44,801	51	Sobun-kei	Reservoir, 300′ x 600′ is reported at W. edge of town (1944). Concrete intake 15′ x 12′ x 11′ (1927).	Settling pond, 180′ x 140′ x 12′ (1927). Rapid sand filters.	2 reservoirs on a hill near Sobun-kei. The dimensions, 102½′ x 89½′ x 13½′, probably apply to each reservoir individually (1927).	Maximum capacity of system 4,489,000 gallons per day. Water pumped to storage well; remainder of system operates by gravity flow (1927).
Takao 152,265	1937	61,008	54	Tansui-kei	Reservoir, 50′ x 140′, at W. edge of town. 2 reservoirs 3½ miles NE. of town 150′ x 300′ and 500′ x 1000′ (1944). Brick intake, 15′ x 12′, and 20′ deep. 2 collecting wells each 15′ in diameter and 9′ deep. 1 pumping well, 20′ x 14′, and 20′ deep (1927).	Brick distributing well, 15′ in diameter and 6′ deep. 2 settling ponds, each 125′ x 100′ x 14′ (1927). 4 filter beds SE. of town, 2 of which are 60′ x 60′ and 2 are 60′ x 155′ (1944).	2 reservoirs, 83′ x 77′ x 12½′. (1927).	Gravity system after distributing pond. Capacity of system 10,568,000 gallons per day. (1937). A waterworks installation is mapped (1943) about 200 yards N. of the inner harbor. Expansion after 1937. Not all of the installations described in the table necessarily belong to one system.
Tamari	1927	5,000 (estimated)		Imafukukei	Stone dam.	No settling pond. No information on other purification facilities is available.	None.	Gravity system.
Tansui	1927	20,000 (estimated)	22	No. 3 & 4 springs at Sōshuntō.	Two reservoirs at N. edge of town, 45′ x 60′ and 60′ x 90′. Covered masonary intake.	No settling pond. No information on other purification facilities is available.	Unknown.	Gravity system.
Toroku	1927	5,500 (estimated)	22	Underground stream in Keishitei.	Covered ditch, 2′ wide, 2′ deep. 6-inch pipe leads from intake to distributing reservoir.	Apparently none.	Reservoir (?)	Gravity system.

93. Construction Materials

With the exception of lumber, brick, and tile, Formosa produces very few construction materials. The island is not self-sufficient even in lumber production despite the extensive forest resources, partly because some of the best timber land is located at great elevations on almost inaccessible mountains. Moreover, the Government-General has discouraged heavy cutting of trees in an announced effort to conserve existing resources. Some lumber is exported to Japan, China, and the Kwantung Leased Territory but a greater amount is imported, mostly from Japan.

Cement is the only other construction material produced in an appreciable amount. It too, however, is imported in much greater quantities than it is exported.

There were 638 ceramics factories employing 9,000 Formosan-Chinese and 100 Japanese at the end of 1935. Exactly how many of these plants produce bricks and other construction materials is not known, although in 1937 the value of bricks, tiles, and cement constituted 1/8 of the total value of ceramics.

An asbestos mine, covering an area of 3,404,900 square yards, was in operation in Formosa in 1939. Plate glass and sheet glass were being produced by the Taiwan Kagaku Kogyo K.K. (Formosa Chemical Industry Company) at Chikutō-gai (Shinchiku-shū) in recent years.

The following units of measurements are used in this section:
shakujime equals about 12 cubic feet
koku equals 10 cubic feet
cho equals 2.45 acres

A. Wood.

Both soft and hard woods are produced in Formosa, including Formosan cypress, hemlock, pine, laurel, oak, cedar, camphor, and hibiscus. These woods are used for buildings and ship construction, crytomeria (Japanese cedar) being especially useful for the latter. An official survey of 1932 estimated there were 136,792,000 cubic meters of broad-leaved trees and 70,902,000 cubic meters of conifers or total timber stands of 207,694,000 cubic meters. There are an estimated 5,825,000 acres of forests and scrub in Formosa, or almost 2/3 of its total area. About 4/5 of this forest acreage (the majority at high elevations) is forest land; about 1/5, scrub land.

Extensive forests are also located in the valley of the Dakusui-kei (Taihoku-shū) and in some parts of Karenkō prefecture. Ari-san is the most famous forest area in Formosa and ranges over areas of from 2,800 to 8,700 feet elevations above sea level. Red cypress, mongolian oak, and hemlock cover this mountain, some trees being 3,000 years old. Conifers such as pine, spruce, red cypress, and hemlock, with a potential yield of over 8,000,000 shakujime (or 96,000,000 cubic feet), and broad-leaved trees (largely oak), with a potential yield of over 18,000,000 shakujime (or 216,000,000 cubic feet), grow on Ari-san. This area is considered a source of primary importance for Japanese shipbuilding, naval arsenal, and dockyard operations. In 1933, the Ari-san forests produced 3,000,000 cubic feet of logs.

Nimandaira, on the slope of Ari-san is connected to Kagi-shi, the lumber mill center, by a 30-inch gauge railroad 46.6 miles long, built in 1913. The Forestry Bureau of the Government-General carries on logging operations with American rope-way lumber conveyors and other modern, mechanical equipment.

Taihei-san, near Ratō-gai in Taihoku province, and Hassen-zan, northeast of Taichū-shi, are also good sources of lumber and are not so extensively cut as the Ari-san forests.

The potential yield of Hassen-zan is almost 3,500,000 shakujime (or 42,000,000 cubic feet) of conifers and almost 5,000,000 shakujime (or 60,000,000 cubic feet) of broad-leaved trees. These forest areas are connected to the main traversing railway by a light railway line. In 1933, the forest on Hassen-zan produced 8,000,000 cubic feet, and the Taihei-san forest produced 17,000,000 cubic feet of timber.

In the Dakusei-kei of Giran-gun (Taihoku-shū), there are about 60,000 cho (or 147,000 acres) of forest area. A special railway, built by the Forestry Bureau, transports this timber to Ratō-gai (Taihoku-shū) on the northeast coast. A new area northeast of Taichū-shi is being opened up, with a lumber depot at Toyohara-gai (Taichū-shū).

Lumber stocks in Formosa at the end of 1940 represented 2.5% of the Empire's total stocks. A large part of the stocks of cut lumber were located at the sawmills in Kagi-shi (Figure IX - 30).

Although lumber production has been increasing and forest resources are extensive, Formosa produced in 1940 only slightly more than half the amount of lumber used locally. The supply of and demand for lumber in Formosa during 1940 is shown in Table IX - 27.

Table IX - 27

FORMOSA'S SUPPLY OF AND DEMAND FOR LUMBER, 1940

(in thousands of board feet)

Lumber production	*226,080
Received from other parts of the Empire	256,320
Imports from foreign countries	2,280
Stocks at end of 1939	103,440
Total supply, 1940	588,120
Shipments to other parts of Empire	26,640
Exports to foreign countries	7,680
Total demand, 1940	450,360
Stocks, end of 1940	103,440

Almost all the other lumber used in Formosa was imported from Japan. The value of total lumber imports increased 66% from 1933 to 1939. Exports of Formosan lumber to Japan also increased from 9,000,000 board feet in 1934 to 13,500,000 board feet in 1938, and then to 26,600,000 board feet in 1940.

Lumber and woodworking production increased 44% from 1933 to 1938. Lumber and wood manufactures were almost equally divided between the total production in 1938.

A large part of this increased activity in the lumber industry was probably due to military needs. A number of wooden ships were being built at Kiirun and Takao in 1943.

With timber stands estimated at 205,000,000 cubic meters of lumber in 1935, it seems likely that Formosa might attain self-sufficiency in lumber in the post-war period. Improved facilities, developed for war production, will be available for civilian lumber needs. Whatever supplementary imports are necessary may possibly be imported from China, a former chief source.

*The figure for Formosa's lumber production varies from that in other sources. The *Japan Year Book* gives figures which are lower, and the *Far East Year Book* figures which are much lower. It seems unlikely, however, that lumber production should be lower in 1936–1938 than in 1927, as these latter sources suggest.

FIGURE IX - 30. *Kagi.*
Sawmill.

There are reported to be 82 sawmills operating in Formosa. Thirty-five are located in Taihoku province, 14 in Taichū province, 14 in Tainan province, 10 in Takao province, 2 in Karenkō prefecture, 1 in Taitō prefecture, and none in Bōko prefecture. Formosan-Chinese manage 84% of these sawmills. TABLE IX - 28 lists the 82 sawmills.

TABLE IX - 28
FORMOSAN SAWMILLS

COMPANY	LOCATION
Taihoku-shū	
Sogo Hatsu Shoto	Tansui-gai
Tenryu Zaimoku	Taihoku-shi
Uematsu Seizai	Taihoku-shi
Chin Yei Yu Seizai (?)	Taihoku-shi
Kishida Seizai	Kiirun-shi
Konichi Yeki Seizai	Taihoku-shi
Miura Seizai	Taihoku-shi
Kyowa Seizai	Ratō-gai
Rosei Seizai	Taihoku-shi
Sandai Gumi Seizai	Taihoku-shi
Shudai Seizai	Taihoku-shi
Sunata Seizai	Ratō-gai
Eiko Seizai	Ratō-gai
Taiwan Seizai	Ratō-gai
Heiwa Seizai	Ratō-gai
Yamato Shoko Seizai	Ratō-gai
Wako Seizai	Ratō-gai
Yamamoto Seizai	Ratō-gai
Yamaju Shoten Seizai	Taihoku-shi
Waryu Shokai	Kiirun-shi
Shinkichi Hatsu Shoko	Kiirun-shi
Rogi Hatsu Shoko	Tansui-gai
Kyoei Shoko	Taihoku-shi
Rieiryu Shoko	Taihoku-shi
Shoki Shoko	Taihoku-shi
Giri Shoko	Taihoku-shi
Juntai Shoko	Taihoku-shi
Kyohatsu Shoko	Taihoku-shi
Sanko Shoko	Taihoku-shi

TABLE IX - 28 (*Continued*)

COMPANY	LOCATION
Taihoku-shū	
Horai Seizai	Taihoku-shi
Koa Seizai	Taihoku-shi
Sanko Seizai Shokai	Taihoku-shi
Suzuki Seizai	Kiirun-shi
Washo Seizai	Kiirun-shi
Rosei Hatsu Kiki	Taihoku-shi
Shinchiku-shū	
Chohatsusei Seizai	Chūreki-gai
Hojun Hatsu Shoko	Shinchiku-shi
Seigi Seizai	Chikutō-gai
Gohatsu Shoko	Shinchiku-shi
Showa Zaimoku	Shinchiku-shi
Taiwan Mokuzai	Tōen-gai
Taichū-shū	
Kyoei Shoko	Toyohara-gai
Ryuki Shoko	Toyohara-gai
Hotai Shoko	Toyohara-gai
Imai Zaimoku	Toyohara-gai
Toko Shoko	Taichū-shi
Tosei Shokai	Taichū-shi
Kyowa Shoko	Taichū-shi
Matsuyama Shoko	Taichū-shi
Omori Shoko	Taichū-shi
Sanchin Shoko	Taichū-shi
Kin Fukko Shokai	Shōka-shi
Toei Shokai	Shōka-shi
Shinto Shoko	Shōka-shi
Ginnichi Shun Shoko	Shōka-shi
Tainan-shū	
Giho Shoko	Kagi-shi
Nanko Seizai Koshi	Tainan-shi
Junhatsu Shoko	Tainan-shi
Choshun Shoko	Kagi-shi
Taiwan Government-General	Kagi-shi
Yeishinki Seizai	Tainan-shi
Mori Zaimoku	Kagi-shi
Shohatsu Seizai	Tainan-shi

TABLE IX - 28 (*Continued*)
FORMOSAN SAWMILLS

COMPANY	LOCATION
Tainan-shū	
Junetai Zaimoku	Tainan-shi
Deneki Shoko	Tainan-shi
Daioku Shoko	Tainan-shi
Eishinki Shoko	Tainan-shi
Gogo Hatsu Shoko	Tainan-shi
Dogan Koshi	Tainan-shi
Takao-shū	
Sego Hatsu	Takao-shi
Fukurin Shoko	Takao-shi
Waryu Zaimoku	Takao-shi
Shinko Shoko	Takao-shi
Eishinki	Takao-shi
Kinken Goki Shoko	Takao-shi
Fukushin Shoko	Takao-shi
Chinko Shoko	Takao-shi
Chinsen Shoko	Takao-shi
Takarabe Seizai	Takao-shi
Karenkō-chō	
Morishige Zaimoku	Karenkō-shi
Zaimoku	Karenkō-shi
Taitō-chō	
Oren Zaimoku	Taitō-shi

B. Cement.

Production of cement in Formosa is considerably less than the demand, imports in 1937 exceeding total production by 50,000 metric tons. A small amount of cement, however, is exported, chiefly to Hong-Kong, Kwantung Leased Territory, and China. These exports to foreign countries rose from 9,067 metric tons in 1933 to 31,800 metric tons in 1935 then decreased to 954 metric tons in 1939. Imports from the Japanese Empire followed the same trend until 1937 when they reached a peak of 196,495 metric tons. In 1939 these imports had decreased to 123,654 metric tons. Production of cement increased from 143,076 metric tons in 1936 to 148,795 metric tons in 1938.

The Asano Cement K.K. factory (FIGURES IX - 31 and IX - 32) sometimes described as the largest cement plant in the Far East, is located 2,000 yards north of Takao City, about

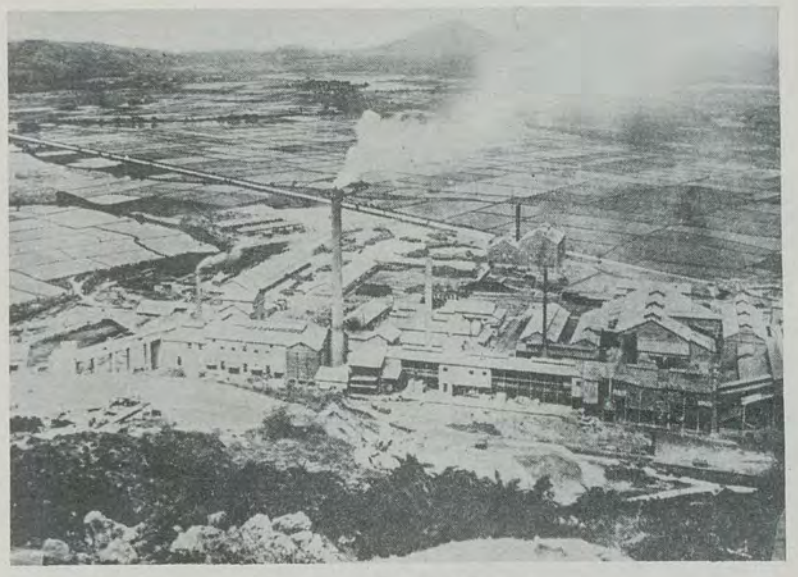


FIGURE IX - 31. *Takao.*
Plant of Asano Portland Cement Co.

2 2/10 miles north-northeast of the harbor mouth. It produced 9,000 bags of cement daily in 1938. The area it covers is 3,000 feet by 2,300 feet, and facilities include: a quarry; 3 buildings for the initial crushing of the material; a building for storage of raw materials; a slurry and storage building, 270 feet by 250 feet; a filter building; 3 rotary kilns 150 feet long with 15-foot diameters; 2 clinker drying and storage buildings, each 90 feet by 45 feet; a probable centrifugal and tube mill building, 280 feet by 110 feet; 8 storage silos with diameters of 25 feet each; a packing and shipping building, 170 feet by 170 feet; and 9 miscellaneous shop buildings. Across the road from the main plant are 2 storage silos, 25 feet in diameter, and 3 storage buildings of an average size of 150 feet by 45 feet. The factory has its own steam power plant with a capacity of 4,500 kw (see TOPIC 97). Wharf and loading facilities in 1929 were 3,000 barrels per day.

Other cement companies operating in Formosa are:

Nippon Asbestos Kogyo K.K. (Japan Asbestos Industries Company) in Taihoku-shi; Taiwan Cement K.K. (Formosa Cement Company) in Taihoku-shi; and Koa Renga K.K. (Koa Brick Company) in Saei-shō, Takao-shū.

FIGURE IX - 32. *Takao.*
Plant of Asano Portland Cement Co.

Because the 14th Air Force has partially destroyed cement plants at Krung Thep (Bangkok) and Haiphong, the importance of the cement plant at Takao has probably increased greatly. A report dated 24 March 1944 stated that the Japanese Army and Navy were requesting cement supplies from Formosa, and cement production has been reported as having increased.

C. Bricks and tiles.

Almost 300,000,000 bricks and 137,000,000, roofing tiles were produced in Formosa in 1938. The ceramics industry, with 638 factories in 1935, ranked second only to the foodstuffs industry in Formosa in the number of factories and workers, employing 13% of the total employed in industry. In 1937, there were 10,528 workers in ceramics, or 12% of total industrial workers.

The center of the brick and tile industry is at Tōen-gai in Shinchiku province. Plants are known to exist in Taihoku-shi, Hokutō-gai (Taihoku-shū), Nantō-gai (Taichū-shū), Kagi-shi (Tainan-shū), Takao-shi, Taichū-shi, Heitō-shi (Takao-shū) (FIGURE IX - 33), and Shinchiku-shi.

FIGURE IX - 33. *Heitō.*
Brick plant, prepared from aerial photograph 4 February 1944.

The Taiwan Renga K.K. factory at Kagi covers an area of 1,100 feet by 800 feet. It includes 3 kilns, each 175 feet by 55 feet, 32 drying sheds, and 4 warehouses, each about 190 feet by 35 feet. The clay pit is near the plant, which is serviced by a railway spur.

The factory is on the left bank of the river. It contains 8 buildings varying in size from 200 feet by 100 feet to 30 feet by 30 feet. Three narrow-gauge railway spurs connect the plant to a clay excavation 1¼ miles north of it.

The Taichū brick factory of the Taiwan Renga K.K. covers an area of 1,000 feet by 500 feet. It consists of 3 large kilns each about 150 feet by 45 feet and 15 drying sheds all 15 feet wide but varying in length from 100 feet to 250 feet. The raw materials are located west of the plant.

The Heitō factory is located ¾ mile south of the railway yards, and has a kiln 175 feet by 50 feet, as well as 18 drying storage sheds.

A smaller brick plant at Shinchiku includes 6 buildings and 22 storage sheds, while another plant at Tainan has 3 buildings and 35 storage sheds.

The companies listed in TABLE IX - 29 are known to be active in the brick and tile industry.

TABLE IX - 29
FORMOSAN BRICK AND TILE COMPANIES

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	FACTORY LOCATIONS
Koa Renga K.K...	150,000	1940	Saei-shō (Takao-shū)
Takao Renga K.K.	100,000	1938	Takao-shi
Taiwan Renga K.K.	3,000,000	1913	Taihoku-shi (3) Shinchiku-shi Taichū-shi Katan-shō (Taichū-shū) Kagi-shi (Tainan-shū) Tainan-shi Giran-gai (Taihoku-shu) Takao-shi Chureki-gai (Shinchiku-shū) Kari-gai (Tainan-shū) Heitō-shi (Takao-shū)
NanshinShoko K.K.	150,000	1939	Taichū-shi
Nanbu Renga K.K.	300,000	1936	Tairyō-shō (Takao-shū)
Kiirun Renga K.K.	600,000	1920	Kiirun-shi (Taihoku-shū)
Koshinko Goshi Kaisha	490,000	1933	Kōheki-shō (Tainan-shū)
Taiwan Tokushu Yogyo K.K.	450,000	1939	Taihoku-shi

D. Other construction materials.

Insulating products made from bagasse are manufactured by the Artex Manufacturing Company, at Taihoku-shi. Bagasse is also made into wall boards by 2 factories in Taihoku-shi.

The Toyo Concrete Company has factories located in Taihoku-shi, Shinchiku-shi, Taichū-shi, Tainan-shi, and Kagi-shi (Tainan-shū).

94. Industrial Raw Materials and Primary Processing

A. Minerals.

Mining plays a relatively minor role in Formosa's economy. The total value of metals and minerals mined in 1936* in Formosa was 28,727,000 *yen* or 10% of all industrial production and less than 1% of total production. The 1930 census reported 24,000 persons or about 1.4% of the total active population occupied in mining.

Formosa lacks deposits of iron and some other minerals essential to an all-round program of heavy industrialization.

(1) Value to Japan.

Formosan coal is valuable to Japan's war economy for use in Formosa. Its existence there saves transportation from other areas and makes possible a considerable degree of industrial development. Representing 39% of the value of all minerals produced on the island in 1936, Formosan coal is a low-grade non-coking bituminous type, which is mainly used for bunkering and generation of electric power in Formosa. Limited

*Later figures have not been released for public use.
The following Japanese standards of weights and measures are used in this section:
kin=1.32 pounds
koku=5.119 bushels
tsubo=3.95 square yards

shipping facilities make it difficult to transport coal from Formosa to other parts of the Empire.

The next most important mineral of Formosa is gold-silver-copper ore, constituting 28% of the total value of mineral production. It is the source of an estimated 10,000 metric tons of copper or 7.5% of the Japanese Empire's total copper production. The Kinkaseki gold mine, where this copper is produced, is said to be the largest gold mine in the Japanese Empire, with an annual output of 2 metric tons of refined gold, valued at $1,234,240.

Salt from Formosa is also of importance to Japan, which received more than ½ of Formosa's total production of about 175,000 metric tons in 1939. In addition to furnishing industrial salt for new industries developed in Formosa, it was planned that Formosan salt would subsequently substitute for salt obtained by Japan from other countries.

(2) *Production and areas.*

Fifteen different minerals, in addition to salt, have been reported in Formosa, but only 13 are actually being produced from licensed mines (FIGURE IX - 76). They are: coal, gold-silver-copper ores, gold and copper ores, gold, alluvial gold, copper, mercury, sand iron, brown coal, petroleum, sulphur, phosphorites, and cupreous iron sulphide. A rich tungsten deposit in the Takkiri range was discovered in 1941, according to the Japanese press, but mining and transportation conditions there would be difficult. Since 1917, a Japanese firm has had phosphate mining establishments in the Spratly Islands. TABLE IX - 30 shows the principal 1936 mineral production.

TABLE IX - 30

OUTPUT OF PRINCIPAL MINERALS, FORMOSA

(1936)

	QUANTITY	VALUE (IN 1,000 YEN)
Gold	1,240 kilograms	4,224
Alluvial gold	54 kilograms	160
Gold ore	4,798 metric tons	494
Gold—silver—copper	198,325 metric tons	7,958
Silver	402 kilograms	17
Coal	1,744 metric tons	11,365
Crude oil	not available	not available
Volatile oil	not available	not available
Sulphur	1,226 metric tons	not available
Carbon black	not available	

Value of total mineral production in Formosa was more than doubled from 1933 to 1937, when a new high of 35,000,000 *yen* was reached. Of this, 18,000,000 *yen* was for gold ore and 16,000,000 for coal.

There were 638 licensed mines in Formosa in 1936, of which only 221 or 35% were in actual operation, covering an area of 192,366,000 *tsubo* (or 757,911,700 sq. yds.). By 1939, the number of lots had increased to 843, with 418 or 50% in operation over an area of 274,657,000 *tsubo* (or 1,084,895,150 sq. yds.).

Exports of all mineral ore in 1936 totalled 231,810 metric tons valued at 15,637,000 *yen*. All these exports went to Japan. The actual weight of iron imports was less than half the total weight of all mineral-ore exports.

Metallic minerals are chiefly in the extreme north and northeastern areas of Formosa, with alluvial gold along the eastern coast. A limited output of sulphur, not exceeding 3,000 tons annually, has been obtained chiefly from the area north of Taihoku-shi and mercury mining is done at Heirin-shō, south of Kiirun-shi. Negligible quantities of iron ore were obtained in 1937 from Chūreki-gun and Tōen-gun in Shinchiku province. Coal and petroleum areas are described in TOPIC 94, B.

On the east coast, nickel and Fuller's earth are reported at Riryū, and manganese near Suō-shō (Taihoku-shū). Production of the latter is reported to have begun in 1937, with an anticipated output of 30,000 tons by 1938. Further information has not been obtained.

(*a*) *Gold.* Ten miles east of Kiirun-shi in Taihoku province is the Kinkaseki mine (FIGURE IX - 34), operated by Taiwan Kogyo K.K. (Formosa Mining Company), subsidiary of the Nippon Kogyo K.K. (Japan Mining Company). The deposit was discovered in 1894, and work was begun on it in 1897. In 1937, the Kinkaseki mine produced gold valued at 12,900,000 *yen*.

Just south of Kiirun-shi is the Zuiho mine, second largest Formosan gold mine, controlled by Taiyo Kogyo K.K. (Taiyo Mining Company). In 1937 this mine produced gold, including auriferous copper ore, valued at 4,750,000 *yen*. Other mines owned by the Taiyo Kogyo K.K. are at Heikei-shō (Taihoku-shū) and Taikei-gai (Shinchiku-shū). These mines and the smaller Butankō mine are often referred to as the "3 gold mines of Kiirun"

Alluvial gold deposits along the east coast of the island may be worked to some extent at present. In 1936, the amount of alluvial gold produced in Formosa was 54 kilograms valued at 160,000 *yen*. The Taiwan Sankin K.K. (Formosa Gold Company) operates alluvial gold deposits in Karenkō prefecture and Taichū province and in Shichito-gai (Taihoku-shū).

(*b*) *Copper.* Copper deposits are found in the north and northeast of Formosa, but most of the copper production comes from the Kinkaseki mine. Small additional amounts are obtained from the Zuiho mine, but are probably treated at the Kinkaseki plant near Kiirun-shi. It is believed that annual copper production in Formosa at present may be about 10,000 metric tons.

A new flotation plant with three 20,000 ton-per-month units was started in 1933. By 1936, the last unit was in operation. This new plant would bring total copper production capacity to about 12,000 tons annually. With the copper ore which is believed to be brought from the Philippines, it is likely that the plant can be kept operating at full capacity.

Formerly, copper precipitates obtained from mine water, and the concentrates and selected ores from the mine were shipped to Japan proper for smelting and refining. It is believed, however, that there are now copper smelters of major importance in Formosa, capable of producing 19,000 metric tons of smelted copper, or 14.3% of the production of all smelters in the Japanese Empire. These are believed to be important for smelting part of the ore brought from the Philippines. Locations of these smelters are at present unknown.

(*c*) *Silver.* The output of silver in 1936 was only 402 kilograms, valued at 17,000 *yen*.

(*d*) *Sulphur.* Sulphur deposits are scattered throughout the island, but the only mines in operation in recent years are in Taihoku province. Production was 1,226 metric tons in 1936. In 1939, there were 9 pits covering an area of 559,000 *tsubo* where sulphur was being mined in Formosa.

(*e*) *Salt.* In 1938, Formosa produced an estimated 272,000 metric tons of salt. The percentage of the volume of salt

FIGURE IX - 34. *Kiirun.*
Ginka quarry of Kinkaseki mine about 12 mi. E of Kiirun.

exports in relation to total salt production in Formosa has varied in recent years from 50–75%. Production and exports of salt from 1936 to 1938 were as follows:

TABLE IX - 31
PRODUCTION AND EXPORTS OF SALT IN FORMOSA
1936–1938

	PRODUCTION (METRIC TONS)	EXPORTS (METRIC TONS)	VALUE OF EXPORTS (YEN)
1936.....	225,053	110,168	1,102,603
1937.....	210,471	107,505	1,096,152
1938.....	272,000 (est.)	192,532	1,744,883

Practically all exports of salt from Formosa are sent to Japan proper, Korea, and Karafuto, the largest share going to Japan proper. Exports in 1942 were believed to be 200,000 metric tons out of a total production of 280,000 metric tons.

The Minami Nippon Engyo K.K. (South Japan Salt Industry Company) capitalized at 10,000,000 *yen*, was organized in 1938 to exploit the salt resources of Formosa. Formerly, the greatest number of salinas was found along the north side of the entrance to the Ampin-kei, where about 200,000 metric tons of salt were produced annually (FIGURE IX - 35). With the establishment of the new company, it was planned to increase acreage of salt-producing fields from the 1938 area of slightly more than 5,000 acres to 15,000 acres by opening areas at Hotei and Hokumon in Tainan province and also areas in Takao province. It was planned to increase production to 250,000 metric tons by 1941 and to 450,000 metric tons by 1945. It is not known whether this was realized.

FIGURE IX - 35. *Ampin.*
Salt field.

There are known to be 4 other salt manufacturing companies operating in Formosa. These are:

TABLE IX - 32
FORMOSAN SALT MANUFACTURING

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION
Rokko Seien K.K.	500,000	1926	Rokkō-gai (Tainan-shū)
Taiwan Seien K.K.	2,500,000	1919	Tainan-shi
Ujurin Seien K.K.	300,000	1923	Mida-shō (Takao-shū)
Entei Seien.....	172,000	1938	Tainan-shi

There are hills of salt stocks near Ampin, where there is practically no rain except from May through September. In other months, light winds keep the atmosphere free of moisture, making practicable the outdoor storage of salt. Salt stocks probably exist also at the new fields at Hotei and Hokumon in Tainan province.

B. Fuel.

The most important source of fuel in Formosa is coal; others include petroleum, alcohol, bagasse, charcoal, and firewood. Except for coal, whose present production is estimated at 2,500,000 metric tons, fuel supplies are small. In the case of petroleum, this deficiency is a result both of the limited natural sources available and of the failure to exploit all potential oil land. The 3 principal petroleum fields are located in Shinchiku province.

Coal is low grade bituminous, located in relatively thin strata, chiefly in Taihoku province. Charcoal and firewood are of minor importance.

(1) *Coal.*

(*a*) *Coal mining districts*. Formosa's most productive coal mining area is Taihoku province and accounts for about 90% of the total. Coal strata stretch across the northern end and foothills of the western slopes of the island. More specifically, these major producing areas are found in Taihoku province (FIGURE IX - 36) and Shinchiku province. While Taihoku layers measure 2 to 3 feet in thickness, those further south in Shinchiku and Tainan provinces and Taitō prefecture are sometimes only 3 to 4 inches. Brown coal is found in Bōko and Karenkō prefectures and at Hori-gai in Taichū province. Coking coal available in northern regions is estimated at 10,000,000 tons.

FIGURE IX - 36. *Kiirun.*
Coal mine on the Kiirun-ka.

Formosa's 579 coal lots cover an area of 151,935,000 tsubo, of which, it has been reported, 342 covering 94,555,000 tsubo were in operation in 1939. Compared with figures of 1935, this shows a 22% increase in operating lots and a 10% increase in the area being worked. Increased demand for coal within Formosa is the major cause for this marked expansion. Production capacity at present, however, is probably still greater than actual production.

(*b*) *Production*. In 1939 and thereafter, production was estimated at 2,500,000 metric tons annually. Of this, 1,050,000 metric tons were supposedly consumed at home, about 850,000 metric tons were used as bunker, 292,000 metric tons were exported abroad, 276,000 metric tons were exported to Japan, and approximately 91,000 metric tons were on hand 31 December 1939. Coal reserves are estimated at 400,000,000 metric tons. In 1938, 100,000 metric tons of coal were converted into 52,000 metric tons of coke.

Small mines are responsible for much of the coal. While 59% of the mines produce but 20,000–30,000 metric tons, only 14% mine above 100,000 metric tons. Likewise, 41% of the mines have less than 50 laborers, while only 4% have above 500.

(*c*) *Quality and composition*. Small quantities of anthracite are in certain Kiirun shafts, but the greater part of Formosa's supply is a soft, brown coal called "saitan". It is a low-grade, bituminous coal with 6,160–7,480 calorie value, .56–4.45% sulphur content, 1.78–4.52% water content, 1.24–16.24% ash content, 32.16–64.78% volatility, and 22.20–54.98% carbon fixation: Ninety per cent is mined in Taihoku province and about 8% in Shinchiku province. TABLE IX - 33, Page IX - 32, analyzes the quality of Formosan coking coal.

(2) *Petroleum and natural gas.*

(*a*) *Location of fields and refineries*. Formosa's principal oil fields are located at Chikutō, Shukkōkō, and Kinsui in Shinchiku province; Rokujukei and Gyūnikuki in Tainan province; and Kōsen-shō and Kōshun in Takao province. Although little actual production of petroleum is reported at Kinsui (FIGURE IX - 37), gas flows are large. The Shukkōkō wells

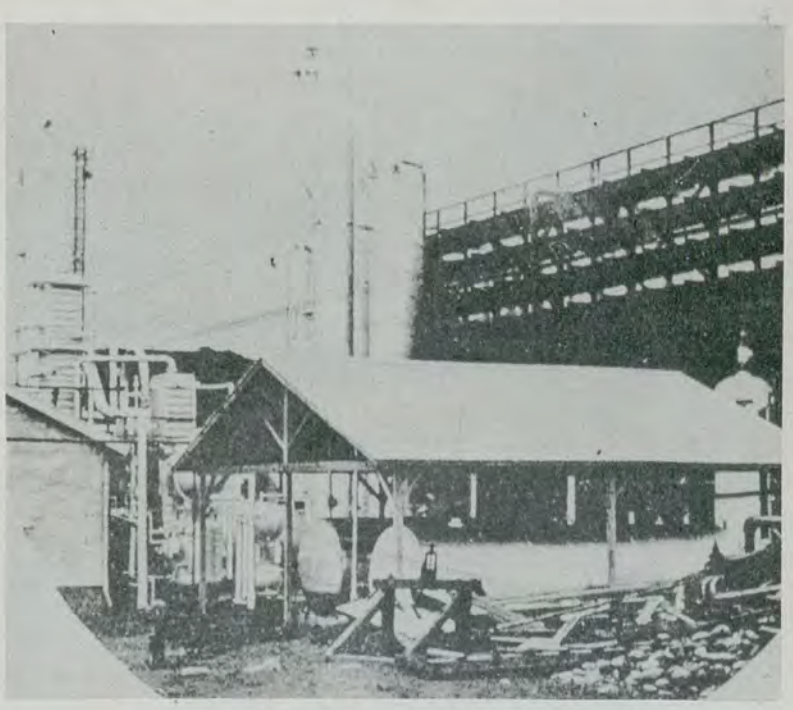


FIGURE IX - 37. *Kinsui.*
Japan Oil Co. installation.

(FIGURE IX - 38) account for most of the crude petroleum output, and conditions in the Tainan fields (Rokujukei, Gyūnikuki) are similar to those at Kinsui. Petroleum production at Gyūnikuki is only 35,500 barrels a year.

Natural gas at Kinsui is piped 20 miles to Shinchiku-shi, in 4-inch pipes. Although it was first limited in its use as fuel to sugar and brick factories in the vicinity of Shinchiku,

TABLE IX - 33

ANALYSIS OF FORMOSAN COKING COAL

Taihoku mines

NAME OF MINE	GAIMOKUSAN	DENRYOKO I	DENRYOKO II	SEKITEI	SHIKYAKUTEI	SANKASHI
Water content	2.78	3.42	4.36	3.54	1.78	3.40
Volatility	64.72	39.50	38.08	42.16	41.07	36.87
Carbon fixation	22.20	54.98	54.28	49.52	57.15	57.57
Coke properties	sticky, hard	slightly sticky, hard	slightly sticky	slightly sticky, hard	slightly sticky, hard	slightly sticky, hard
Ash content	1.24	2.12	3.28	4.78	3.77	2.16
Ash color	light red	brown	brown	light brown	light brown	grey
Calories	6,930	7,425	6,875	7,371	7,480	7,150
Specific gravity	—	1.27	1.14	1.28	—	—
Thickness of coal strata (in feet)	3	3	—	3	3.3	3
Sulphur content	1.20	4.45	4.14	—	slight	.85

Shinchiku mines

NAME OF MINE	SANSHIKYAKU	KANSAI	TAIBOTEI
Water content	4.16	4.52	1.37
Volatility	32.16	37.79	30.25
Carbon fixation	47.44	48.44	66.14
Coke properties	slightly sticky, hard	slightly expansive, hard, sticky	slightly expansive, sticky
Ash content	16.24	9.25	2.24
Ash color	light brown	blue-black	brown
Calories	6,564	6,160	7,590
Specific gravity	1.30	1.36	1.28
Thickness of coal strata (in feet)	2	2	—
Sulphur content	—	—	.56

FIGURE IX - 38. *Shukkōkō.*
Oil field.

it became available to all industry after 1932. The gas here and elsewhere on the island is rich in methane and contains helium. American machinery was installed at Kinsui, and Japanese (rather than Formosan) labor went into its construction. In 1931, a duplicate plant was shipped to the island and set up, possibly at Chikutō-gai.

The Japanese Navy utilizes much of Chikutō and Gyūnikuki gasoline. With the exception of various areas in southern Formosa, exclusive rights for drilling, prospecting, and refining of oil have been given to Nippon Sekiyu K.K. (Japan Oil Company), whose main interests are centered at Kinsui and Shukkōkō in Shinchiku province.

Refineries are located at the Kinsui, Shukkōkō, and Chikutō fields (FIGURE IX - 39). A kerosene refinery at Takao may be processing Gyūnikuki oil for the Navy.

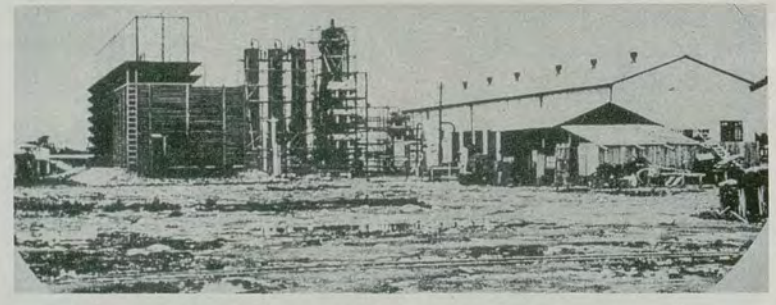


FIGURE IX - 39. *Chikutō.*
Oil refinery.

In 1939, only 21 of Formosa's 82 petroleum fields, covering an area of 31,164,000 *tsubo* out of a total of 61,006,000 *tsubo* were in operation.

(*b*) *Production of petroleum and natural gas.* Formosan petroleum resources are sufficient to cover only 10% of her needs, or a bare 3% of Japan's wartime demands. The estimated production for 1938 was 2,330,000 gallons including 800,000 gallons of gasoline, 790,000 gallons of kerosene, 200,000 gallons of fuel oil, 140,000 gallons of lubricating oil, and 400,000 gallons of light oil. Although the government has granted subsidies to the oil industry since 1937, increased production is difficult. Thus in 1937 petroleum production was 2,272,000 gallons and total sales were 29,802,000 gallons, leaving 27,530,000 gallons to be filled, presumably by imports. Natural gas, however, is abundant.

Kinsui as a whole spouts anywhere from 30,000,000 to 300,000,000 cubic feet of gas daily and has a daily gasoline capacity of 60,000 gallons. In the Kinsui fields, 2 wells produce 30,000 gallons of gasoline daily, and another spouts 40,000,000 to 50,000,000 cubic feet of gas daily. 40,000,000

cubic feet of gas are utilized for operations in the plant itself; about 30,000,000 are wasted each day. The pipe lines (Topic 94, B, (2), (a)) handle several hundred thousand feet daily, servicing Shinchiku, Taichū, and Kagi.

Capacity of the Shukkōkō field is estimated at 60,000 gallons of gasoline daily, while the Japan Oil Co. refinery at Byōritsu in Shinchiku province can treat 250 barrels of crude oil daily or 100,000 barrels annually (Figures IX - 40 and IX - 41.) The first installation at Shukkōkō was completed in 1925, and equipped to extract 5% gasoline, 65% heavy kerosene, 17% "light oil", 3% paraffin, and 10% residium (used as road binder), but no lubricating oil. Both the Shukkōkō and Kinsui plants are equipped to bottle butane gas.

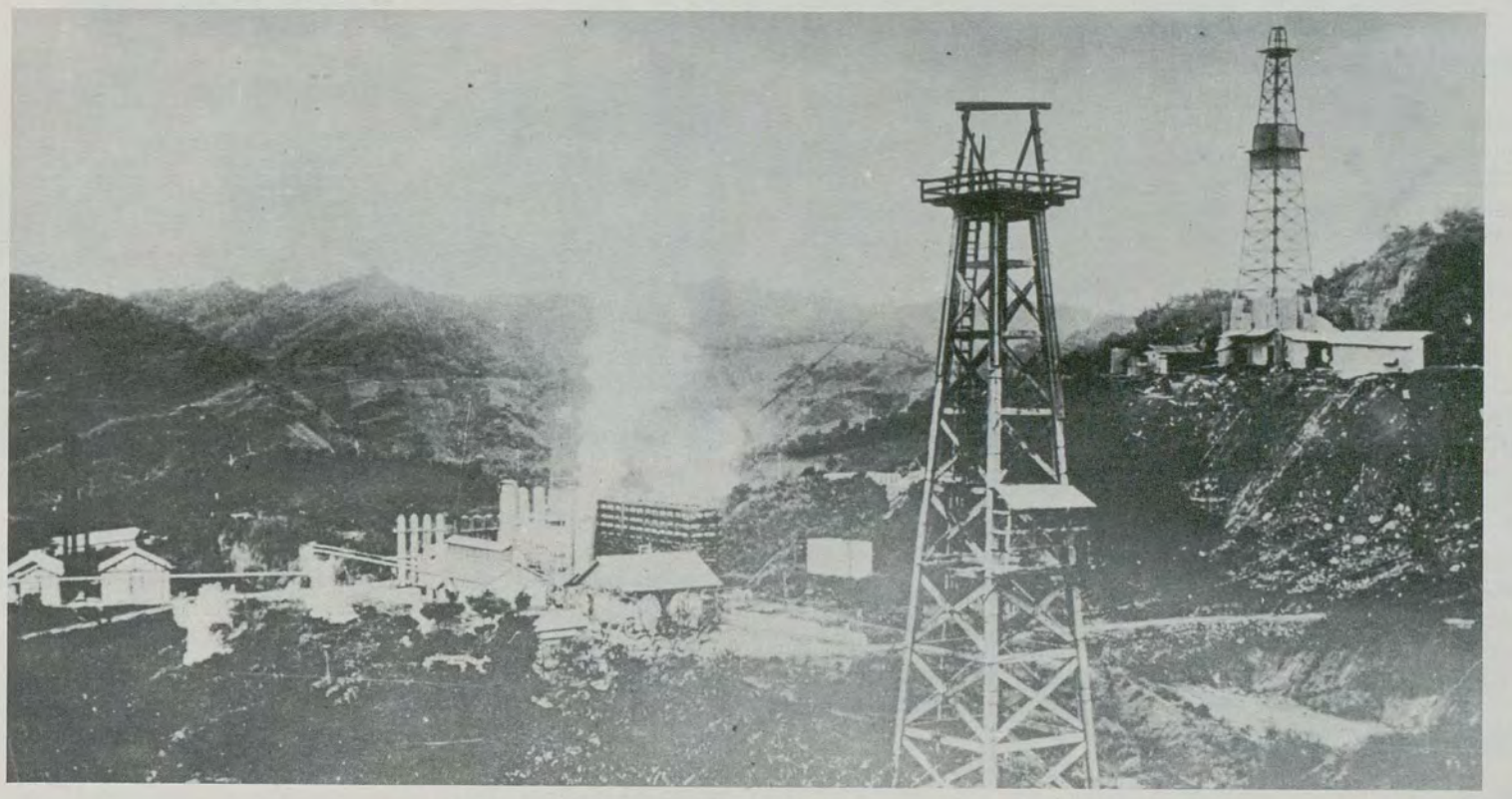


Figure IX - 40. *Byōritsu.*
Japan Oil Co. field and refinery.

Figure IX - 41. *Byōritsu.*
Japan Oil Co. distillation plant.

(*c*) *Imports of petroleum.* Formosan petroleum needs must be filled with imports. Local lubricating oils are of low quality, and no grease whatsoever is produced. Over ⅔ of Formosa's petroleum imports during 1937 consisted of fuel oil (11,049,000 gallons) and gasoline (9,121,000 gallons). A total of 807,275 pounds of grease was imported during the first half of 1937; 798,939 pounds from Japan proper, and 8,336 pounds from foreign countries.

TABLE IX - 34

FORMOSA'S PRODUCTION AND NET IMPORTS OF PETROLEUM

(in 1,000 gallons)

PRODUCT	PRODUCTION	TOTAL SALES	PRESUMABLE NET IMPORTS
Gasoline	810	9,931	9,121
Kerosene	761	4,601	3,840
Fuel oil	171	11,200	11,049
Lubricating oil	130	2,650	2,520
Light oil	400	1,400	1,000
Total	2,272	29,802	27,530

The major part of Japan's annual imports of petroleum coke from Palembang, Sumatra (15,000 tons), has been consigned to Takao. Japan has practically no domestic source and has depended principally on imports from the United States and Sumatra. Petroleum coke is important in making aluminum electrodes. About 1 ton is needed to produce 1 ton of finished aluminum. However, there was no evidence of a stockpile until 1941.

(*d*) *Fuel storage.* TABLE IX - 35 lists the known fuel storage facilities in Formosa.

TABLE IX - 35

FUEL STORAGE FACILITIES IN FORMOSA

LOCATION	DESCRIPTION
Takao-shi	7 tanks (100 feet in diameter); 10 (30 feet in diameter)—under construction November 1943.
Takao-shi	15 tanks (30 feet by 160 feet)—Mitsubishi oil tank storage farm (FIGURES IX - 42 and IX - 43).
Tōshien (Takao-shi)	16 tanks (120 feet in diameter); 3 (130 feet in diameter, 2 (40 feet in diameter); 2 buried tanks (225 feet in diameter).
Makō (Bōko-chō)	6 underground tanks, dimensions unknown.
Tansui (Taihoku-shū)	2 tanks (2,500 and 1,200 ton capacities respectively) Asahi Sekiyu K.K. (Rising Sun Petroleum Company) (FIGURES IX - 44 and IX - 45).
Kiirun-shi (Taihoku-shū)	Unknown number of underground tanks—report unconfirmed.
Kyūshi-zan (Taihoku-shū)	4 tanks (35,000 tons total capacity).

FIGURE IX - 42. *Takao.*
Mitsubishi petroleum storage facility near harbor.

FIGURE IX - 43. *Takao.*
Mitsubishi petroleum storage facility.

In addition to these known fuel storage facilities, it is certain that all airfields, oil fields, and cities and principal towns have fuel storage facilities. In 1930, gasoline storage capacity at Shukkōkō was 100,000 gallons.

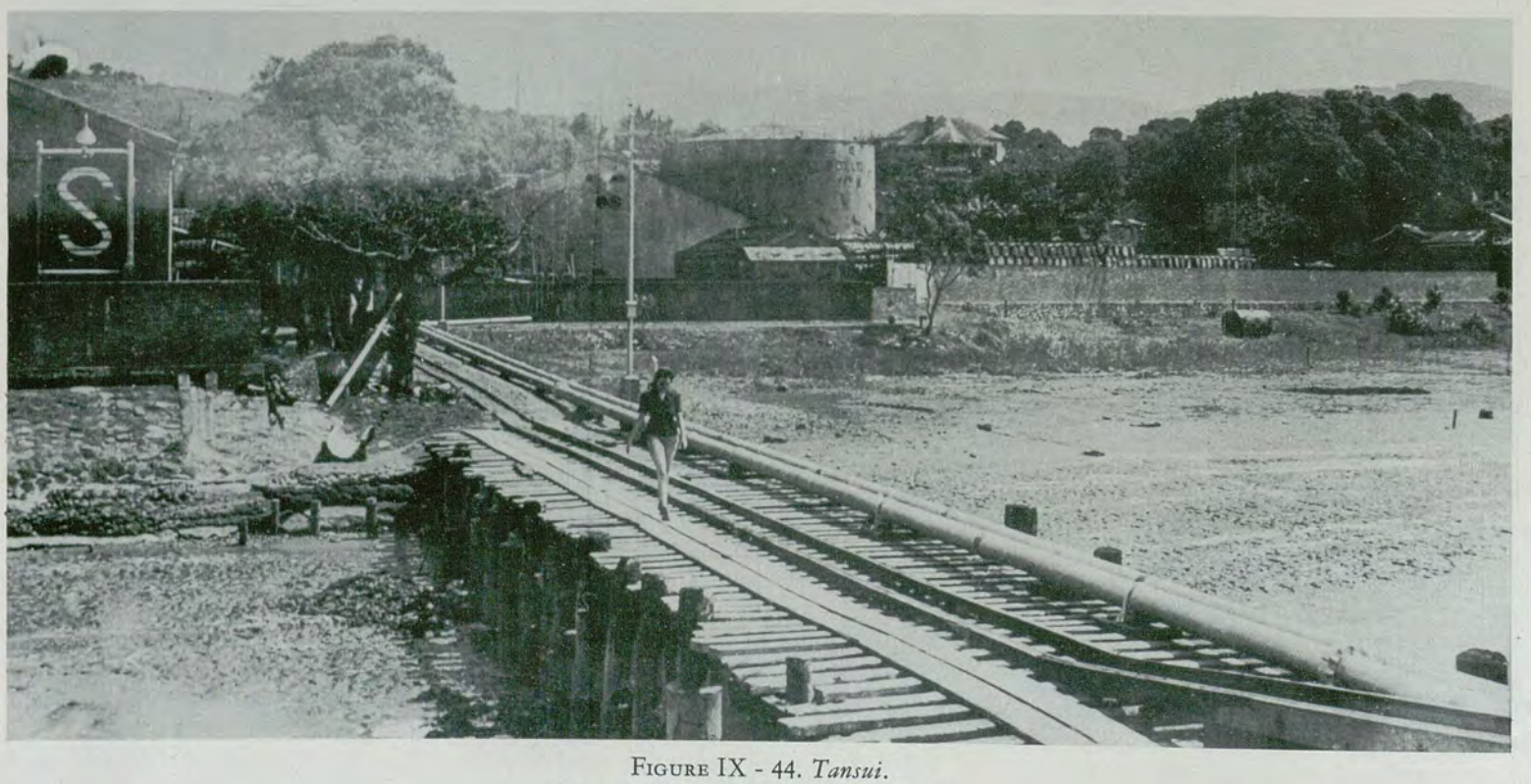


FIGURE IX - 44. *Tansui.*
Tanks and pier of Rising Sun Oil Co.

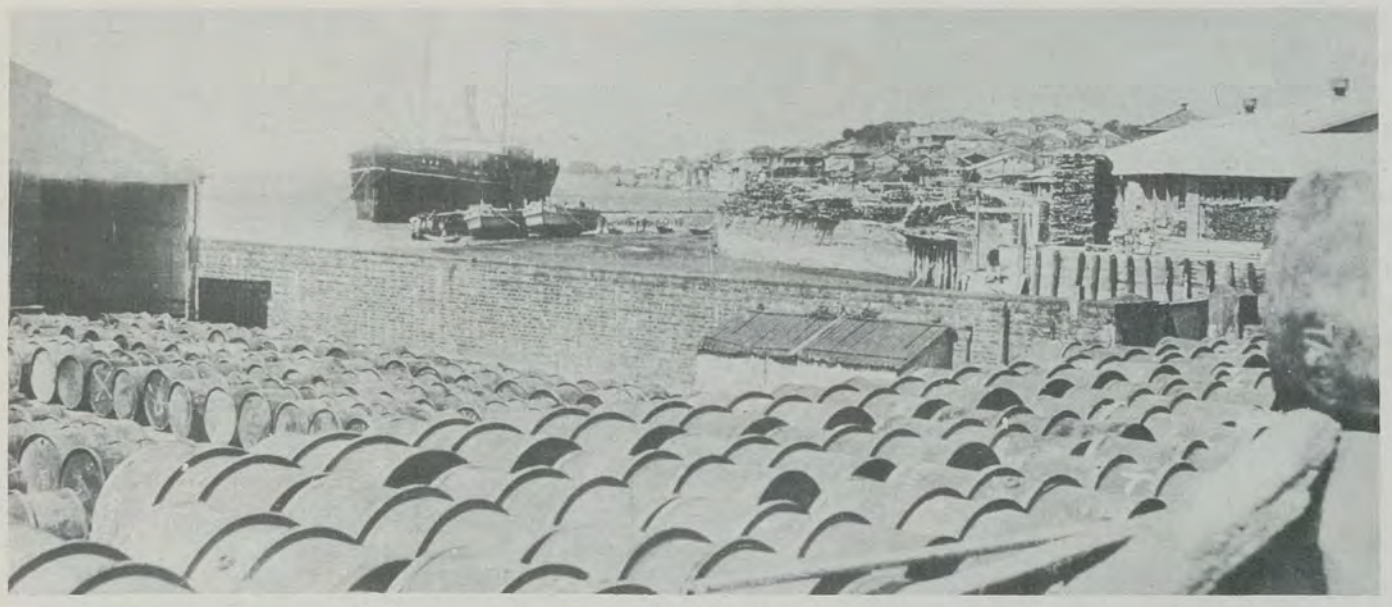


FIGURE IX - 45. *Tansui.*
Rising Sun Oil Co. storage facility at harbor.

(3) *Alcohol.*

In 1939, 17 private plants listed by the Government-General produced 351,910 *koku* of alcohol and planned to produce 800,000 *koku* by 1944.

Forty sugar refineries in Formosa produce industrial alcohol comprising 30% of Japan's total alcohol supply. Formosan production represents 85% to 95% of the Japanese Empire's sugar-derived alcohol. Six leading sugar refineries produce most of Formosa's alcohol (TABLE IX - 36).

TABLE IX - 36
ALCOHOL PRODUCTION BY FORMOSAN SUGAR COMPANIES, 1933

COMPANY	DAILY CAPACITY (IN GALLONS)
Dai Nippon Seito K.K.	4,480
Ensuiko Seito K.K.	3,200
Meiji Seito K.K.	10,400
Niitaka Seito K.K.	2,920
Taiwan Seito K.K.	6,600
Teikoku Seito K.K.	4,000

Although recent figures on individual companies' capacities are not available, it is important to note that the government has required all refineries to install distilleries, if possible, or to ship molasses to companies equipped to produce alcohol. An agricultural experimental station and factory at Kagi produced 75,000 barrels in 1940 (FIGURE IX - 46).

FIGURE IX - 46. *Kagi.*
Government alcohol experiment plant.

Both sugar cane and sweet potatoes are now used as raw materials. The Taiwan Seito K.K. butyl alcohol plant at Kagi has an estimated capacity of 1,429,614, much of which is produced from sweet potatoes.

Since 1937, a ruling has been in effect requiring that 3% to 20% alcohol must be mixed with all gasoline fuel. Use of alcohol as fuel has greatly increased. Formosan alcohol production in 1935–1936 was 92% of the total production in the Japanese Empire. In 1936–1937 it amounted to 86%.

TABLE IX - 37 lists important Formosan alcohol plants with their annual capacities.

TABLE IX - 37
FORMOSAN ALCOHOL PLANTS

PLANT	LOCATION	ANNUAL CAPACITY (IN GALLONS)
Taichū	Taichū-shi	23,700
Kobi	Kobi-gai (Tainan-shū)	30,000
Nansui	Tainan-shū (23° 24′ N, 120° 16′ E)	30,000
Reigaryō	Takao-shi	unknown, believed to be large.
Kyoshito	Nanshi-shō (Takao-shū)	30,000
Heitō	Heitō-shi	15,000
Unknown name	22° 37′ N, 120° 16′ E	12,000

Ōsaka, Tōkyō, and Yokohama handle a major part of Formosan alcohol exports, amounting to about 315,000 *koku* in 1939. Ōsaka received 171,508 *koku*, Tōkyō 97,755, and Yokohama 46,134. Total exports from Formosa in 1939 were 338,291 *koku*, of which 337,898 *koku* went to points in the Empire (334,332 *koku* to Japan proper), and 393 *koku* to places outside the immediate empire (China, Manchuria, Kwantung, Hong Kong, and Hsia-men).

Storage facilities are situated at most of the alcohol plants. Aerial reconnaissance has revealed extensive facilities in Heitō-shi and Tainan-shi.

(4) *Bagasse.*

Produced from sugar-cane stalks, and used in small quantities as a building material, the major importance of bagasse hitherto lay in paper manufacturing as a substitute for wood pulp. Its fiber content is 50%. Until comparatively recently its use as fuel was insignificant. In view of increased difficulties in mining coal, and the shortage of shipping facilities, sugar refineries have successfully experimented with

bagasse pulp as a possible source of power. Produced at the sugar plants, its use as fuel there saves much time and energy. As a new, though limited, substitute for coal and petroleum in sugar refineries, it appears promising.

Bagasse's importance in the pulp industry, on the other hand, has by no means diminished, nor has it been affected at all adversely by rapid development of the new use. On the contrary, increased bagasse production is now demanded more and more for both purposes. Bagasse is not, however, fit for the manufacture of rayon or synthetic fiber.

Bagasse production is closely tied up with the quantity and quality of sugar cane grown during a given year. In 1940, 3,042,050,000 *kin* were produced. The maximum output is estimated at about 60,000 metric tons a year.

(5) *Charcoal.*

Charcoal is not an important source of fuel in Formosa, only 53,000 metric tons being produced in 1938.

The Kyokunan Nenryo K.K. (Kyokunan Fuel Company) established in September 1936, and capitalized at 100,000 *yen*, buys and sells charcoal. Its main office is in Takao-shi.

(6) *Firewood.*

A minor fuel source in Formosa, 407,000 metric tons of firewood were produced in 1938. Production value in 1939 is estimated at 4,650,000 *yen*. Thus, while the quantity of firewood produced in 1938 is almost 8 times that of charcoal, the value of 1939 production is not even double. One study cites coastal mangrove trees as an important source of firewood.

95. *Manufacturing Plants*

A. Industrialization and labor conditions.

Industrialization in Formosa is a comparatively recent development. Industrial production increased from 43.2% of total production in 1937 to 47.6% in 1941, while agricultural production in the same period decreased from 47.9% of total production to 40.9%. Militarily and economically linking Japan, China, and the southern Territories, Formosa is being transformed into an important industrial base in the Japanese war economy. At present, considerable quantities of aluminum, nickel, magnesium, chrome, copper and glass are produced (FIGURE IX - 77).

TABLE IX - 38 shows the production value of industries for 1938, and TABLE IX - 39, the 1938 output of principal manufacturers.

TABLE IX - 38
PROPORTIONATE SHARE OF VARIOUS INDUSTRIES IN FORMOSA'S TOTAL PRODUCTION IN 1938

INDUSTRY	VALUE OF PRODUCTION (IN 1,000 YEN)	1938 PERCENTAGE	1940 PERCENTAGE
Textiles	6,140	1.5	1.8
Metals	20,890	5.3	5.0
Machinery	13,516	3.4	4.3
Ceramics	9,978	2.5	2.7
Chemicals	39,746	10.1	11.9
Foodstuffs	265,816	67.4	64.2
Lumber	13,309	9.8	3.4
Printing	6,843	9.8	1.3
Miscellaneous	17,178	9.8	5.4

TABLE IX - 39
OUTPUT OF PRINCIPAL MANUFACTURES, 1938
(Exclusive of sugar)

COMMODITY	UNIT OF QUANTITY	QUANTITY	VALUE IN 1,000 YEN
Hemp yarn	Metric tons	397	610
Cotton textiles			3,297
Linen			1,233
Casting			1,461
Tin-plate goods			200
Gold-silver ware			2,526*
Bricks	1,000,000 pieces	291	3,424
Roofing tiles	1,000,000 pieces	137	1,131
Cement	Metric tons	143,000	3,291*
Cement products			856
Lime	Metric tons	25,000	352
Drugs			480
Soap	Metric tons	1,716	669
Vegetable oil	Metric tons	4,772	2,351
Refined camphor	Metric tons	609	1,480
Paper	Metric tons	21,668	3,870
Superphosphate of lime	Metric tons	13,800	1,173
Mixed fertilizers	Metric tons	54,600	9,696
Coke	Metric tons	9,000**	102**
Beer	Hectoliters	25,604	916
Soy	Hectoliters	648,390	2,473
Table water			1,715
Flour	Metric tons	10,844	2,416
Salt	Metric tons	17,878	1,450
Canned pineapple	1,000,000 pieces	59	18,891
Tea	Metric tons	7,200	14,237
Lumber			6,843
Wood manufactures			6,466
Printing and binding			6,843
Paper ware			503
Bamboo ware			1,749
Hats and caps			2,371

*1936.
**1935.
NOTE: Sugar, molasses, and alcohol production are excluded from this table. Footwear production, which formerly amounted to over 2,000,000 yen a year, was negligible in 1937 and hence was also excluded.

An estimated 9,000 factories are in operation at present on the island, but the fact that 95% of the factories employed less than 30 workers each in 1938 indicates the small scale of industry. Outstanding examples of large-scale enterprise, nevertheless, are found in the sugar industry and among those plants set up under the wartime industrialization program.

In order of military importance, the principal industrial centers are at Takao, Kiirun, Shinchiku, and Karenkō cities. The Takao and Karenkō areas have the greatest concentration of factories. In 1938 the Government-General appropriated 1,000,000 *yen* for the "establishment of industrial zone facilities in Takao." A 500-acre tract is already occupied by 12 companies and an additional 500 acres were to be available for factory sites by 1942. This district, known as "Gishido," adjoins the Japan Aluminum K.K. Works (FIGURES IX - 47 and IX - 48) and is southeast of Takao-shi.

At the other end of the island, a 1,960 acre tract is being developed at Karenkō. Although harbor facilities here are poor and the coastal plain is narrow, proximity of hydroelectric power sources is a decided advantage. Karenkō production was 23,000,000 *yen* in 1938. It is expected to increase 9 times to 200,000,000 *yen* by 1945. Freight in this area is estimated at 2,300,000 metric tons in 1945. New industrial establishments at Karenkō are: the Japan Aluminum K.K., Toho Kinzoku K.K. (Nickel), Toyo Denka K.K. (phosphate fertilizers), Shinko Chisso K.K. (urea gypsum), and Ensuiko Paypupu K.K. (pulp).

Aluminum production falls to the Nippon Aluminum K.K., and magnesium to the Minami Nippon Kagaku Kogyo K.K.

FIGURE IX - 47. *Takao.*
Location of Japan Aluminum Co. works.

(South Japan Chemical Industries Company). The Asahi Denka K.K. (Rising Sun Electro-Chemical Company) handles nickel production and the Taiwan Kagaku Kogyo K.K. (Formosa Chemical Industry Company) manufactures ammonia-sulphate. The Taiyo Kogyo K.K. (Taiyo Mining Company) produces sulphuric acid, and the Taiwan Denka K.K. (Formosa Electro-Chemical Company) mainly manufactures iron alloys.

The small role played by heavy industry, the importance of a few large Japanese companies, the shortage of Formosan labor, and the use of Japanese in technical positions are outstanding characteristics of the island's industry. The presence of a labor shortage is shown by the steps being taken to import workers from Korea and China. In Taitō prefecture, for example, only half of the required labor supply is available. In January 1939, an employment bureau brought 500 west coast laborers to work in the Nippon Aluminum K.K. factory at Karenkō. At least 9,000 additional laborers were needed during 1938. The situation is further complicated by the fact that Japan has begun drafting all Formosan men of 20–24 years for labor in the construction of roads, fortresses, and harbors outside of Formosa. Thirteen companies engaged in labor supply and transportation of workers are known to be in operation in Formosa.

Unlike Japan, Formosa has no labor laws, social insurance, workmen's compensation regulations, or labor unions. Strikes virtually never occur. However, medical treatment is usually provided for injured workmen.

The working day is 10 hours, 7 days a week in most industries, with no increased rate for overtime. Wages average 1 *yen* a day for all but the Japanese workers, who receive from 25% to 50% more than the Formosan-Chinese for the same work.

Japanese usually hold positions as managers, foremen, or skilled workers, and comprise less than 5% of the total engaged in industrial production, or 10,622. Of the 169,064 laborers employed in 1,627 factories in 1938, 152,887 were Formosan-Chinese; less than 2% (4,090) were Chinese nationals; 1,256 were aborigines; and 209 were Koreans.

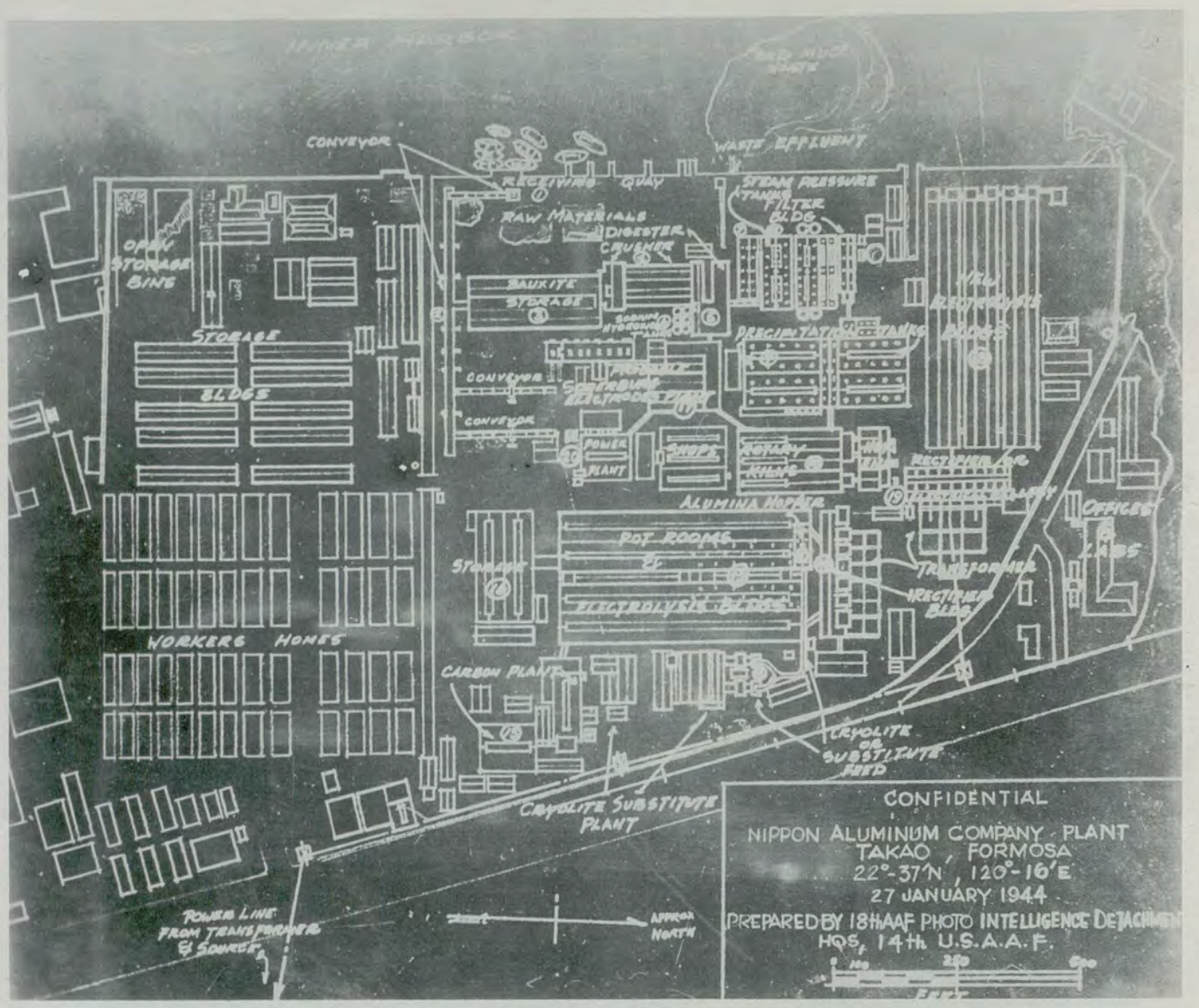


FIGURE IX - 48. *Takao.*
Plan of Japan Aluminum Co. works.

B. Metallurgical industries.

The importance of Formosan metal manufacture, although still minor in the Japanese economy, has noticeably increased under the impact of emergency war conditions. In 1938 metal manufacture was valued at 20,890,000 *yen*, or 5.3% of total Formosan industrial production. The principal metals involved are: aluminum, manganese, ferro-silicon, ferro-magnesium, iron and steel, nickel and cobalt, and copper.

(1) Aluminum.

Establishment of 2 aluminum plants in 1938 and 1940 by the Nippon Aluminum K.K. is of great importance in Formosa's industrialization. They handle all of her aluminum production. A third plant is now supposedly being set up near Kiirun-shi, where the abundance of electric power and raw materials is a determining factor. One source expects this new venture to increase Japanese aluminum production by 30%.

In 1943, Formosa produced an estimated 10% of Japan's alumina, and 15% of her aluminum. (Total Empire production for that year was estimated at 227,000 metric tons of alumina, and 105,000 metric tons of aluminum.)

Materials essential to aluminum production are for the most part not available within the Empire, although Korean supplies of fluorite are ample. Consequently, in 1943 an estimated 48,000 metric tons of bauxite were imported from Bintan, Netherlands Indies, and processed at the Takao plant. 16,000 metric tons of alumina were shipped in 1943 to Formosa from Japan proper, 2,400 metric tons of fluorite from Korea, and about 11,000 metric tons of petroleum coke from Palembang, Sumatra.

The Nippon Aluminum K.K. was established in 1935, and had a paid-up capital of 25,000,000 *yen* in 1940.

Takao plant. The Takao plant was built in 1936–37 by a combination of the Mitsui, Mitsubishi, Sumitomo, and Furukawa interests and German technicians were employed (FIGURES IX - 47 and IX - 48). In 1937, the plant employed 125 technicians and 500 workmen. The capacity of the plant is estimated to be 20,000 metric tons of aluminum and 40,000 metric tons of alumina per year or 10% of Japanese Empire aluminum and alumina capacity. Actual production of aluminum was estimated to be 10,000 metric tons in 1943, but no figure is available for alumina production. The plant's power supply is obtained from the Jitsugetsu-tan development. Materials used for 1943 production were: 48,000 metric tons of bauxite ore, 60,000 metric tons of coal, 1,500 metric tons of fluorite, 6,600 metric tons of carbon electrodes, and 372,000,000 kilowatt hours of electrical energy. The plant is not served by rail; most of its shipments are handled by water.

The equipment of the plant consists of a main building, 30 meters by 100 meters, housing the electrolytic cells; a

building containing mercury rectifiers; a repair and machine shop; an alumina plant, 100 meters by 25 meters; a metal construction plant, used for making the paste for Soderberg electrodes; and a bauxite stock-pile and storage bins.

Karenkō plant. The Karenkō plant was completed in 1940. It has a capacity of 6,000 to 10,000 metric tons of aluminum a year, but no alumina capacity. Actual production of aluminum in 1943 was estimated at 10,000 metric tons, using as raw material, alumina brought from Kyūshū. For this production, an estimated 3,960 metric tons of electrodes, 900 metric tons of fluorite, and 180,000,000 kilowatt hours of electric energy were required. The plant uses electric power from 4 plants on the Mokkui-kei owned by the Nippon Aluminum K.K.

The plant is reported to have made plans for a yearly production of 1,000 metric tons of magnesium by means of a carbon reduction process. Magnesite would be imported from Manchuria.

(2) *Manganese and ferro-silicon.*

The main office of the Taiwan Denke K.K. (Formosa Electro-chemical Company) is in Kiirun-shi and it operates plants at Kiirun and Ratō, both in Taihoku province.

The Kiirun plant has an annual capacity of 10,000 metric tons of ferro-silicon, and produces electro-ferro-silicon, manganese, and carbide. The raw materials used are manganese deposits from the east coast and Suō, manganese ore sent from the Philippines, silicon imported from Dairen, and scrap-iron from Japan.

The Ratō plant produces manganese from ore obtained from deposits near Karenkō.

(3) *Ferro-magnesium.*

Two Japanese companies have plants in Takao for the production of ferro-magnesium. The Asahi Denka Kogyo K.K. (Rising Sun Electro-Chemical Industries Company) produces annually 1,500 metric tons of ferro-magnesium and some caustic soda and chlorides. For this production it uses magnesite imported from Manchuria and Korea and salt produced locally. Its electric power is furnished by the Jitsugetsu-tan development. The Minami Nippon Kagaku Kogyo K.K. (South Japan Chemical Industries Company) was planned to produce 2,400 metric tons of ferro-magnesium and 16,000 tons of caustic soda. Detailed information is not available but it appears that the plant works by electrolysis of brine.

(4) *Iron and steel.*

The Maruyama Electric Iron Experimental Factory in Taihoku-shi, pioneer in iron and steel manufacture, began operation in June, 1939. Capacity was 1,500 metric tons of pig iron, 1,500 metric tons of ordinary steel and 500 tons of special steel per year. Additional iron and steel works have probably been built at Kiirun or Takao. TABLE IX - 40 lists Formosan iron and steel producers.

(5) *Nickel cobalt.*

The Toho Kinzoku Seiren K.K. (Toho Metallurgical Refining Company) plant at Karenkō was completed in March 1940 and its machinery installed in December 1940.

Arsenical nickel mines in South Rhodesia, formerly supplied the ore (25% nickel) for this plant, but more recently it is believed to obtain its supplies from the Celebes. It is now

TABLE IX - 40
FORMOSAN IRON AND STEEL PRODUCERS

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION
Kiirun Keitetsu K.K.	600,000	1912	Kiirun-shi
Kaizan Keitetsu K.K.	500,000	1921	Sankyō-shō (Taihoku-shū)
Kotake K.K.	150,000	1938	Taihoku-shi
Taichu Keitetsu K.K.	1,225,000	1918	Toyohara-gai (Taichū-shū)
Taichu Chuzo Tekko K.K.	200,000	1919	Taichū-shi
Taihoku Tekkosho K.K.	100,000	1932	Taihoku-shi
Taihoku Seikosho K.K.	180,000	1939	Taihoku-shi
Taiwan Keitetsu K.K.	200,000	1911	Tainan-shi
Taiwan Tekkosho K.K.	2,000,000	1919	Takao-shi
Takechi Tekkosho K.K.	200,000	1929	Takao-shi
Toyo Kogyo K.K.	220,000	1938	Taihoku-shi

believed to have large stocks on hand. The plant had an initial capacity of 2,100 metric tons of nickel and 20 metric tons of cobalt per year, and plans were made to develop a capacity of 26,000 metric tons of nickel and 50 metric tons of cobalt. For this production an estimated labor force of 15,000 persons would be required.

The facilities of the plant include sections for crushing, ore-mixing, cobalt crushing, an electric concentration plant for cobalt, a repair shop, a transformer, a furnace, and a laboratory and dust chamber.

The Karenkō smelter produces about 10% of Japan's nickel requirements. The plant is believed also to process chromium ore from the Philippines.

(6) *Copper.*

Only the first step in copper ore processing is performed in Formosa, final refining being done in Japan proper. A dry process smelter was opened at Suinandō in 1907 by Kinkaseki mines, but only 205 metric tons were refined in 1924. Greatly expanded copper smelting facilities are believed to exist in Formosa today.

A Tōkyō broadcast in September 1943, reported that a revolutionary electro-smelting process for copper had been discovered by the Taiwan Denryoku K.K. experts. This new method was to be adopted in the construction of the company's electric furnaces. It was reported to be the most advanced copper smelting process in the world.

C. Machinery and vehicles.

Although most of Formosa's needs in this field must be filled by imports, several ironworks on the island manufacture various types of machine tools and engines. Production has steadily increased. In 1933 output of machinery was valued at 5,695,000 *yen*. In 1938, it had risen to 13,515,760 *yen*, or 3.4% of the total industrial production, and to 4.3% of the total in 1940.

There are 4 leading machinery plants in Formosa:

Taiwan Tekkosho. The Formosa Ironworks in Takao-shi manufactures sugar plantation equipment and other machinery. In 1936 it employed 348 men.

Maeda Tekkosho. The Maeda Ironworks, in Kiirun-shi, manufactures machine tools to fill orders of Japan Mining Company, Taiwan Electric Power Company and Taiwan Development Company.

Oba Tekkosho. The Oba Ironworks, in Takao-shi manufactures marine engines. Other details of its operations are not available.

TABLE IX - 41

MINOR FORMOSAN MACHINERY COMPANIES

COMPANY	CAPITALIZATION (IN YEN)	DATE OF FOUNDING	LOCATION	TYPE OF MACHINERY
Yamashita Shoten K.K.	100,000	1919	Taihoku-shi	machine tools
Yamanaka Shoten K.K.	300,000	1928	Takao-shi	machine tools
Towa Shoko K.K.	100,000	1939	Ratō-gai (Taihoku-shū)	machine tools
Kyoei Tekkosho K.K.	100,000	1937	Tainan-shi	machine tools
Kinzan Shoten K.K.	100,000	1939	Taichū-shi	machine tools
Taishodo K.K.	100,000	1938	Ratō-gai (Taihoku-shū)	electrical tools
Taiwan Denka K.K.	2,000,000	1935	Kiirun-shi (Taihoku-shū)	furnaces for alloy manufacturing
Taiwan Tessen K.K.	500,000	1937	Takao-shi	iron wire
Taiwan Seitetsusho K.K.	200,000	1938	Tainan-shi	general
Kanshirei Kido K.K.	150,000	1927	Tainan-shi	rails
Taiwan Senkyo K.K.	5,000,000	1937	Kiirun-shi	ship docks
Toyo Kogyo K.K.	220,000	1938	Taihoku-shi	cast iron goods, pots and pans
Toyo Suido K.K.	180,000	1939	Taichū-shi	water works machinery, pumps
Taiwan Casu Hasseito K.K.	1,000,000	1934	Taihoku-shi	furnaces
Taiwan Kido K.K.	500,000	1919	Shinchiku-shi	rails
Komei Sha Shokai K.K.	120,000	1939	Taihoku-shi	printing machines
Taiwan Seiki Kogyo K.K.	180,000	1938	Taihoku-shi	refining machines
Giwa Tekkosho K.K.	120,000	1939	Tainan-shi	general
Taihoku Tetsudo K.K.	180,000	1939	Taihoku-shi	general
Takasuna Tekkosho K.K.	120,000	1939	Taihoku-shi	cast iron machines
Toko Kogyo K.K.	600,000	1936	Taihoku-shi	machine tools
Taihoku Seikosho K.K.	180,000	1939	Taihoku-shi	general
Toyohara Kogyo K.K.	180,000	1940	Toyohara-gai (Taichū-shū)	machine tools
Nakada Seisakusho K.K.	180,000	1937	Taihoku-shi	steam engines
Daido Tekkosho K.K.	180,000	1939	Taihoku-shi	cast iron machines
Taiei Shoji K.K.	160,000	1937	Kagi-shi (Tainan-shū)	agricultural tools
Sakurai Denki Chukosho K.K.	1,000,000	1939	Taihoku-shi	cast iron machines
Taiwan Godo Noki K.K.	100,000	1938	Taichū-shi	agricultural machines
Koa Seiko K.K.	400,000	1939	Taihoku-shi	cast iron machines
Taiwan Noki K.K.	100,000	1939	Kagi-shi (Tainan-shū)	agricultural machines

Sugihara Kogyo K.K. (Sugihara Industries Company). The Sugihara Industries Company, in Taihoku-shi, manufactures light machinery, also chemicals, fibers, paper, and foodstuffs. Other details of its operations are not available.

Other machinery companies are listed in TABLE IX - 41.

As yet, there are no automobile plants in Formosa, although the Kokusan Jidosha K.K. (Kokusan Automobile Company) has considered expanding its Taihoku service station and establishing an auto plant in Takao-shi. The estimated number of motor vehicles in Formosa for 1938 was 2,700. The Government-General's railroad shops employed 1,500 workers, including over 1,000 in Taihoku-shi, 300 in Takao-shi, and 100 in Karenkō-shi.

D. Aircraft industry.

Aerial reconnaissance during late 1943 and early 1944 has made available exact data on repair and assembly facilities at Okayama (Takao-shi), Shinchiku, and Heitō (Takao-shū). (FIGURES IX - 49 and IX - 50). The Okayama Aircraft Assembly Plant is located at Okayama Airfield, just east of the airfield. Its transportation facilities include railroad branches from the main line north of the town and highways. The type of aircraft which it produces is not clear, but it is probably the Nakajima trainer. Its plant installations include 42 buildings and shops among which are receiving and stock storage facilities; 2 shops for stock processing; 1 small parts and shapes shop; 2 hardening and plating shops; 2 buildings for cutting and die making; 1 sheet shaping shop; 1 machine shop; 3 buildings for sub-assembly; 4 buildings for assembly; 12 tubing shops; 2 engine testing blocks; and storage area containing hangars, sheds, and warehouses. The assembly plant is probably connected to an underground storage depot where aircraft parts and material are kept. Details are not available.

The Heitō airfield is located 1⅔ miles west of Heitō. The plant's assembly and repair facilities, operated by the Heitō Branch Army Air Arsenal, are located at the northeast corner of the airfield. The plant is served by a single-track railroad. It contains 6 pitch shop buildings, 2 large saw-toothed hangars, an engine repair and assembly shop, an engine-testing building, an airplane salvage and "bore" yard for crashed and unserviceable craft, 5 large hangars used in the initial stage of assembly and for the repair of damaged aircraft and parts, and an area containing 14 shop buildings.

The Shinchiku airfield is located 2 miles west of Shinchiku-shi. It operates complete facilities for maintenance, repair, and final assembly of all types of aircraft, and has 8 hangars, 19 shops, 10 barracks, a radio station, and fuel and ammunition storage. A repair depot and assembly plant, covering an area of 2,500 feet by 1,500 feet, are now under construction 7,500 feet south-southeast of the center of the airfield.

E. Munitions.

A dearth of detailed information on Formosan munition plants makes impossible any definite statement on this industry, but it seems likely that such plants do exist. One source suggests that they operate under some form of subcontracting system, possibly situated at the new Kiirun and Takao industrial areas, or at Taihoku and Karenkō.

F. Chemicals.

The chief chemical plants in Formosa are the Taiwan

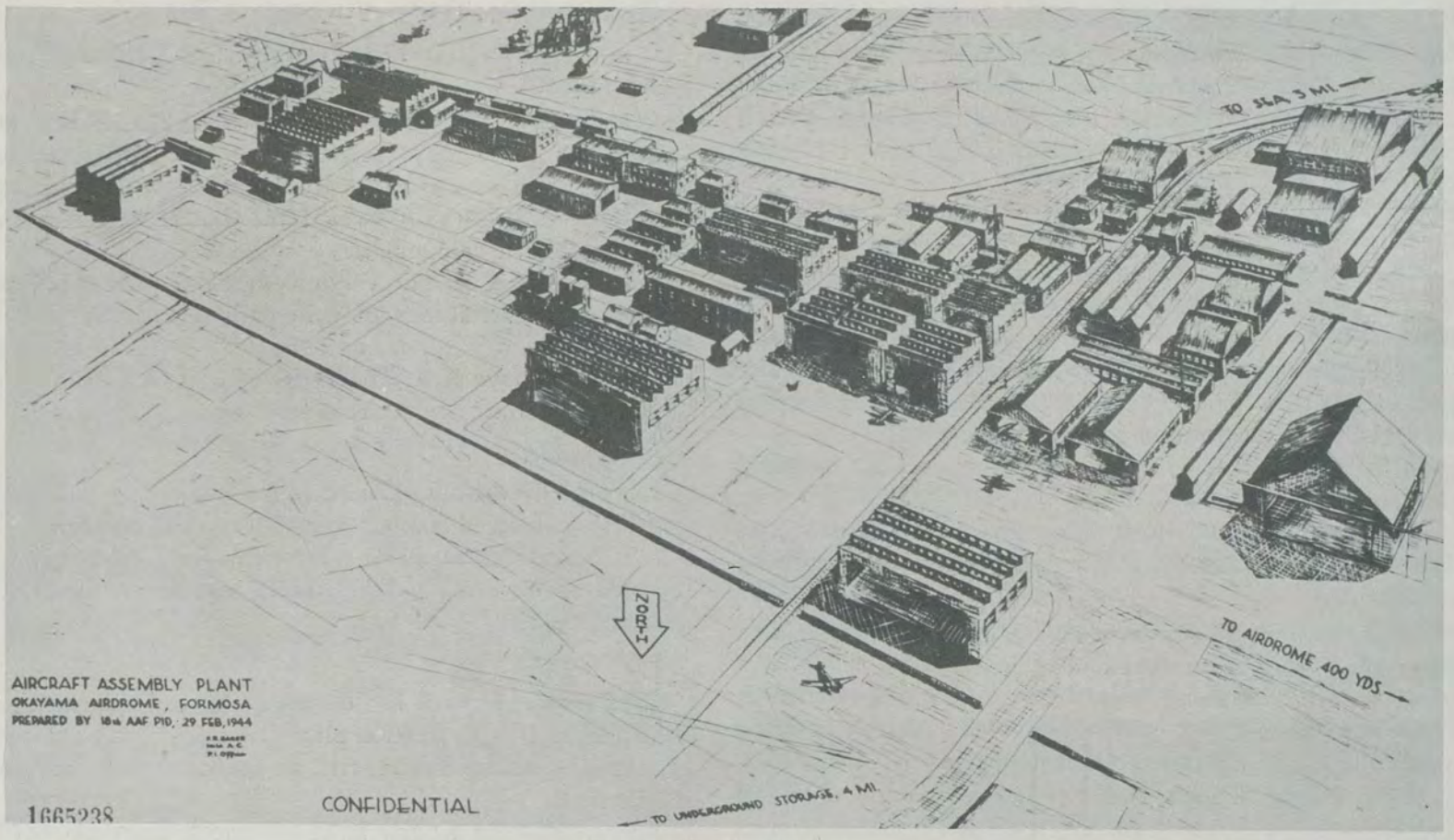


FIGURE IX - 49. *Okayama.*
Aircraft assembly plant, 29 February 1944.

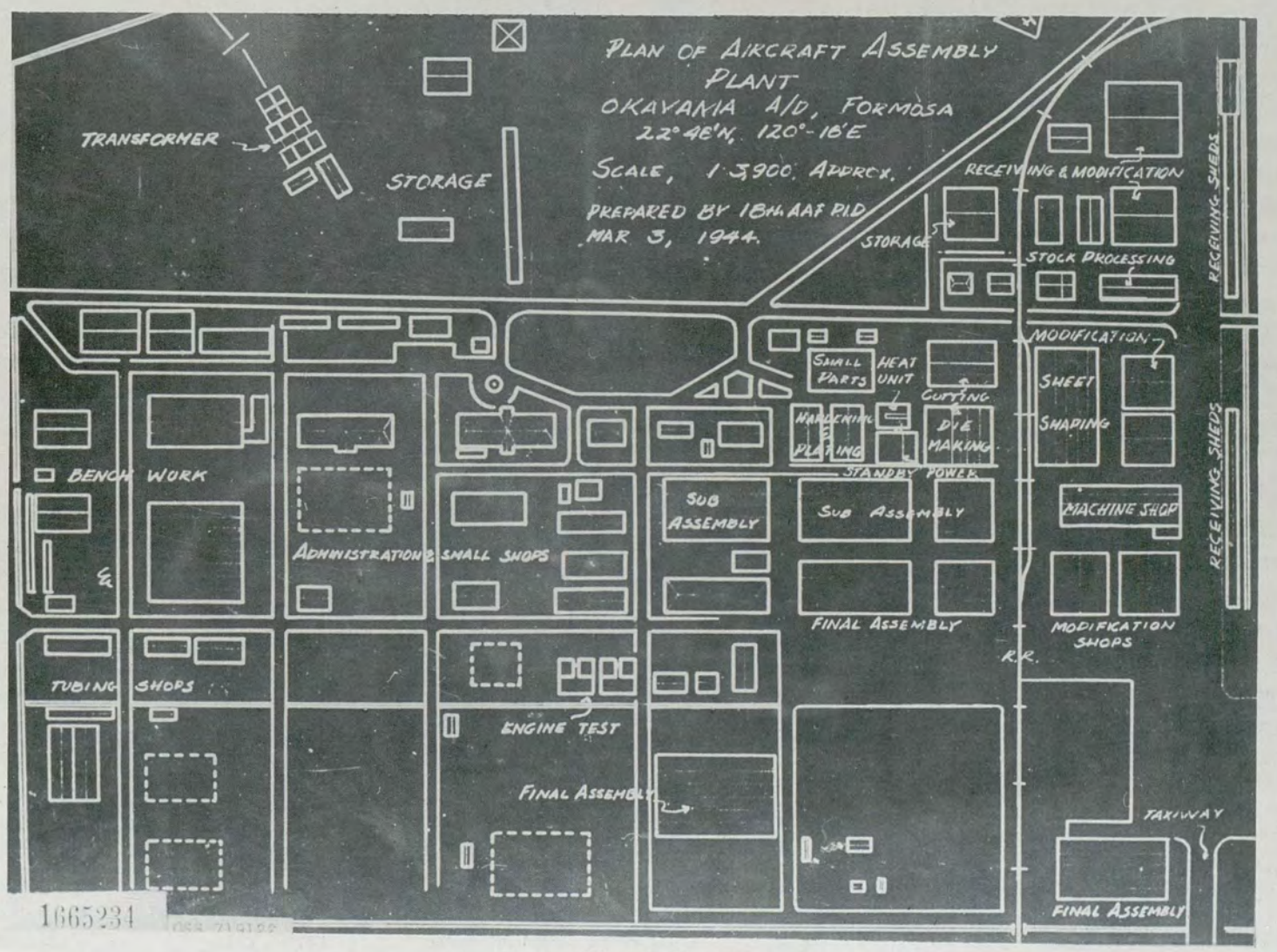


FIGURE IX - 50. *Okayama.*
Plan of aircraft assembly plant, 3 March 1944.

Hiryo K.K. (Formosa Fertilizer Company) ammonium sulfate factory at Shinchiku, and the Taiwan Denka K.K. (Formosa Electro-Chemical Company) factory at Kiirun. In 1938, the output of chemical plants had risen to 39,746,000 *yen* or 10.1% of total industrial production. In 1940, chemicals comprised 11.9% of the total.

(1) *Fertilizer.*

Chemical fertilizer production in 1940 is estimated at 6,656 metric tons of lime nitrate, 20,478 metric tons of superphosphate of lime, and 101,898 metric tons of mixed fertilizer.

(*a*) *Fertilizer plants—miscellaneous fertilizers.* Minami Nippon Engyo K.K. (South Japan Salt Industries Company) is planning the production of potassium fertilizer.

Taiwan Denka K.K. (Formosa Electro-Chemical Company) produces lime nitrate at Kiirun.

Taiwan Hiryo K.K. (Formosa Fertilizer Company) at Kiirun and Takao has a capacity of 70,000 tons of compound fertilizers.

(*b*) *Fertilizer plants—ammonium sulfate.* Taiwan Kagaku Kogyo K.K. (Formosa Chemical Industries Company) has a plant at Akashizaki in Shinchiku province, at which it plans to produce 75,000 metric tons a year. Electric power is secured from the Jitsugetsu-tan development.

Toyo Denka Kogyo K.K. (Oriental Electro-Chemical Industries Company) at Karenkō, with an estimated production for 1942 of 40,000 metric tons, was to be expanded to 80,000 metric tons by 1945. Kinkaseki Mine sulfides, and Kinsui natural gas are used. Phosphate rock came from Angaur island in the Carolines.

Taiwan Jukogyo K.K. (Formosa Heavy Industries Company) announced plans for an ammonium sulfate installation at Takao, but no details are known.

(*c*) *Fertilizer plants—phosphates.* Construction of a Karenkō factory of the Toyo Denka Kogyo K.K. was begun in June 1939, and production was presumably begun by June 1940. Phosphate rock was to be brought from Angaur island and annual production was planned to be 20,000 metric tons of "amo-phos," 1,500 metric tons of artificial rock crystal, 1,500 metric tons of sulfuric acid, and 1,500 metric tons of absolute ammonia.

The Shinko Chisso Kogyo K.K. (Shinko Nitrogen Industries Company) was set up 25 August 1939 to control the chemical industry in eastern Formosa. It established a factory at Karenkō which plans to produce 75,000 metric tons of phosphate beginning in 1944.

(*d*) *Fertilizer plants—urea gypsum.* The Chosen Kagaku Kogyo K.K. (Korea Chemical Industries Company) was to erect a factory at Karenkō to produce urea gypsum from Karenkō limestone. Production was estimated at 70,000 metric tons for 1941, and the same for 1942, while a goal of 300,000 metric tons was to be reached by 1945.

(2) *Sulfuric acid.*

(*a*) *Production.* 11,949 kilograms of sulfuric acid were produced in 1938.

(*b*) *Sulfuric acid plants.* Taiwan Hiryo K.K. The Taiwan Hiryo K.K. has a single chamber process installation at Kiirun with an estimated production capacity of 15,000 metric tons of pure sulfuric acid and 27,000 metric tons of super-phosphoric acid annually.

Taiyo Kogyo K.K. The Taiyo Kogyo K.K. plant at Zuihō produces 50 metric tons of acid daily using the Matsui-Osame process.

Taiwan Jukogyo K.K. The Taiwan Jukogyo K.K. planned to produce sulfuric acid at Takao.

(3) *Cyanide.*

The Formosa Mining Company has a plant at Kinkaseki which it operates in conjunction with its gold flotation mill.

The Nippon Soda K.K. (Japanese Soda Company) is reported to have a plant at Ampin manufacturing caustic soda and cyanide.

(4) *Nitrates.*

The Taiwan Denka K.K. (Formosa Electro-Chemical Company) has a nitrogen fixation plant at Karenkō, and a calcium cyanamide plant at Kiirun with an annual capacity of 2,400 metric tons.

Taiwan Kagaku Kogyo K.K. (Formosa Chemical Industries Company) has a nitrogen fixation plant at Shinchiku which uses the Haber method and has a production rating of 20,000 metric tons a year.

The Shinko Chisso Kogyo K.K. (Shinko Nitrogen Industries Company) also produces nitrogeneous phosphates.

(5) *Miscellaneous chemical industries.*

(*a*) *Oxygen.* An oxygen factory is reported at Takao. Formosan production rose from 240,986 cubic meters in 1936 to 410,555 cubic meters in 1938.

(*b*) *Liquefied carbonic acid.* Production of liquefied carbonic acid in Formosa rose from 58,717 kilograms in 1936 to 224,602 kilograms in 1938.

(*c*) *Explosives.* The Taiwan Bakuchiku K.K. (Formosa Firecracker Company) at Taihoku has probably been converted to war use either processing wolfram or manufacturing small arms and ammunition.

G. Textile manufacturing.

Textile manufacture, of minor importance in the Formosan economy, includes hemp yarn, cotton goods, and linen. In 1938, 397,000 kilograms of hemp yarn were produced, but the quantities of cotton textile and linen are not known. Out of a total of 17,600 metric tons of jute produced, probably 14,000 metric tons were made available to Japan proper. Most of Formosa's textile needs must be satisfied with imports from Japan, Korea, or Manchuria. TABLE IX - 42 lists textile manufacturing companies operating in Formosa.

TABLE IX - 42

FORMOSAN TEXTILE COMPANIES

COMPANY	CAPITALIZATION (IN YEN)	DATE FOUNDED	LOCATION	PRODUCT	NUMBER OF WORKERS
Taiwan Choma Boseki KK...	—	—	Tainan (Taihoku-shū)	ramie yarn	627
Taiwan Seima KK.....	1,400,000	1911	Toyohara (Taichū-shū)	hemp cloth and yarn	505
Takekoshi Yoko KK.....	300,000	1937	Taihoku-shi	cotton and rayon goods	—
Tainan Seima KK.....	2,000,000	1935	Tainan-shi	jute cloth and jute bags	—

H. Pulp and paper.

Bagasse is the chief source of Formosan pulp (Topic 94, B, (4)). Three large companies control the Formosan pulp industry. The Ensuiko Parupu K.K. (Ensuiko Pulp Company) produces about 30,000 metric tons of bagasse pulp annually at its factory in Shinei-gai, Shinchiku province.

The Taiwan Parupu K.K. (Formosa Pulp Company) plant in Taikō-gai, Taichū province, produces 15,000 metric tons of bagasse pulp annually, using a magnesium sulphite process.

The Taiwan Kogyo K.K. (Formosa Industrial Company) plant in Goketsu-shō, Taihoku province, produces 13,000 metric tons of bagasse pulp annually.

The Artex Manufacturing Company (in Taihoku-shi) manufactures and sells paper and paper goods. An important household industry in Formosa is the manufacture of pith paper from the *akebia* vine.

I. Other industries.

(1) *Carbon black.*

Carbon black is produced at the natural gas fields in Kinsui, Chikutō, and elsewhere. Production at Chikutō dropped from 2,000 metric tons in 1937 to 400 tons in 1939. The Nippon Sekiyu K.K. plant at Kinsui (Figure IX - 51) produced 2,250

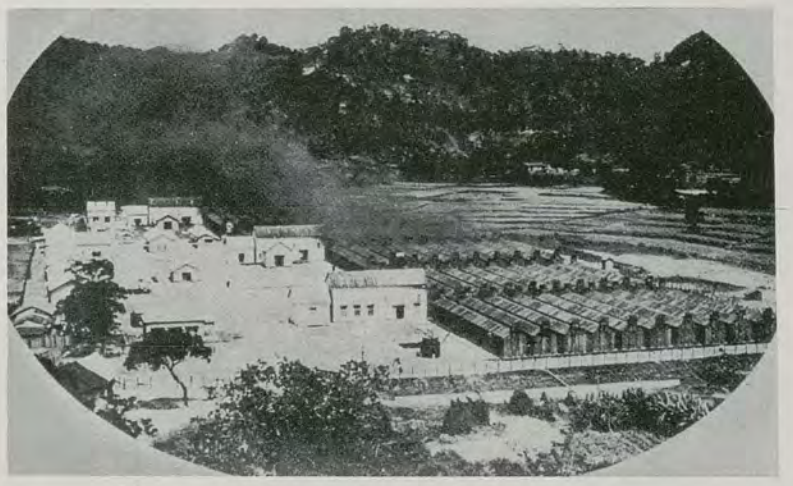


Figure IX - 51. *Kinsui.*
Carbon black plant.

metric tons in 1939. The quality of Formosan carbon black is low, and Japan formerly depended upon imports from the United States for manufacture of such essential rubber goods as tires. The Formosan product went into the manufacture of phonograph records, electrodes, printing ink, and paint. Nippon Sekiyu K.K. is reported to have set up 3 small plants at Gyuzan, Bochiriʼ and Chikutō, with capacities of 150 metric tons, 670 metric tons, and 330 metric tons, respectively.

(2) *Rubber.*

The Taiwan Gomu Kogyo K.K. expects to begin production in a factory outside of Taihoku city. Rubber shoes and tires are to be manufactured.

96. *Electric Power*

A. Generating facilities.

The known installed generating capacity of Formosan electric power plants is 315,982 kilowatts (Figure IX - 78). By the end of 1945 it is expected that capacity will be doubled through completion of 6 additional plants totaling 320,300 kilowatts. Present installations range in capacity from 7½ to 100,000 kilowatts. Of the present installed capacity, 235,002 kilowatts are in hydroelectric plants and 80,980 kilowatts in fuel plants. The 6 plants to be completed by 1945 are all public utility hydroelectric plants.

There are a number of good hydroelectric sites on Formosan rivers and streams. The most recent available survey of Formosa's hydroelectric potentiality (1938) shows that over 2,500,000 kilowatts could be made available from 19 principal rivers and streams. At least 1,000,000 additional kilowatts could be made available through the construction of dams and reservoirs.

The climatic changes in Formosa are roughly the same as those for Japan proper, namely, a wet and dry season. The dry season generally lasts from November to March with slight variations between the northern and southern parts of the island. During the dry season, the normal stream flow and resulting hydroelectric generation are cut by almost 50%.

Hydroelectric generating plants act as base load plants during 8 or 9 months of the year, and during the dry season the fuel plants generate a portion of the load. There are only 4 public utility fuel plants in Formosa with capacities of 1,000 kilowatts or over. All Formosan fuel plants are located in urban areas and receive their fuel supplies either by ship or rail. They generally use Formosan coal, oil, or gas as fuel.

Destruction of the Takao No. 2 Steam Plant (13,000 kilowatts) and the Kiirun Steam Plant (38,000 kilowatts) before the occupation of Formosa would result in a serious power shortage during the dry months from November to March. Destruction of the plants in the Jitsugetsu-tan hydroelectric development (Figure IX - 79) would have the same effect during the other months of the year. Portable generating units brought in by United Nations' forces might prove to be the most effective means of offsetting such losses, which seem to be an almost certain concomitant of operations in the Formosan theatre, due either to Allied bombing attacks or to Japanese scorched-earth tactics.

There follows a list* of known hydroelectric and fuel generating plants in Formosa. These are grouped according to type of prime mover and location within each province. Coordinates are given for all plants above 1,000 kilowatts whose locations could be determined from the Dai Nippon Teikoku Rikuchi Sokuryo-bu, *Nijuman-bun-ichi Teikoku-zu* (Great Japan Imperial Land Survey, *Maps of the Japanese Empire*). Capacities given are the installed or name-plate capacity of fuel plants and the maximum capacity or capacity available during the wet season for hydroelectric plants. Plants of over 1,000 kilowatts are ranked according to size.

*The following abbreviations of terms and symbols are used in this section:

cap	capacity	kwh	kilowatt hour
cm	centimeter	m	meter
conn	connection	m 3/sec	cubic meters per second
cyc	cycle	max	maximum, maximum output
D-Y, D-D	types of transformer connections	ph	phase
		reg	regular output
eff	effective	res	reserve output
hp	horsepower	rpm	revolutions per minute
kg	kilogram	sec	second
km	kilometer	spec	special output
kv	kilovolt	sup	supplementary output
kva	kilovolt ampere	v	volt
kw	kilowatt	@	each

The following trade name abbreviations are likewise used:

AEG—Allgemaine Elektrische Gesellschaft, B & W—Babcock and Wilcox, EW—Escher Wyss, GE—General Electric, SS—Siemens Schukert.

(1) *Taihoku province.*

(a) Hydro plants.

Dakusui.
Company: Taiwan Denryoku K.K.
Location: Plant—Believed to be in Ratō-gun, Taihoku-shū on Dakusui-kei; exact location unknown
Capacity; 1500 kw as of June 1939
Importance: Rank in Formosa supply area—20
Date of Construction: Unknown; in operation as early as Dec. 1934 and as recently as June 1940

Inzan. Approx. Lat. 24° 48′, Long. 121° 45′.
Company: Taiwan Denryoku K.K.
Location: Plant—Believed to be in Inzan-sho, Giran-gun, Taihoku-shu on Dakusui-kei
Capacity: 16,300 kw
Importance: Rank in Formosa supply area—7
Date of Construction: Construction was begun in 1939 and completion was scheduled for Oct. 1941

Kizan (Figure IX - 52).
Company: Taiwan Denryoku K.K.
Location: Kizan-oaza, Shinten-shō, Bunzan-gun, Taihoku-shū, believed to be on Shinten-kei
Capacity: 750 kw as of May 1939
Date of Construction: Completed 1905, in operation May 1939

Figure IX - 52. *Taihoku-shū.*
Kizan hydro plant.

Shin Kizan. Approx. Lat. 24° 55′, Long. 121° 30′.
Company: Taiwan Denryoku K.K.
Location: Plant—Kizan-oaza, Shinten-shō, Bunzan-gun, Taihoku-shū, believed to be on Shinten-kei
Capacity: 13,000 kw as of January 1941
Importance: Rank in Formosa supply area—8
Date of Construction: Construction was begun in 1939 and completed March 1941
Other details: Eff head—54 m
Plant, equipment
Turbines—2 @ 7500 kw, Francis-type, vertical-shaft, Hitachi-make
Generators—2 @ 7500 kva, 3-ph, 300 rpm, 60 cyc, Hitachi-make

Shirin.
Company: Taiwan Denryoku K.K.
Location: Shirin-gai, Shichisei-gun, Taihoku-shū, believed to be on Tamsui-ka
Capacity: 500 kw as of May 1939
Date of Construction: Unknown; in operation May 1939

Shosoko (Figure IX - 53). Approx. Lat. 24° 58′, Long. 121° 27′
Company: Taiwan Denryoku K.K.
Location: Plant—Believed to be in Shinten-shō, Bunzan-gun, Taihoku-shū, on Shinten-kei
Capacity: 4,400 kw as of May 1939
Importance: Rank in Formosa supply area—14
Date of Construction: Completed 1909; in operation June 1940
Details: Plant, equipment
Turbines—1 @ unknown cap, vertical-shaft, Dengyosha-make. At least 1 additional unit in operation
Generators—1 @ 1,250 kva, 3-ph, 11,000 v, 450 rpm, 60 cyc, Shibaura-make. At least 1 additional unit in operation

Tenrei.
Company: Taiwan Denryoku K.K.
Location: Plant—Believed to be in Taihoku-shū on Taikō-kei
Capacity: 98,000 kw (see Date of Construction)
Importance: If completed, rank in Formosa supply area—2
Date of Construction: Planned in 1939; scheduled for completion by 1945

Tensopi. Approx. Lat. 24° 40′, Long. 121° 36′
Company: Taiwan Denryoku K.K.
Location: Plant—Believed to be in Giran-gun, Taihoku-shū on Dakusui-kei
Capacity: 8,600 kw as of June 1939
Importance: Rank in Formosa supply area—9
Date of Construction: In operation as early as December 1934 and as recently as June 1940

Figure IX - 53. *Taihoku-shū.*
Shosoko hydro plant.

FUEL PLANTS

Kiirun (Steam). Approx. Lat. 25° 09′, Long. 121° 47′
Company: Taiwan Denryoku K.K.
Location: Hattoshi (Kiirun-shi, Taihoku-shū)
Capacity: 38,000 kw as of June 1939
Importance: Rank in Formosa supply area—5
Date of Construction: Construction was begun Feb. 1937 and completed Mar. 1939; in operation June 1940
Other details:
Plant, external features—Of reinforced concrete construction, 5 stories high, about 100 ft. high with 2 or 3 tall chimneys, 2,660 yd² area
Plant, equipment
Fuel supply—Uses coal from Zuihō coal mine which is delivered via a 3,200 m long cable line @ 70 m ton/hr cap; 8,000 m ton coal storage cap
Boilers—2 @ B & W-type
Turbines—Believed to be 2 @ 17,500 kw, AEG-make 1 @ 3,000 kw, AEG-make (house unit)
Generators—Believed to be 2 @ 17,500 kw, 3-ph 1 @ 300 kw, 3-ph, (house unit)

Matsuyama (Steam). Approx. Lat. 25° 03′, Long. 121° 33′
Company: Taiwan Denryoku K.K.
Location: Matsuyama-shō, Shichisei-gun, Taihoku-shū
Capacity: 5,500 kw as of June 1939
Importance: Rank in Formosa supply area—11
Date of Construction: Unknown; in operation as early as May 1939 and as recently as June 1940

Taihoku
Company: Taihoku-shi
Location: Taihoku-shi, Taihoku-shū
Capacity: 500 kw as of April 1935
Date of Construction: Unknown; in operation April 1935

~~*(b) Fuel plants. None known.*~~

(2) *Shinchiku province.*

(a) Hydro plants.

Nansho
Company: Taiwan Denryoku K.K.; formerly Nanshō Denki K.K.
Location: Nanshō (Chikunan-gun, Shinchiku-shu), believed to be on Chuko-kei
Capacity: 7½ kw as of Dec. 1935
Date of Construction: Unknown; in operation Dec. 1935

(b) Fuel plants.

Byōritsu (Diesel).
Company: Taiwan Denryoku K.K.; formerly Taiwan Dento K.K.
Location: Byōritsu-gai (Byōritsu-gun, Shinchiku-shū)
Capacity: 100 kw as of Dec. 1935
Date of Construction: Unknown; in operation Dec. 1935

Chikunan (Diesel).
Company: Taiwan Denryoku K.K.; formerly Taiwan Godo Denki K.K.
Location: Chikunan-gai (Chikunan-gun, Shinchiku-shū)
Capacity: 60 kw as of Dec. 1935
Date of Construction: Unknown; in operation Dec. 1935

Tōen (Steam).
Company: Taiwan Denryoku K.K.; formerly Taiwan Godo Denki K.K.
Location: Tōen-gai (Tōen-gun, Shinchiku-shū)
Capacity: 132 kw as of Dec. 1935
Date of Construction: Unknown; in operation Dec. 1935

(3) *Taichū province.*

(a) Hydro plants.

Hokuzankō (Figure IX - 54). Approx. Lat. 23° 59′, Long. 120° 52′
Company: Taiwan Denryoku K.K.
Location: Hokuzankō, Kokusei-shō. Nōkō-gun, Taichū-shū, believed to be on Nanko-kei
Capacity: 1,800 kw as of June 1939
Importance: Rank in Formosa supply area—18
Date of Construction: Unknown; in operation as early as Dec. 1934 and as recently as June 1940

Kori (Figure IX - 55)
Company: Taiwan Denryoku K.K.
Location: Kori (Naiho-shō, Toyohara-gun, Taichū-shū) believed to be on Taian-kei
Capacity: 960 kw as of May 1939
Date of Construction: Completed 1911, in operation May 1939

Jitsugetsu-tan No. 1 (Figures IX - 56 to IX - 62). Approx. Lat. 23° 51′, Long. 120° 52′
Company: Taiwan Denryoku K.K.
Location: Plant—On the Suiri-kei at Mompaitan in Shūshū-shō, Niitaka-gun, Taichū-shū
Dam 1—About 15 km northeast of Jitsugetsu-tan-ko at Bukai-shō, Nōkō-gun, Taichū-shū
Dam 2—Suisha in Gyochi-shō, Niitaka-gun, Taichū-shū
Dam 3—Tōsha-ōaza in Gyochi-shō, Niitaka-gun, Taichū-shū
Capacity: 100,000 kw as of Dec. 1934
Importance: Rank in Formosa—1
With the Jitsugetsu-tan No. 2 Hydro Plant, serves the calcium carbide and ferroalloy factories of the Taiwan Denka K.K. (10,000 kw) and the Takao factory of the Nippon Aluminum K.K. (30,000 kw). Plant can produce about 515,000,000 kwh per annum operating with a 58.8% load factor
Source of Power: Dakusui-kei
Date of Construction: Construction was begun Oct. 1931 and partly completed Sept. 1934 when 2 of the 5 units went into operation; plant in full operation June 1940
Other details:
Layout—Aqueduct-type with Jitsugetsu-tan as storage reservoir
Eff head—320.5 m; flow—41.53 m³/sec.
Dam 1—90.91 m long at top, 48.48 m high, of concrete construction, gravity-type with 6 taintor gates
Dam 2—Of earthen construction
Dam 3—Of earthen construction
Reservoir—14,200,000 m³ eff cap
Aqueducts—50,000 ft long tunnel and open ditch from intake to Jitsugetsu-tan and 9,800 ft long tunnel to plant from lake
Penstocks—5 @ 2,000 ft. long
Plant, equipment
Turbines—5 @ 33,000 hp., Pelton-type, horizontal-shaft, Voith-make
Generators—5 @ 22,222 kva., 3-ph., 11,000 v., 300 rpm, 60 cyc., GE-make
Transformers—15 @ 7,400 kva., 1-ph., 11/89 kv., D-Y conn., water-cooled, core-type, GE-make
Other equipment—2 arc suppressors for transmission lines, including 1 @ 16,465 kva. and 1 @ 14,062 kva.; 5 exciters @ 125 kw.
Area served—Serves Taihoku district via a 187.1 km. transmission line and Takao district via a 159.7 km. line, both 154 kv.

Jitsugetsu-tan No. 2 (Figures IX - 63 to IX - 66). Approx. Lat. 23° 49′, Long. 120° 51′
Company: Taiwan Denryoku K.K.
Location: Plant—At the tail race of the Jitsugetsu-tan No. 1 Hydro Plant at Suirikō, Shūshū-shō, Niitaka-gun, Taichū-shū
Dam—Mompaitan in Shūshū-shō, Niitaka-gun, Taichū-shū
Capacity: 43,500 kw as of Dec. 1937
Importance: Rank in Formosa supply area—4. See Jitsugetsu-tan No. 1 Hydro Plant. Plant can produce about 470,000,000 kwh. per annum operating with a 90% load factor.
Source of Power: Dakusui-kei and the discharge from the Jitsugetsu-tan No. 1 Hydro Plant
Date of Construction: Construction was begun Dec. 1935 and completed Aug. 1937; in operation June 1940.
Other details: Layout—Aqueduct-type with Jitsugetsu-tan as storage reservoir
Eff head—123.63 m.; flow—41.6 m³/sec.
Dam—Fixed part: 2.5 m. high, 20.5 m. high, 20.5 m. wide; movable part: 1.28 m. high with 9 gates; of concrete construction

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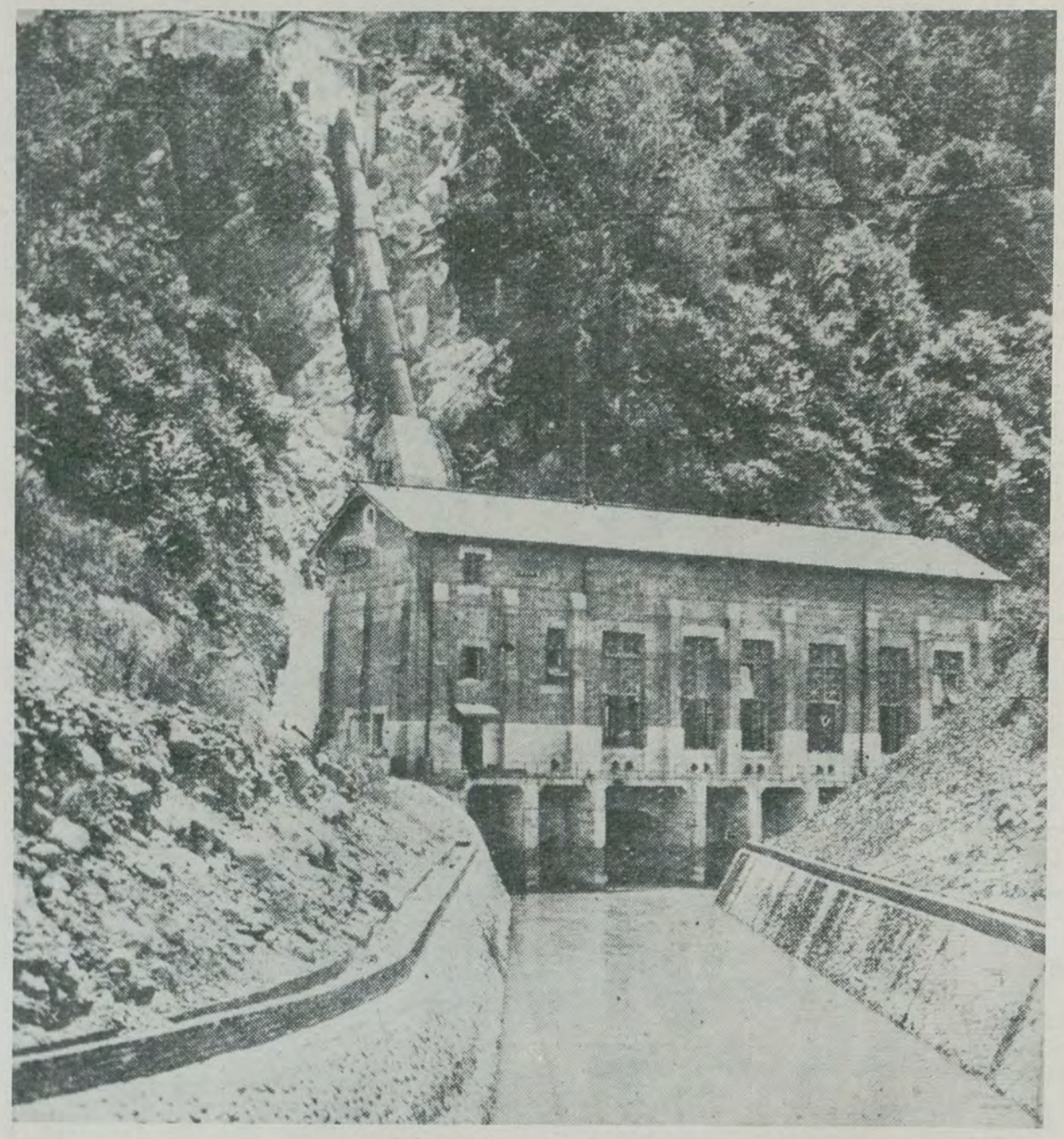


FIGURE IX - 54. *Taichū-shū*.
Hokuzanko hydro plant.

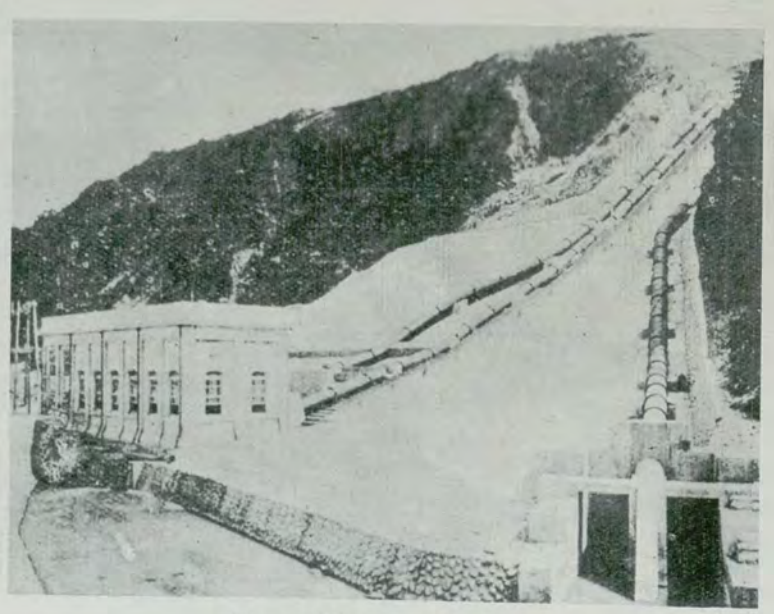


FIGURE IX - 55. *Taichū-shū*.
Kori hydro plant.

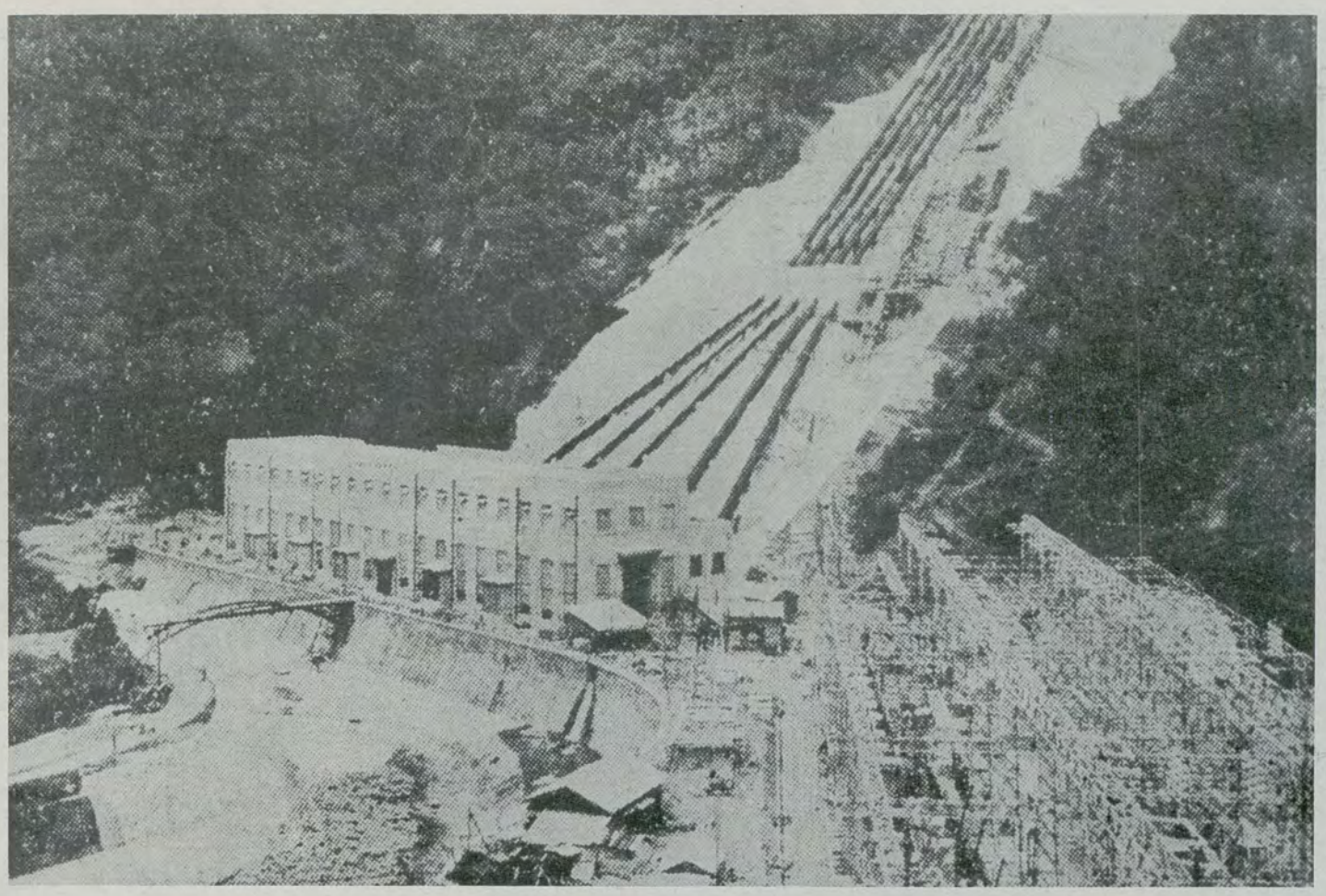


FIGURE IX - 56. *Taichū-shū*.
Jitsugetsu-tan No. 1 hydro plant.

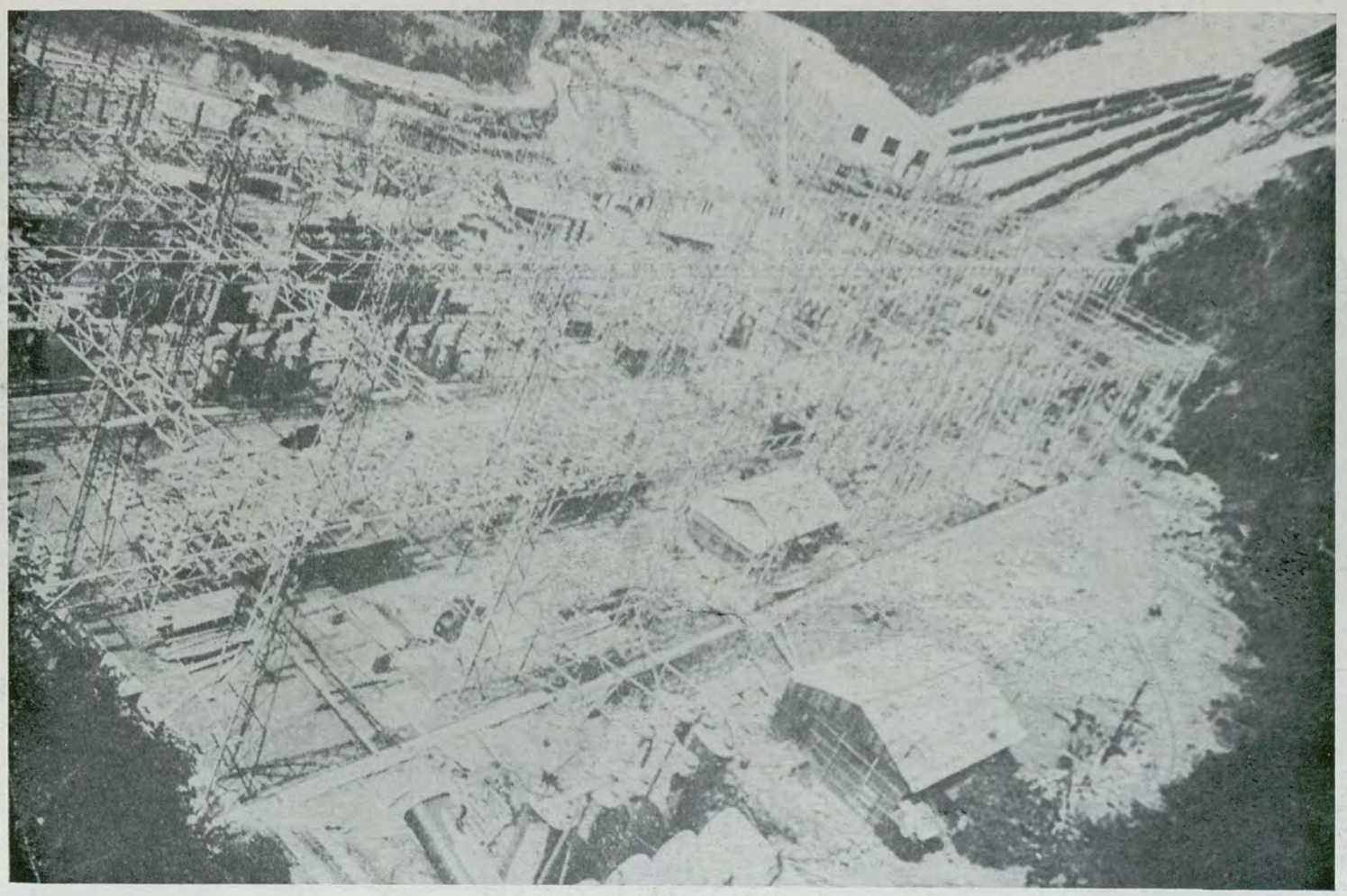


FIGURE IX - 57. *Taichū-shū*.
Station facilities Jitsugetsu-tan No. 1 hydro plant, 1934.

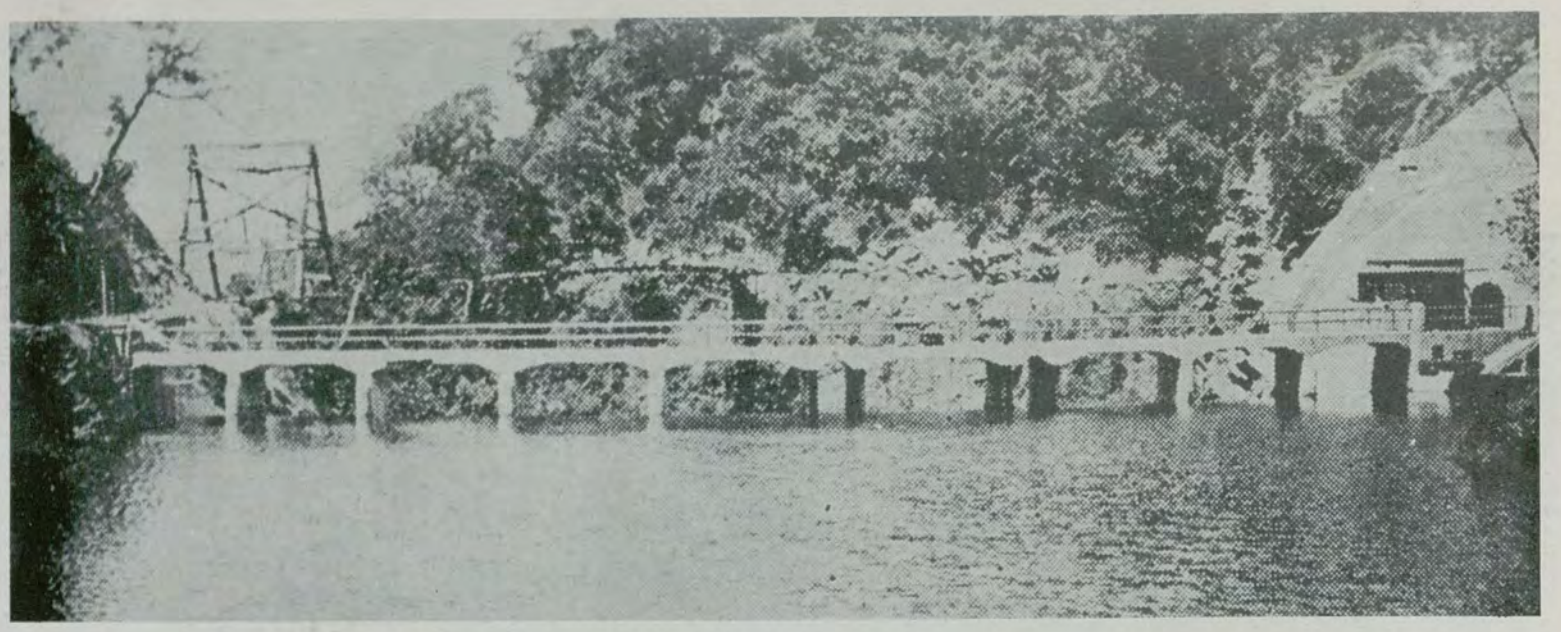


FIGURE IX - 63. *Taichū-shū.*
Dam for Jitsugetsu-tan No. 2 hydro plant.

FIGURE IX - 64. *Taichū-shū.*
Aqueduct bridge leading water to Jitsugetsu-tan No. 2 hydro plant.

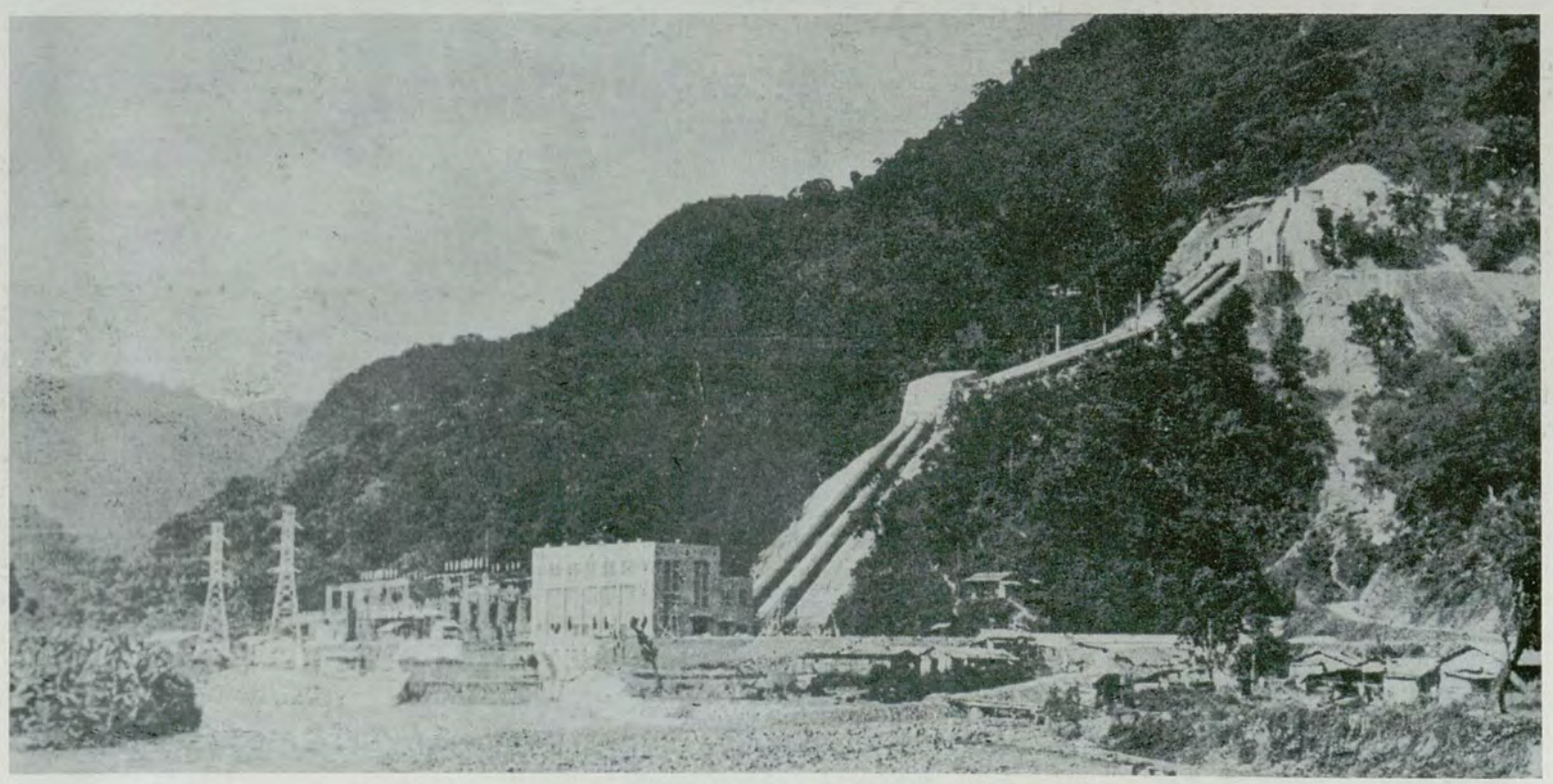


FIGURE IX - 65. *Taichū-shū.*
Jitsugetsu-tan No. 2 hydro plant.

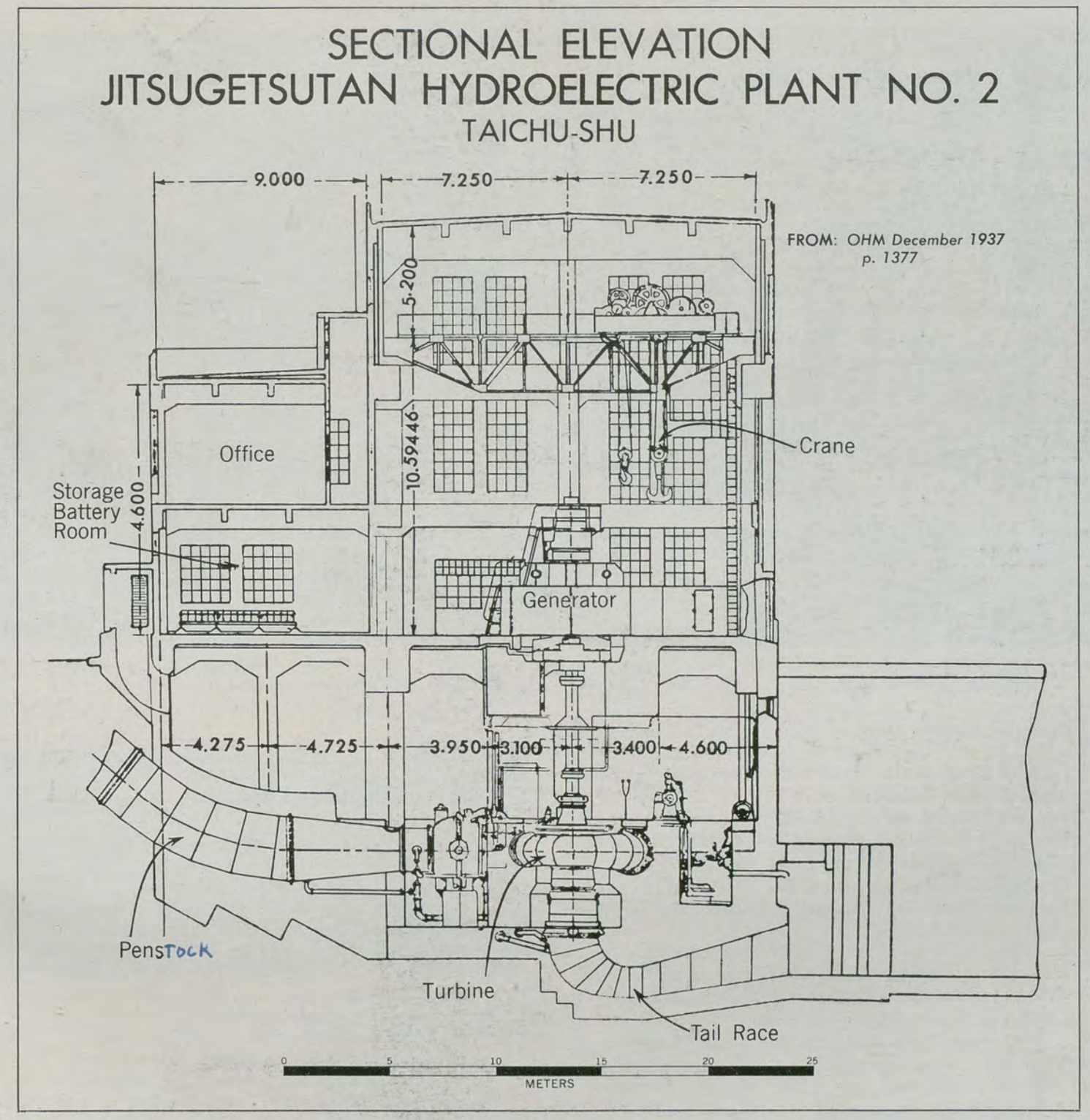


FIGURE IX - 66. *Taichū-shū.*
Drawing of Jitsugetsu-tan No. 2 hydro plant.

Jitsugetsu-tan No. 2 (*Continued*)

Intake—3 m. wide and 1.7 m. high

Aqueducts—Intake to forebay: 4,326 m. tunnel, 60 m. aqueduct bridge, and 33 m. intake; forebay to plant 14 m. intake and 491 m. tunnel

Forebay—110m³ cap

Surge tank—9 m. inner diam., 23.5 m. high, cylindrical

Penstocks—2 @ 289 m. long

Plant, external features—2 and 3 stories high, of reinforced concrete construction, 17 m. high and 23 m. wide

Plant, equipment

Turbines—2 @ 30,000 hp., Francis-type, vertical-shaft, Voith-make

Generators—2 @ 23,300 kva., 3-ph., 11,000 v., 360 rpm, 60 cyc., AEG-make

Transformers—2 @ 23,300 kva., 3-ph., 11/154/3.3 kv., D-y conn., self-cooled, core-type, Shibaura-make

Other equipment—2 exciters @ 110 kw., AEG-make

Tail race—152 m. long

Jitsugetsu-tan No. 3. APPROX. LAT. 23° 50′, LONG. 120° 47′

Company: Taiwan Denryoku K.K.

Location: Plant—At the tail race of the Jitsugetsu-tan No. 2 Hydro Plant in Shūshū-shō, Niitaka-gun, Taichū-shū

Capacity: 23,100 kw. (See Date of Construction)

Importance: If completed, rank in Formosa supply area—6

Source of Power: Dakusui-kei and the discharge from the Jitsugetsu-tan No. 2 Hydro Plant

Date of Construction: Planned Dec. 1935; no evidence received that construction has begun

Other details: Layout—Aqueduct-type with Jitsugetsu-tan as a reservoir

Eff head—70 m.; flow—41.6 m.³/sec.

Aqueduct—Discharge from Jitsugetsu-tan No. 2 Hydro Plant led to No. 3 Plant via a 10 km. aqueduct

Musha No. 1. Approx. Lat. 23° 57′, Long. 121° 05′
Company: Taiwan Denryoku K.K.
Location: Plant—Musha in Nōkō-gun, Taichū-shū, on Dakusui-kei and Bukai-kei
Capacity: 21,400 kw. (see Date of Construction)
Importance: If completed, rank in Formosa supply area—6
Date of Construction: Construction planned in 1935 for completion by end of 1943; no information on the actual construction or completion has been received
Other details: Layout—Aqueduct-type
Eff head—78.2 m.; flow—33.5 m³/sec.
Reservoir—Upper Bukai-kei and Dakusui-kei impounded to form reservoir with 3,200,000,000 ft.³ cap.
Aqueduct—700 m. long from reservoir to plant

Musha No. 2. Approx. Lat. 23° 55′, Long. 121° 03′
Company: Taiwan Denryoku K.K.
Location: Plant—At the tail race of the Musha No. 1 Hydro Plant at Musha in Nōkō-gun, Taichū-shū
Capacity: 27,100 kw. (see Date of Construction). An unconfirmed source estimates capacity at 30,650 kw.
Importance: If completed, rank in Formosa supply area—5
Source of Power: Dakusui-kei, Bukai-kei, and the discharge from the Musha No. 1 Hydro Plant
Date of Construction: Under construction Sept. 1938 and completion scheduled for end of 1943; no information on completion has been received
Details: Layout—Aqueduct-type
Eff head—99 m.; flow—33.5 m³/sec.
Reservoir—Upper Bukai-kei and Dakusui-kei impounded to form reservoir with 3,200,000,000 ft.³ cap.
Aqueduct—6,700 m. long

Sharyōkaku.
Company: Taiwan Denryoku K.K.; formerly Taiwan Godo Denki K.K.
Location: Sharyōkaku, Ishioka-shō, Tōsei-gun, Taichū-shū, believed to be on Taikō-kei
Capacity: 900 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Toyohara. Approx. Lat. 24° 15′, Long. 120° 40′
Company: Taiwan Denryoku K.K.
Location: Plant—Toyohara-gai, Toyohara-gun, Taichū-shū on Taikō-kei
Capacity: 70,700 kw. (see Date of Construction)
Importance: If completed, rank in Formosa supply area—3
Date of Construction: Planned in 1939; completion expected by 1945

(*b*) *Fuel plants. None known.*

(4) *Tainan province.*

(*a*) *Hydro plants. None known.*

(*b*) *Fuel plants.*

Kagi (Steam). Approx. Lat. 23° 30′, Long. 120° 26′
Company: Taiwan Denryoku K.K.; formerly Taiwan Dento K.K.
Location: Kagi-shi, Tainan-shū
Capacity: 3,000 kw. as of 1935
Importance: Rank in Formosa supply area—16
Date of Construction: Unknown; in operation as early as Dec. 1934 and as recently as June 1939

Tainan (Steam).
Company: Tainan-shi
Location: Tainan-shi, Tainan-shū
Capacity: 660 kw. as of April 1935
Date of Construction: Unknown; in operation April 1935

(5) *Takao province.*

(*a*) *Hydro plants.*

Chikushimon Hydro Plant (Figure IX - 67). Approx. Lat. 22° 45′, Long. 120° 20′
Company: Taiwan Denryoku K.K.
Location: Plant—Chikushimon, Jimba-shō, Hōzan-gun,

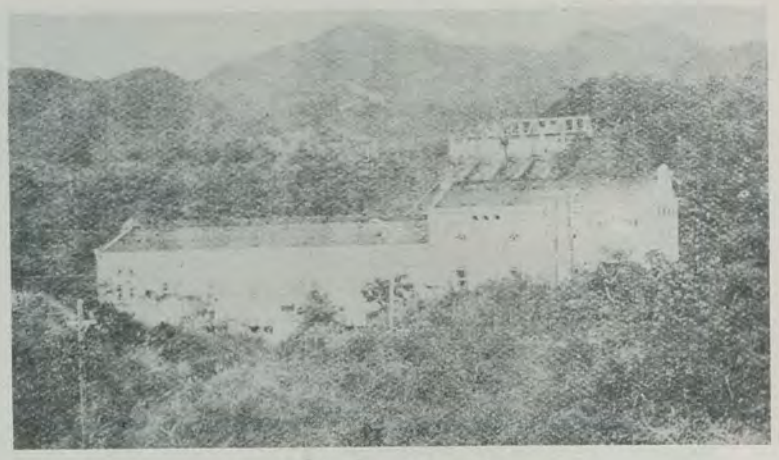


Figure IX - 67. *Takao-shū.*
Chikushimon hydro plant.

Takao-shū, believed to be on Gokei-kawa
Capacity: 1950 kw. as of June 1939
Importance: Rank in Formosa supply area—17
Date of Construction: Completed 1909; in operation as early as Dec. 1934 and as recently as June 1940

Doryūwan (Figure IX - 68). Approx. Lat. 23° 02′, Long. 120° 40′. Company: Taiwan Denryoku K.K.
Location: Doryūwan, Rokki-shō, Kizan-gun, Takao-shū, believed to be on Rōnō-kei
Capacity: 3,100 kw. as of June 1939
Importance: Rank in Formosa supply area—15
Date of Construction: Completed 1917, in operation as early as Dec. 1934 and as recently as June 1940

(*b*) *Fuel plants.*

Kōshun (Diesel)
Company: Taiwan Denryoku K.K.; formerly Kōshun Denki K.K.
Location: Kōshun-gai, Kōshun-gun, Takao-shū
Capacity: 50 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Takao (Steam)
Company: Takao Denryoku K.K.
Location: Takao-shi, Takao-shū
Capacity: 120 kw. as of April 1935
Date of Construction: Unknown; in operation April 1935

Takao No. 2 (Steam) (Figure IX - 69). Approx. Lat. 22° 38′, Long. 120° 16′
Company: Taiwan Denryoku K.K.
Location: Sankaiseki, Takao-shi, Takao-shū
Capacity: 13,000 kw. as of Sept. 1934
Importance: Rank in Formosa supply area—8
Date of Construction: Plant completed in May 1923 with No. 1 unit of 1,000 kw.; No. 2 unit of 2,000 kw. added in Dec. 1927; No. 3 unit of 10,000 kw. installed in Jan. 1931; plant in operation June 1940
Other details: Plant, external features—3 stories high with 1 chimney and 2 smokestacks
Plant, equipment
Fuel supply—Coal probably delivered by barge from canal; .65–.95 kg. coal used for each kwh. generated by the No. 3 unit and 1.734 kg. coal used for each kwh. for the No. 1 and No. 2 units
Boilers—Units No. 1 and 2—2 @ B&W-type, 14 kg./cm² 332 m.², B&W-make
Unit No. 3—2 @ B&W-type, 24.6 kg./cm², 592.25 m.², B&W-make
Turbines—Unit No. 1—1 @ 1,000 kw., impulse-type, horizontal-shaft, GE-make
Unit No. 2—1 @ 2,000 kw., Zoelly-type, horizontal-shaft, EW-make
Unit No. 3—1 @ 10,000 kw., Curtis-type, horizontal-shaft, AEG-make
Generators—Unit No. 1—1 @ 2,250 kva., 3-ph., 2,300 v., 3,600 rpm, 60 cyc., GE-make
Unit No. 2—1 @ 2,500 kva., 3-ph., 3,300

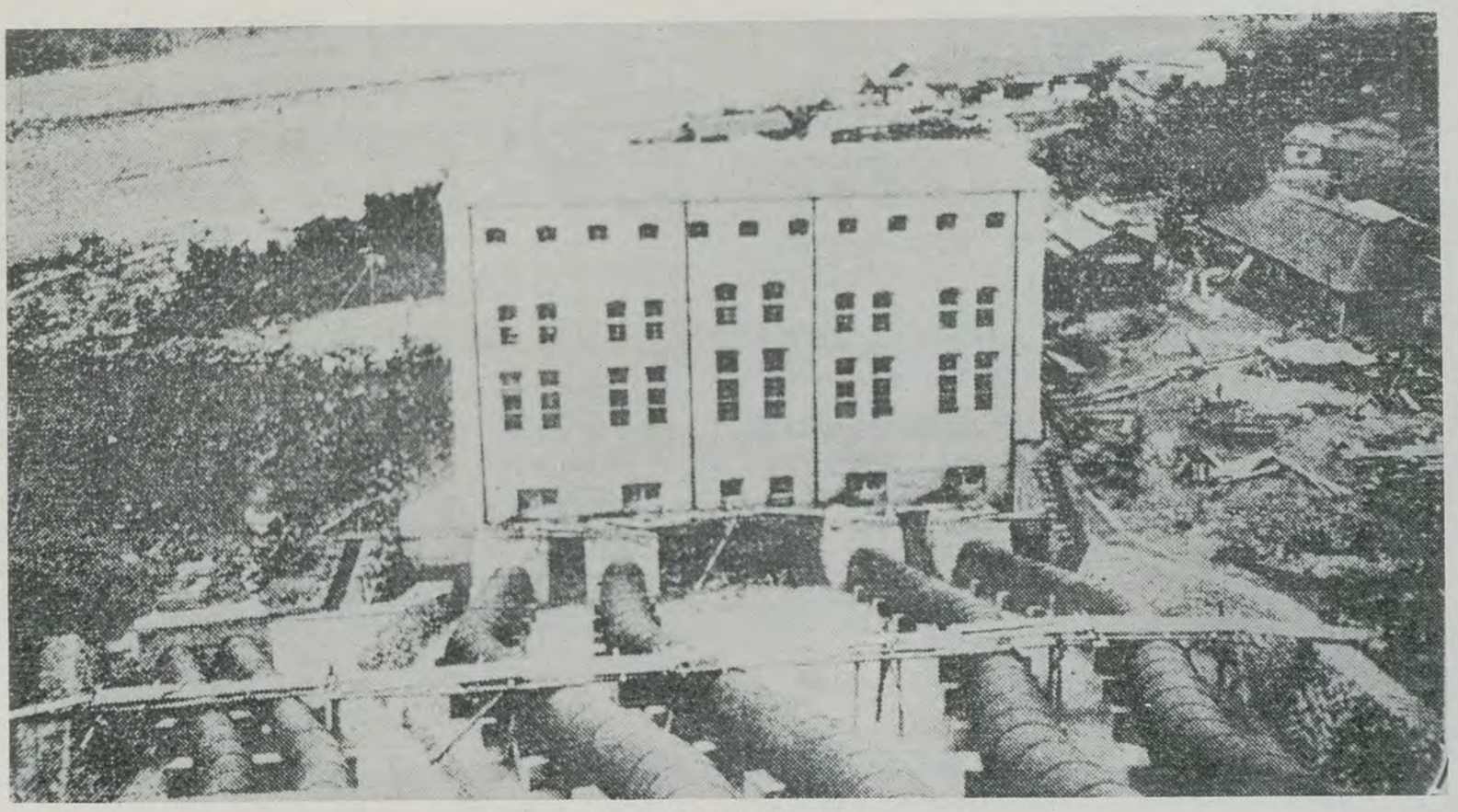


FIGURE IX - 68. *Takao-shū.*
Doryūwan hydro plant.

FIGURE IX - 69. *Takao-shū.*
Takao No. 2 steam plant.

v., 3,600 rpm, 60 cyc., SS-make

Unit No. 3—1 @ 12,500 kva., 3-ph., 11,500 and 10,500 v., 3,600 rpm, 60 cyc., AEG-make

Transformers—4 @ 1,800 kva., 3-ph., 3.3, 2.2/19.94, 19.07, 18.2, 17.32 kv., D-Y conn., self-cooled, Shibaura-make

4 @ 4,200 kva., 3-ph., 11/19.94, 19.07, 18.2, 17.32 kv., D-Y conn., self-cooled, shell-type, Mitsubishi-make

Other equipment—1 asynchronous phase advancer @ 5,000 kva., 3,300 v., 900 rpm, 60 cyc., Shibaura-make; 2 surface condensers; 4 superheaters, incl. 2 @ 157.92 m^2 and 2 @ 51.1 m^2; compartment chain-grate stokers; 4 economizers; 3 exciters, incl. 1 @ 70 kw., 1 @ 18.5 kw., and 1 @ 13.5 kw.

Area served—Takao-shi

Takao Factory (Steam). APPROX. LAT. 22° 38′, LONG. 120° 16′ 30″
Company: Asano Cement K.K.
Location: Ta-machi, Takao-shi, Takao-shū
Capacity: 4,500 kw. as of 1939
Importance: Rank in Formosa supply area—13
Date of Construction: Unknown; plant in operation as early as 1929 and as recently as Mar. 1940
Other details: Plant, equipment
Fuel supply—Uses waste gas from cement kilns
Boilers—Unknown number @ Edgemoor water tube-type
Turbines—1 @ 1,000 kw., Parsons-type. Additional units in operation
Generators—1 @ 1,000 kw., 3-ph. Additional units in operation

(6) *Karenko province.*

(*a*) *Hydro plants.*

Dōmon. APPROX. LAT. 23° 58′, LONG. 121° 29′
Company: Nippon Aluminum K.K.
Location: Dōmon, Karen-gun, Karenkō-chō on Mokkui-kei
Capacity: 23,200 kw. (see Date of Construction)
Importance: Rank in Formosa supply area—6. Serves the Karenkō factory of the Nippon Aluminum K.K.
Date of Construction: Under construction Dec. 1938 at which time completion was scheduled for 1940
Details: Eff head—172 m.
Plant, equipment
Turbines—3 @ 9,300 kw., Francis-type, vertical-shaft, Hitachi-make
Generators—3 @ 10,000 kva., 3-ph., 600 rpm, 60 cyc., Hitachi-make

Hatsune. APPROX. LAT. 23° 57′, LONG. 121° 31′
Company: Nippon Aluminum K.K., formerly Karenkō Denki K.K.
Location: Plant—Hatsune in Karen-gun, Karenkō-chō on Mokkui-kei
Capacity: 1,600 kw. as of Dec. 1938. An unconfirmed source estimates capacity at 1,770 kw.
Importance: Rank in Formosa supply area—19. Serves the Karenkō factory of the Nippon Aluminum K.K.
Date of Construction: Construction was begun Oct. 1938
Other details: Plant, equipment
Turbines—1 @ est. 2,000 kw., Kaplan-type, Mitsubishi-make
Generators—1 @ 2,500 kva., 3-ph., Mitsubishi-make

Hōrin
Company: Karenkō Denki K.K.
Location: Hōrin-gai, Hōrin-gun, Karenkō-chō, stream unknown
Capacity: 25 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Karenkō No. 1
Company: Karenkō Denki K.K.
Location: Yoshino-shō, Karen-gun, Karenkō-chō, stream unknown
Capacity: 200 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Karenkō No. 2
Company: Karenkō Denki K.K.
Location: Yoshino-shō, Karen-gun, Karenkō-chō, stream unknown
Capacity: 400 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Kiyomizu No. 1. Approx. Lat. 23° 58′, Long. 121° 33′
Company: Believed to be Nippon Aluminum K.K.; formerly Karenkō Denki K.K.
Location: Plant—Karen-gun, Karenkō-chō on Mokkui-kei and Kiyomizu-kei
Capacity: 7,000 kw. (see Date of Construction)
Importance: Rank in Formosa supply area—10. Serves the Karenkō factory of the Nippon Aluminum K.K.
Date of Construction: Under construction Oct. 1937; 2,000 kw. planned to go into operation at end of 1938 and additional 5,000 kw. to be completed in 1939; plant probably in full operation now

Kiyomizu No. 2. Approx. Lat. 23° 58′, Long. 121° 33′
Company: Believed to be Nippon Aluminum K.K.; formerly Karenkō Denki K.K.
Location: Plant—Karen-gun, Karenkō-chō on Mokkui-kei and Kiyomizu-kei
Capacity: 5,000 kw. (see Date of Construction)
Importance: Rank in Formosa supply area—12. Serves the Karenkō factory of the Nippon Aluminum K.K.
Date of Construction: Construction was begun Oct. 1938 at which time completion was scheduled for 1940

Takkiri-kei. Approx. Lat. 24° 08′, Long. 121° 38′
Company: Higashi-Taiwan Denryoku Kogyo K.K.
Location: Plant—Karen-gun, Karenkō-chō on Takkiri-kei
Capacity: 80,000 kw. (see Date of Construction)
Date of Construction: A series of hydro plants on the Takkiri-kei were planned for completion after 1941, with 70,000 kw. of the proposed total 80,000 kw. cap. to be completed by 1941. One plant (30,000 kw. cap.) was to supply the Karenkō factory of the Toho Kinzoku Seiren K.K. As of early 1940, no construction work was in progress. No information on completion or construction has been received.

(*b*) *Fuel plants.*

*Karenkō**
Company: Karenkō Denki K.K.
Location: Karenkō-gai, Karen-gun, Karenkō-chō
Capacity: Unknown; less than 500 kw.
Date of Construction: Unknown; in operation Mar. 1940

Tamazato (Gas)
Company: Karenkō Denki K.K.
Location: Tamazato-gai, Tamazato-gun, Karenkō-chō
Capacity: 30 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

(7) *Taitō province.*

(*a*) *Hydro plants.* None known.

(*b*) *Fuel plants.*

*Tamazato**
Company: Karenkō Denki K.K.
Location: Tamazato-shō, Tamazato-gun, Karenkō-chō
Capacity: Unknown; less than 500 kw.
Date of Construction: Unknown; in operation Mar. 1940

*It is not known whether this plant uses gas, oil, or coal as fuel.

Taitō No. 1 (Diesel)
Company: Taiwan Denryoku K.K.; formerly Taiwan Godo Denki K.K.
Location: Hinan-sho, Taitō-gun, Taitō-chō
Capacity: 50 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

Taitō No. 2 (Diesel)
Company: Taiwan Denryoku K.K., formerly Taiwan Godo Denki K.K.
Location: Taitō-gai, Taitō-gun, Taitō-chō
Capacity: 110 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

(8) *Bōkō-chō.*

(*a*) *Hydro plants.* None known.

(*b*) *Fuel plants.*

Bōko (Diesel)
Company: Taiwan Denryoku K.K., formerly Taiwan Godo Denki K.K.
Location: Makō-gai, Bōkō-chō
Capacity: 210 kw. as of Dec. 1935
Date of Construction: Unknown; in operation Mar. 1940

(9) *Unlocated plants.*

(*a*) *Hydro plants.*

Nankyo
Company: Taiwan Denryoku K.K., formerly Taiwan Dento K.K.
Capacity: 200 kw. as of May 1939
Date of Construction: Unknown; in operation May 1939

Taparoku
Company: Taiwan Denryoku K.K., formerly Taiwan Godo Denki K.K.
Capacity: 110 kw. as of April 1935
Date of Construction: Unknown; in operation April 1935

(*b*) *Fuel plants.*

Operator	Number of Generators	Kilowatt Capacity
Meiji Seito K.K. (Meiji Sugar Manufacturing Company)	13	3,301
Dai Nippon Seito K.K. (Dai Nippon Sugar Manufacturing Company)	9	2,630
Taiwan Seito K.K. (Taiwan Sugar Manufacturing Company)	25	2,689
Niitaka Seito K.K. (Niitaka Sugar Manufacturing Company)	9	437
Teikoku Seito K.K. (Teikoku Sugar Manufacturing Company)	7	391
Ensuiko Seito K.K. (Ensuiko Sugar Manufacturing Company)	15	3,260
Taiwan Hemp Company	1	240
Forestry Bureau of Taiwan Government-General	3	1,010
Total		13,958

B. Transmission and distribution lines.

The latest available information shows that there were slightly less than 10,000 kilometers of transmission lines in Formosa in 1937. These range in capacity from 154 kilovolts, through 66, 33, and 11 kilovolt levels, down to voltages suitable for distribution.

The single 154-kilovolt line runs the length of Formosa with the Jitsugetsu-tan development as the point of generation. The north line is 192.8 kilometers long; the south line

161.9 kilometers. It is a 2-circuit, 3-phase line. Most of the line is of copper construction with steel core aluminum used in long stretches over rivers. 1,250 transmission towers are used. The north line passes through the Muho Substation (Muhō-shō, Taichū-shū), the Shinchiku Switching station (Shinchiku-shi), and the Taihoku substation (Taihoku-shi). The south line passes through the Kagi substation (Kagi-shi, Tainan-shū), the Yamakami switching station (Yamakami-shō, Tainan-shū), and the Takao substation (Takao-shi).

Transformer substations and switching stations are distributed throughout Formosa. The principal substations are as follows:

Principal substations.

Kagi transformer station
Company: Taiwan Denryoku K.K.
Location: Kagi-shi, Tainan-shū
Installed Capacity: 20,000 kva. as of March 1937
Equipment: Transformers—4 (incl. 1 res.) @ 5,000 kva., 1 ph., 95.4/39.84, 19.92/11 kv., Y-Y-D conn., self-cooled, Mitsubishi-make
Importance: Handles power from Jitsugetsu-tan development for transmission to southern Formosa

Muho transformer station
Company: Taiwan Denryoku K.K.
Location: Muhō-shō, Daiton-gun, Taichū-shū
Installed Capacity: 20,000 kva. as of March 1937
Equipment: Transformers—4 (incl. 1 res.) 5,000 kva., 1 ph., 95.4/39.84, 19.92/11 kv., Y-Y-D conn., self-cooled, Mitsubishi-make
Importance: Handles power from Jitsugetsu-tan development for transmission to northern Formosa

Shinchiku switching station
Company: Taiwan Denryoku K.K.
Location: Shinchiku-shi, Shinchiku-shū
Importance: Switching station on 154 kv. transmission line going north from Jitsugetsu-tan development

Taihoku transformer station (FIGURE IX - 70)
Company: Taiwan Denryoku K.K.
Location: Taihoku-shi, Taihoku-shū
Installed Capacity: 127,000 kva. as of December 1937
Equipment: Transformers—6 @ 7,000 kva., 154/11 kv., D-D conn., GE make, 9 @ 5,000 kva., 66, 33/11 kv., D-Y conn., Mitsubishi-make, 1 @ 40,000 kva., 3 ph., 146, 144, 142, 140, 138, 134, 132, 130, 128, 126, 124, 122/69, 65.86, 62.72, 59.62, 56.46, 34.5, 32.93, 31.36, 29.81, 28.23/11 kv., 60 cyc., Y-Y-D conn., water-cooled, AEG-make; Phase advancers—2 @ 10,000, synchronous-type, Shibaura-make
Importance: Northern terminus of power transmitted for Jitsugetsu-tan development

Takao transformer station (FIGURE IX - 71)
Company: Taiwan Denryoku K.K.
Location: Takao-shi, Takao-shū
Installed Capacity: 113,000 kva. as of December 1940
Equipment: Transformers—9 @ 7,000 kva., 1 ph., 140/11 kv., D-D conn., water-cooled, GE-make, 1 @ 50,000 kva., 3-ph., self-cooled, Shibaura-make, Phase advancers—2 @ 15,000 kva., synchronous type, 900 rpm, Shibaura-make
Importance: Southern terminus of power transmitted from Jitsugetsu-tan development

Yamakami switching station
Company: Taiwan Denryoku K.K.
Location: Yamakami-shō, Shinka-gun, Tainan-shū
Importance: Switching station on 154 kv. transmission line going south from Jitsugetsu-tan development

It is estimated that the output of Formosan generating plants is 1,500,000,000 kilowatt-hours annually. The largest consumers of electric power in Formosa today are the aluminum and magnesium factories, consuming about 50% of all power generated in the island. Other large consumers are the calcium carbide and other chemical plants and coal mining. Smaller consumers of power are agriculture and fishing, food processing, woodworking and lumbering, ceramics, and spinning. There are 18 electric lights for each 100 persons in Formosa. The Taiwan Denryoku K.K. (Formosa Electric Company) alone supplies 710,000 lights.

FIGURE IX - 70. *Taihoku-shū.*
Transformer switching station on 154 kv transmission line N from Jitsugetsu-tan hydro development.

FIGURE IX - 71. *Takao.*
Switching station at S terminus of 154 kv transmission line S from Jitsugetsu-tan hydro development.

97. Commerce

A. Flow of trade.

Formosa's present foreign trade could be better described as trade with Japan, since only 10% is with other countries. The island has been a vital source of food and raw materials for Japan's industrialized economy, and Japan's intensive exploitation of Formosa has necessitated Formosan importation from Japan of fertilizers, cement, machinery, metals, and textiles.

Formosa's 1939 excess of exports over imports amounted to 184,288,359 *yen*. Of this, only 32,151,795 *yen* came from countries other than Japan proper. In previous years, imports exceeded exports from countries other than Japan. This new export trade has been mainly with China, Manchuria, and the Kwantung Leased Territory, all within the *yen bloc*.

In 1940, exports-imports aggregated 900,000,000 *yen* ($210,870,000), of which 500,000,000 *yen* ($117,150,000) represented exports. About half of the value of exports was in sugar and about 30% in rice. In descending order of importance, other export items were bananas, alcohol, canned pineapples, coal, ores, camphor, fish, tea, salt, and sweet potatoes.

Imports from Japan, valued at 400,000,000 *yen* ($93,720,000) included fertilizers, iron and iron products, cloth and manufactured goods, building materials, machinery, bicycles, and dried and salted fish.

Some allowance should be made in import-export figures because some goods were shipped to Japan by foreign countries and reshipped by Japanese exporters to Formosa, and some Formosan commodities are reshipped by Japanese importers to foreign countries. There has also been some smuggling, particularly in kerosene and sugar, between Formosa and South China.

It is apparent that Japan has forced a sharp bargain with Formosa, to the disproportionately greater expense of the latter, for if a larger share of the so-called surplus of production now being exported to Japan or an equivalent amount of imports were permitted to be consumed in Formosa, her standard of living would be raised considerably.

The large excess of exports over imports of Formosa (recently over 300,000,000 *yen* per year) indicates the benefit that Japan has derived from exploiting the island. It also indicates the extent to which the occupation of Formosa will benefit the United Nations' forces as a military supply base and source of food for other nearby areas.

B. Principal commodities in Formosan trade.

The principal imports and exports of Formosa in 1939 are shown in the following 4 tables:

TABLE IX - 43
CHIEF IMPORTS FROM FOREIGN COUNTRIES IN 1939

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Wheat	Metric tons	777	23
Australia	Metric tons	—	—
Other countries	Metric tons	777	23
Soybeans	Metric tons	42,055	1,696
"Manchukuo"	Metric tons	42,055	1,696
Other countries	Metric tons	—	—
Fish, salted or dried	Metric tons	1,046	76
U.S.S.R.	Metric tons	1,044	76
Canada	Metric tons	—	—
Other countries	Metric tons	2	—
Leaf tobacco	Metric tons	150	63
United States	Metric tons	—	—
Other countries	Metric tons	150	63
Heavy oil		N.A.	N.A.
Gasoline		N.A.	N.A.
Kerosene and light oil		N.A.	N.A.
Lubricating oil		N.A.	N.A.
Jute	Metric tons	2,591	283
British India	Metric tons	2,591	283
Other countries	Metric tons	—	—
Hemp cloth (from China)	1,000 sq. yds.	—	—
Gunny bags	Thousands	5,075	703
British India	Thousands	5,075	703
Other countries (chiefly China & Kwantung Lease)	Thousands	—	—
Packing mats (from China)	1,000 sheets	4,433	170
Iron and steel		N.A.	N.A.

TABLE IX - 43 (*Continued*)

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Lumber	1,000 bd. ft.	944	21
China	1,000 bd. ft.	—	—
Other countries	1,000 bd. ft.	944	21
Bran	Metric tons	14,597	330
China	Metric tons	7,326	158
Kwantung and "Manchukuo"	Metric tons	7,271	172
Soybean cake	Metric tons	176,333	5,278
"Manchukuo"	Metric tons	105,279	3,118
Kwantung Leased Terr.	Metric tons	71,054	2,160
Other countries	Metric tons	—	—
Sulfate of Ammonia	Metric tons	12,376	380
Germany	Metric tons	—	—
"Manchukuo"	Metric tons	6,259	194
Kwantung Leased Terr.	Metric tons	6,117	186
Other countries	Metric tons	—	—
Other commodities	—	—	4,229
Total			13,252

TABLE IX - 44

CHIEF EXPORTS TO FOREIGN COUNTRIES IN 1939

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Bananas	Metric tons	11,406	126
China	Metric tons	5,239	57
Kwantung Leased T.	Metric tons	3,153	34
"Manchukuo"	Metric tons	3,014	35
Other countries	Metric tons	—	—
Oranges	Metric tons	8,459	297
Kwantung Lease	Metric tons	7,492	262
China	Metric tons	960	34
Hong Kong	Metric tons	—	—
Other countries	Metric tons	7	1
Tea, Oolong	Metric tons	2,460	1,118
United States	Metric tons	2,320	1,012
Great Britain	Metric tons	125	97
Other countries	Metric tons	15	9
Tea, Pouchong	Metric tons	3,903	2,164
Neth. Indies	Metric tons	144	54
Kwantung Lease	Metric tons	2,725	1,642
Thailand	Metric tons	85	31
Indochina	Metric tons	41	11
Straits Settle.	Metric tons	—	—
"Manchukuo"	Metric tons	230	114
Other countries	Metric tons	678	312
Tea, black	Metric tons	4,298	1,422
Great Britain	Metric tons	34	7
United States	Metric tons	2,164	746
Australia	Metric tons	167	49
Iran	Metric tons	17	6
"Manchukuo"	Metric tons	292	88
Kwantung Lease	Metric tons	503	184
Other countries	Metric tons	1,121	342
Sugar	Short tons	174,581	7,938
China	Short tons	83,243	3,694
Kwantung Lease	Short tons	62,153	2,779
Hong Kong	Short tons	—	—
"Manchukuo"	Short tons	29,185	1,464
Macan	Short tons	—	—
Other countries	Short tons	—	1
Fish, dried and salted	Metric tons	2,390	214
China	Metric tons	2,390	214
Hong Kong	Metric tons	—	—
Other countries	Metric tons	—	—
Cuttlefish	Metric tons	728	206
Pineapple, canned	Metric tons	6,374	553
Kwantung Lease	Metric tons	1,545	169
United States	Metric tons	1,427	57
"Manchukuo"	Metric tons	1,662	188
China	Metric tons	1,174	113
Other countries	Metric tons	566	26

TABLE IX - 44 (*Continued*)

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Camphor	Metric tons	470	514
United States	Metric tons	398	426
France	Metric tons	29	34
Great Britain	Metric tons	43	54
Other countries		—	—
Alcohol	Gallons	18,720	10
Kwantung Leased Territory		N.A.	N.A.
Other countries		N.A.	N.A.
Coal	Metric tons	291,670	1,215
Hong Kong	Metric tons	4,804	18
China	Metric tons	286,866	1,196
Other countries		—	—
Cement	Metric tons	954	6
China		N.A.	N.A.
Kwantung Leased Territory		N.A.	N.A.
Hong Hong		N.A.	N.A.
Other countries		N.A.	N.A.
Lumber	1,000 bd. ft.	5,590	181
Other commodities	—	—	5,303
Total			21,600

TABLE IX - 45

CHIEF IMPORTS FROM JAPAN PROPER, CHOSEN, KARAFUTO, AND THE JAPANESE MANDATED ISLANDS IN 1939

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Wheat	Metric tons	9,332	506
Wheat flour	Metric tons	28,744	1,980
Sugar, refined	Short tons	1,068	122
Confectionery	—	—	1,018
Ajinomoto	—	—	1,139
Soy	1,000 gallons	1,045	335
Fish, salted, dried	Metric tons	26,900	2,426
Cuttlefish	Metric tons	2,254	642
Condensed milk	1,000 dozen	414	496
Other canned food	—	—	1,595
Sake	1,000 gallons	1,428	1,794
Beer	1,000 cases	262	1,331
Cigarettes	Millions	709	1,429
Kerosone & light oil		N.A.	N.A.
Lubricating oil		N.A.	N.A.
Other mineral oils		N.A.	N.A.
Soap	—	—	1,450
Matches	1,000 cases	118	727
Yarn and thread	—	—	676
Cotton and silk fabrics	—	—	5,128
Wool fabrics	—	—	1,136
Gunny bags	Thousands	7,418	1,404
Underwear, cotton	—	—	858
Paper	—	—	1,934
Cement	Metric tons	123,654	668
Iron and steel		N.A.	N.A.
Iron manufactures	—	—	2,760
Construction material	—	—	540
Insulated wire	—	—	568
Bicycles and parts	—	—	1,093
Automobiles and parts	—	—	N.A.
Porcelain and Earthenware	—	—	569
Lumber	1,000 bd. ft.	178,127	4,930
Ammonium sulfate		N.A.	N.A.
Other fertilizers	Metric tons	333,547[1]	9,675[1]
Other commodities	—	—	43,918
Total			92,846

[1]Includes ammonium sulfate.

TABLE IX - 46

CHIEF EXPORTS TO JAPAN PROPER, KOREA, KARAFUTO, AND THE JAPANESE MANDATED ISLANDS IN 1939

COMMODITIES	UNIT OF MEASUREMENT	QUANTITY	VALUE IN $1,000
Rice	1,000 lbs.	1,251,959	32,529
Sweet Potatoes, dried & sliced	Metr. tons	11,513	214
Bananas	Metr. tons	126,872	4,289
Tea, black	Metr. tons	871	580
Sugar	Sht. tons	1,271,976	59,521
Molasses	Sht. tons	N.A.	315
Fresh fish	Metr. tons	5,479	801
Dried bonito	Metr. tons	72[1]	35
Pineapple, canned	1,000 doz.	2,995	2,911
Salt	Metr. tons	92,290	280
Camphor	Metr. tons	1,778	1,046
Camphor oil	Metr. tons	1,098	425
Alcohol	Gallons	16,081,778	4,291
Paper, European style	1,000 lbs.	35,080	1,601
Wall-board	1,000 lbs.	N.A.	247
Hats	1,000's	5,029	987
Coal	Metr. tons	276,258	1,165
Ores	Metr. tons	N.A.	N.A.
Lumber	1,000 bd. ft.	19,108	1,225
Other commodities	—	—	19,883
Total			132,345

[1]Sources gave this figure as 7,222; presumably error in decimal.

C. Import-export problems.

Formosa's economy, although self-sufficient in basic foodstuffs, is dependent upon the import of certain necessities, especially textile raw materials, iron and steel, fertilizers, and machinery. Metals, petroleum, vehicles, and cement must also be imported.

(*1*) *Textiles.*

Loss of textile imports would cause a real shortage in Formosa. The only large textile mills there produce jute, hemp, and ramie fabrics which are insufficient for the island's needs. No wool is produced in Formosa; cotton crops have failed in several successive years; and sericulture is only a minor industry. Imports of silk and cotton fabrics were valued at $6,000,000 annually and imports of wool at $500,000, before the war.

(*2*) *Iron, steel, and iron manufacture.*

Imports of iron, iron manufactures, vehicles, and machinery are also of primary importance to Formosa. Only a very small amount of iron is produced there, and, exclusive of the Kiirun dockyard, only a few manufacturers are producing machinery. Production may have increased somewhat if recently reported attempts to establish iron foundries in Takao-shi to utilize ore from Hai-nan have materialized. Prior to 1937, over 100,000 metric tons of iron were imported annually, and also 1,000 metric tons of copper, and 1,500 metric tons of lead. About $500,000 each of iron manufactures, construction materials, and railway materials, and $1,500,000 of automobiles and parts were imported annually in the same period, but part of these were for military uses.

(*3*) *Fertilizers.*

Plans to increase fertilizer production in Formosa have probably been realized. The amount of imported fertilizers needed after the war will consequently be smaller than before the war, when fertilizer imports were valued at $15,000,000 annually, but a need for substantial fertilizer imports will continue.

(*4*) *Consumers' goods.*

Imported consumers' goods are not essential to Formosan-Chinese. Such commodities as cigarettes, alcoholic beverages, and canned foods, have been imported mainly for the small minority of Japanese residents.

(*5*) *Fish.*

Formosan-Chinese would feel the loss of dried and salted fish imports, valued in 1939 at $2,502,000, unless the fishing and fish drying and salting industries were expanded. This expansion is possible, since the island has rich supplies of fish and salt.

(*6*) *Lumber.*

Imports of lumber, amounting to about 225,000,000 board feet in 1940, may not be necessary in such large quantities after the war, as production may have been substantially increased and lumber now being used for military purposes will meet the civilian demand.

(*7*) *Cement.*

The amount of cement that will have to be imported after the war will depend, to some extent, on the amount of damage to dams, roads, and structures caused by hostilities in Formosa. In 1937, 200,000 metric tons of cement were imported but cement production has probably since been increased.

98. Finance

A. Currency.

The currency of Formosa is based upon the Japanese *yen* (symbol Y) which is divided into 100 *sen* or 1,000 *rin*. Banknotes, issued by the Bank of Taiwan (Taiwan Ginko) are in denominations of 1, 5, 10, 20, 50, and 100 yen (FIGURES IX - 72 and IX - 73). Subsidiary note currency, issued by the government, is in denominations of 10 *sen*, 20 *sen*, and 50 *sen*. Subsidiary coinage is the same as that in Japan, in denominations shown in TABLE IX - 47.

TABLE IX - 47

FORMOSA—DENOMINATIONS OF SUBSIDIARY COINAGE

SILVER	COPPER (NICKEL OR ALUMINUM ALLOY)	COPPER (TIN OR ZINC ALLOY)
50 *sen*	10 *sen*	1 *sen*
20 *sen*	5 *sen*	5 *rin*

The Bank of Taiwan's notes are legal tender in the island for any amount. As they are on a par with the notes of the Bank of Japan and of the Bank of Chosen (Korea), the notes of the latter 2 are accepted freely throughout the island, although they are withdrawn from circulation in Formosa when presented to banks. It is possible that military *yen* are at present accepted in the island because of large military expenditures, although military *yen* when once paid into banks are not reissued as legal tender.

In December 1943, the total note issue of the Bank of Taiwan amounted to 410,000,000 *yen*, which represented a 42% increase over 1942 and a 135% increase over 1939. The 1944–45 Formosan budget of 613,371,000 *yen* is nearly double

FIGURE IX - 72. *Formosa.*
One yen bank note, Bank of Taiwan. Top, front side; bottom, reverse side.

FIGURE IX - 73. *Formosa.*
Ten yen bank note, Bank of Taiwan. Top, front side; bottom, reverse side.

that of 1941–42, requiring at least another 40% increase in the note circulation for the current year.

The use of checks as a means of payment in commercial transactions is common in the cities, but it has not spread among the masses of the population. The Bank of Taiwan acts as the clearing bank in those cities in which it maintains branches.

B. Foreign exchange value of the Formosan *yen.*

The depreciation of the Formosan *yen* followed that of the Japanese *yen*, when the latter abandoned the gold standard in December 1931. The *yen* was linked to the pound sterling from 1934 until 1939, when Great Britain abandoned the gold standard. Thereafter, until 6 January 1942, it was officially linked to the U. S. dollar at the rate of $23\frac{7}{16}$ cents per *yen*. With the freezing of Japanese assets in the United States on 26 July 1941, trade with Japan was cut off, and since that date there has been no regular direct buying or selling of exchange between the 2 countries.

C. Purchasing power.

The index of wholesale prices in Taihoku, Formosa, for December 1942 was 124.16 on the basis of December 1939 index as 100. The index of wholesale prices in the United States in December 1942, taking the December 1939 index as 100, was 127.52. The purchasing power of the *yen* on this basis appears to have improved over that of the U. S. dollar, the relationship being $\frac{127.52}{124.16} \times 100$ or 102.70 as the comparative improvement of the *yen* over the 3-year period. Later price indices of Formosa are not available.

D. The banking system.

The Bank of Taiwan (Taiwan Ginko). Controlled by Japanese law through the Japanese Ministry of Finance, the Bank of Taiwan dominates the banking system of the island. It alone has the right of issue and it serves as the central bank. Its 16 branches hold ⅔ of the bank deposits and have ⅕ of the loans and advances outstanding. As the government's fiscal agent and depository, it holds tax and customs receipts, as well as all other government funds. During the war, it has served as liquidator of foreign banks in occupied territories and as financial backer of development projects both in Formosa and in the southern regions.

The authorized capital of the Bank of Taiwan was 60,000,000 *yen* in 1942, of which only about 30,000,000 *yen* was paid up. Control of the bank is exercised directly by the Japanese Government through its appointment of the president, vice-president, and several directors and supervisory officers. The bank's affairs are directed from the central office in Tōkyō.

There are 6 other banks on the island, which operate an aggregate of 63 branches. These are The Hypothec Bank of Japan (Nippon Kangyo Ginko), and the Sanwa Bank (Sanwa Ginko), each of which operates 3 branches on the island from head offices in Japan; the Taiwan Commercial and Industrial Bank (Taiwan Shoko Ginko), with a head office in Taihoku and 30 branches throughout the island; The Shōka Bank (Shōka Ginko), with a head office in Taichū and 19 island branches; The Taiwan Savings Bank (Taiwan Chochiku Ginko), with a head office in Taihoku and 8 island branches; and the South China Bank (Kanan Ginko), which has its head office in Taihoku-shi and its branches outside the island.

99. Principal Sources

1. Chamberlain, Basil H., and W. B. Mason.
   1913. Murray's Handbook of Japan. London, John Murray. pp. 529, 530.
2. Far East Year Book, 1941. Tokyo.
3. Grajdanzev, A. J.
   1942. Formosa Today. New York, Institute of Pacific Relations. 193 pp.
4. ——— GOVERNMENT GENERAL OF TAIWAN, SECRETARIAT
   1934. Taiwan Sotokufu Tokei-sho, 1932. (Taiwan Government General Statistical Gazette, 1932). Taihoku.
5. Government General of Taiwan, Bureau of Aboriginal Affairs.
   1911. Report on the Control of Aborigines in Formosa. Taihoku. pp. 22–23.
6. Government General of Taiwan, Finance Bureau.
   1935. Taiwan Boeki Nempyo, 1934. (Formosa Annual Trade Tables, 1934). Taihoku.
7. ———.
   1938. Taiwan Boeki Nempyo, 1937 (Formosa Annual Trade Tables, 1937).
8. Government General of Taiwan, Productive Industries Bureau.
   1938. Taiwan Nogyo Nempo, 1937 (Formosa Agriculture Annual Report, 1937). Taihoku.
9. Government General of Taiwan, Secretariat.
   1940–1941. Taiwan Sotokufu-ho, 1940, 1941 (Taiwan Government General Gazette, 1940, 1941). Taihoku.
10. ———.
    1941. Taiwan Nogyo Nempo, 1939 (Formosa Agriculture Annual Report, 1939). Taihoku.
11. Great Britain, Admiralty, Hydrographic Department.
    1937. China Sea Pilot, Vol. III, pp. 169, 180, 187. London.
12. Japan, Department of Finance.
    1941. The Fortieth Financial and Economic Annual of Japan, 1940. Tokyo.
13. Japan, Government Printing Bureau.
    1939. Shokuin Roku, 1939 (Roster of Government Officials). Tokyo.
14. Kokusai Nippon Kyokai.
    1941. Taiwan Keizai Nempo, 1941 (Formosa Economic Annual Report, 1941). Tokyo.
15. Nakashima, Eiji.
    1927. Nippon-Suido-shi. pp. 670–681.
16. Nasu, S.
    1941. Aspects of Japanese Agriculture. New York, Institute of Pacific Relations, 168 pp.
17. Nippon Chimei Dai-Jiten (Dictionary of Japanese Place Names).
    1938. Vol. 2. Tokyo.
18. Nippon Chiri Fuzoku Taikei (Outline of Japanese Geography and Customs).
    1931. Vol. 15. Tokyo.
19. Nippon Chiri Taikei (Outline of Japanese Geography).
    1930. Vol. 11. Tokyo.
20. Nippon Sato Kyokai.
    1940. Sato Nenkan, 1940. (Sugar Year Book, 1940). Tokyo.
21. Nippon Yusen Kaisha's Official Guide.
    1936–37. Glimpses of the East. 19th annual issue, p. 7 of the section on Taiwan. Tokyo.
22. Oye, Jiro.
    Distribution of Hot Springs in Formosa. Chigaku Zasshi, Vol. 40, pp. 555–563.
23. Shoken Hikiu Kaisha Kyokai.
    1941. Kabushiki Kaisha Nenkan, 1941 (Joint Stock Company Year Book, 1941). Tokyo.
24. Steere, J. B.
    1876. Formosa. Bull. Amer. Geog. Soc., Vol. 6, p. 319.
25. Taiwan Ginko.
    1939. Taiwan Ginko Yojunen-shi (Forty-Year History of the Bank of Taiwan). Tokyo.
26. Takahashi, K.
    1937. Gendai Taiwan Keizairon (Present Formosan Economy). Tokyo.
27. Takaki, Dr. T.
    1911. Die Hygienischen Verhaltnisse der Insel Formosa, Im Auftrage des Generalgovernments Formosa. pp. 78–87.
28. Teikoku Koshinsho Kabushiki Kaisha.
    1940. Teikoku Ginko Kaisha Yoroku, 1940 (Empire Banks and Corporations Guide, 1940). Tokyo.
29. U. S. Army Air Forces, Office Director of Intelligence.
    1 Dec. 1942. Air Objective Folders:
    91.3 Taihoku.
    91.6 Takao.
30. ———.
    1943. Air Objective Folder 91.7, Pescadores Islands.
31. U. S. Army Air Forces, Office Assistant Chief of Air Staff, Intelligence.
    1943. Photographic Interpretation Report 403. Mako, Pescadores.
32. ———.
    1944. Third Phase Photographic Interpretation Report 47. Heito.
33. US WAR DEPT, MILITARY INTELLIGENCE SERVICE
    1944. Survey of the Island of Formosa. S30–783A, pp. 17, 30, 31, 55, 102, 103; maps, illus. (Confidential.)
34. U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce.
    1942. Military and Industrial Objectives in Taiwan (Formosa). (Confidential.)
35. U. S. Navy Department, Hydrographic Office.
    1943. Sailing Directions for the Coast of China. HO 124, pp. 569–629.
36. U. S. Navy Department, Office of Naval Intelligence.
    1944. Report on Keelung, Formosa. ONI 49, Change 14.
37. U. S. Navy Department, Office of Naval Operations.
    1944. Civil Affairs Handbook, Taiwan (Formosa). OPNAV 50E—12. (Restricted.)
38. ———.
    1944. Economic Supplement OPNAV 50E—13. (Restricted.)
39. U. S. Office of Strategic Services.
    1932. Japanese Sailing Directions—Island of Taiwan. Translated for the Branch of Research and Analysis, with supplement of Sept. 1939. 111 pp.
40. US Navy DEPT, OFFICE OF NAVAL INTELLIGENCE
    1943. Japan—Island of Formosa. ~~Central Information Division document 50218, p. 4.~~ (Confidential.)
41. ———.
    1944. Taiwan—Physical Geography—Bases and Important Areas. ~~Central Information Division document 61619, pp. 2–3.~~ (Confidential.)
42. Yanaihara, T.
    1937. Teikoku Shugi Shita No Taiwan (Taiwan under Japanese Imperialism).

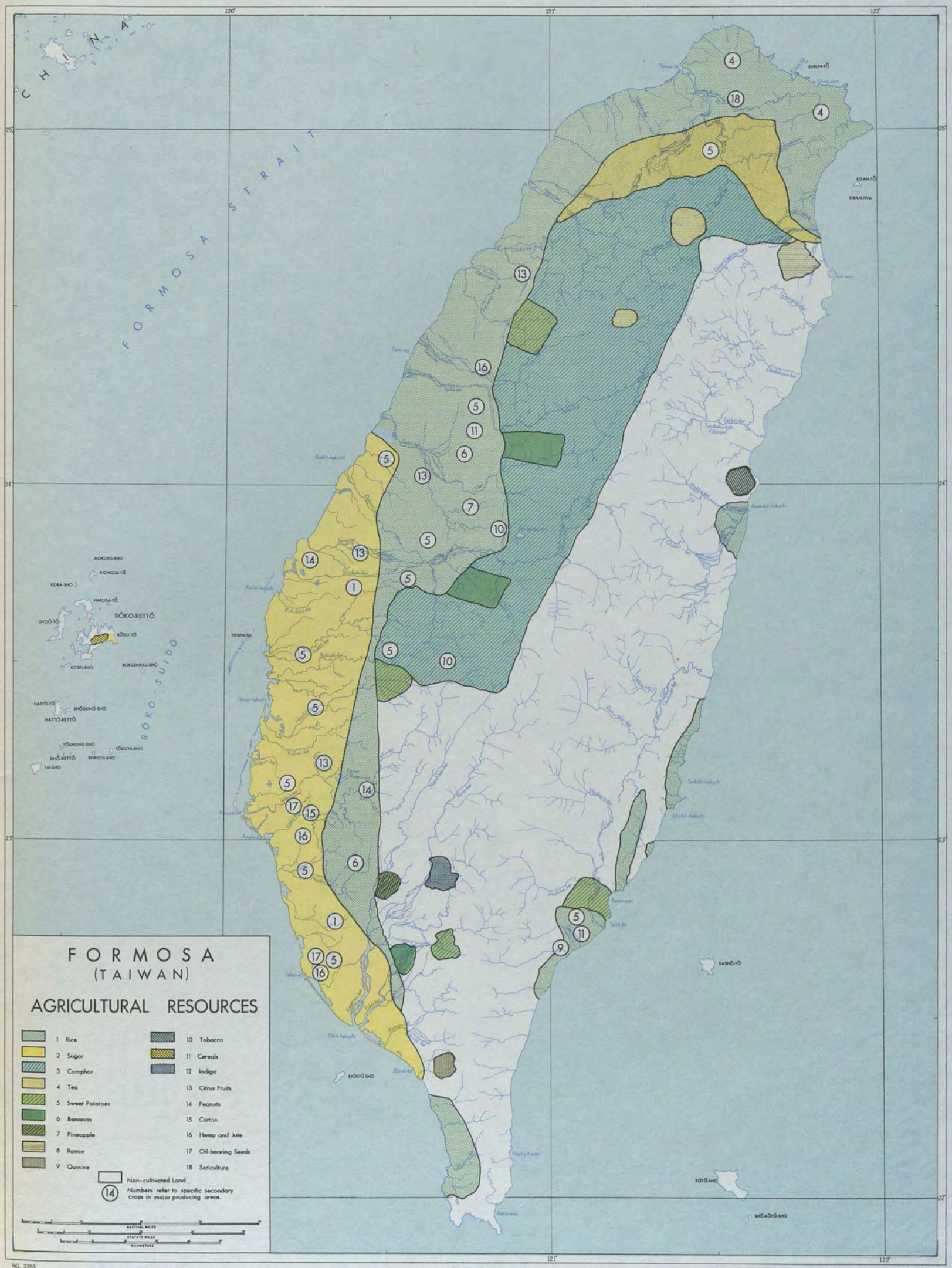
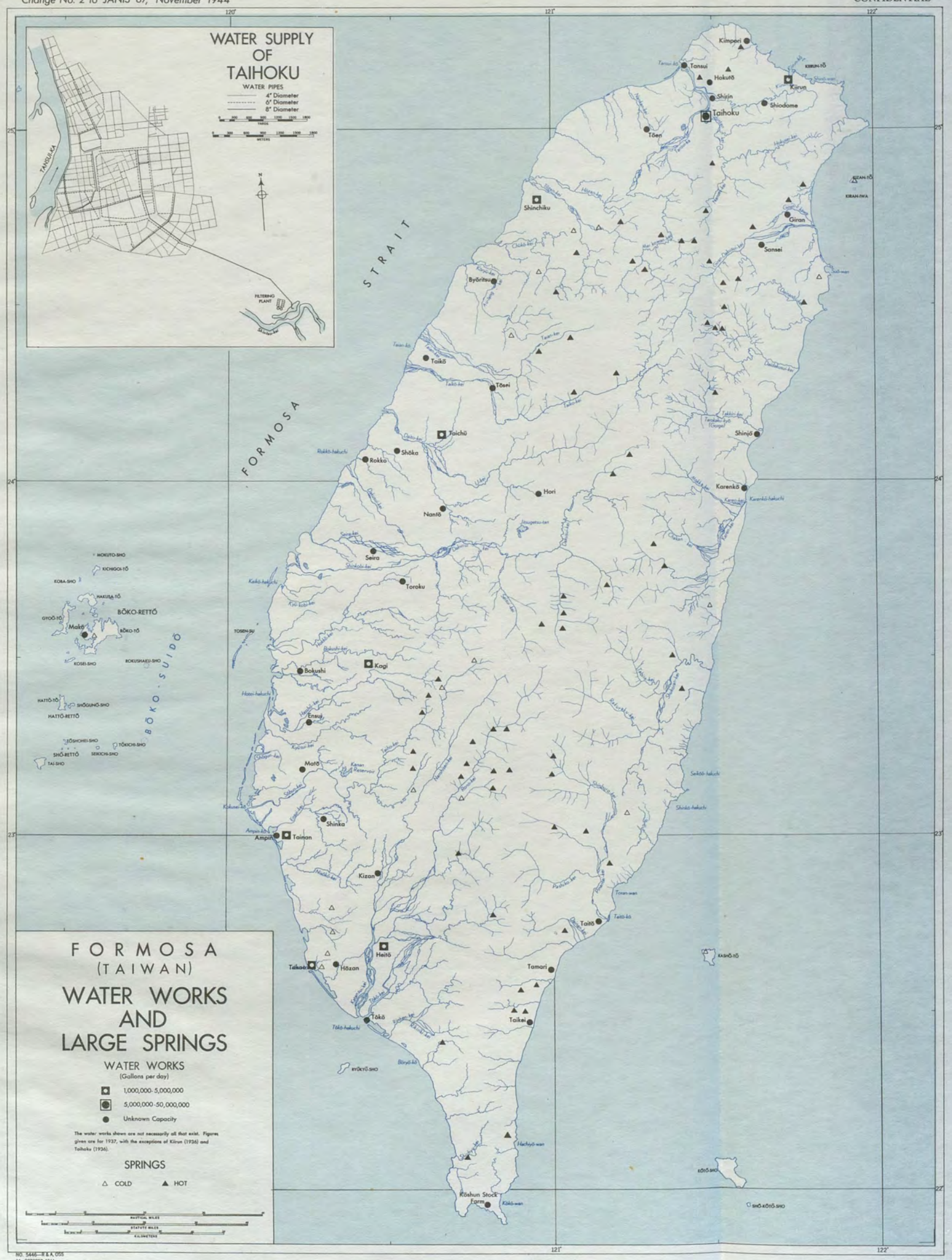


FIGURE IX - 74. *Formosa.*
Map of agricultural resources.



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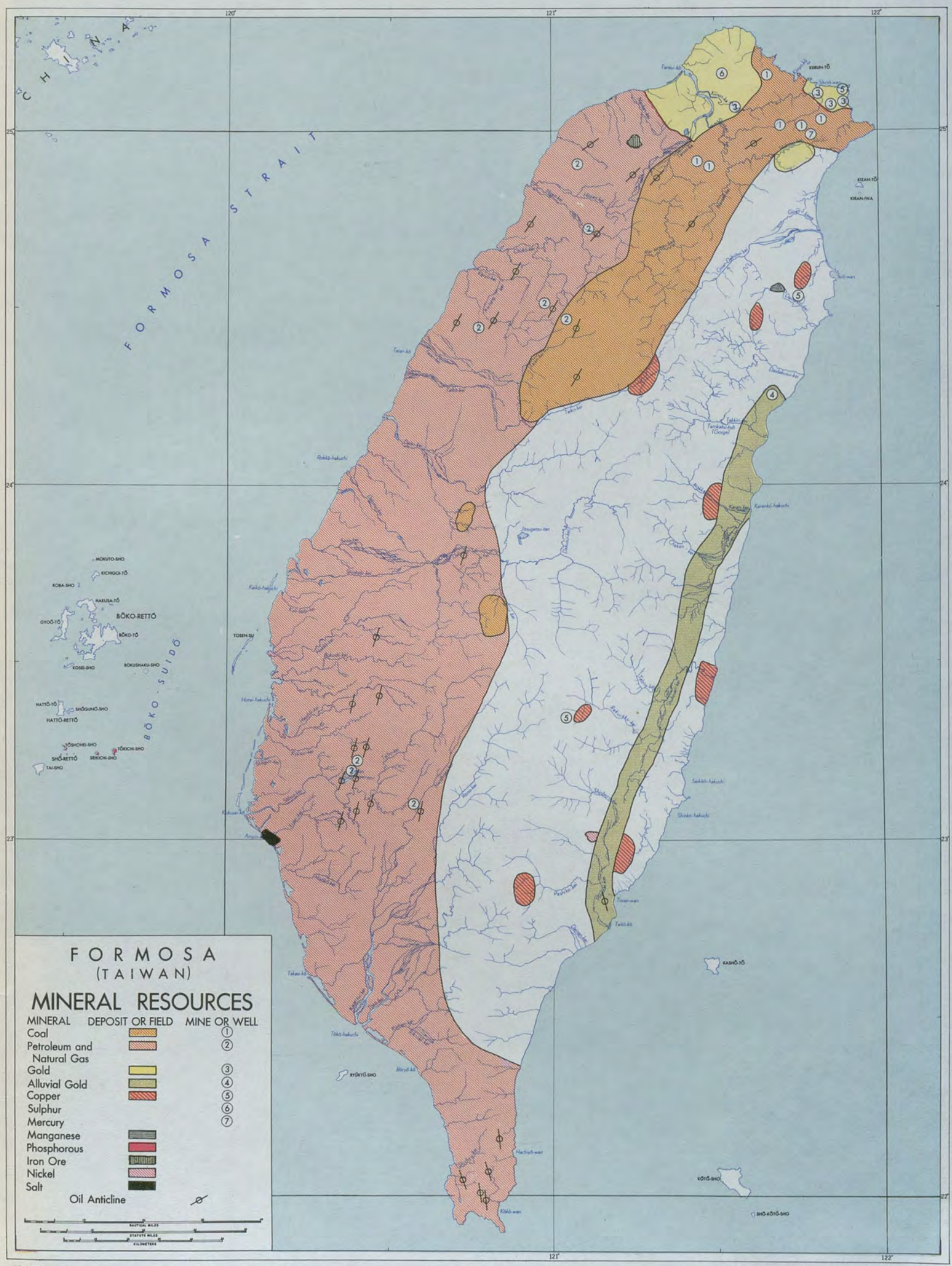

FORMOSA
(TAIWAN)

MINERAL RESOURCES

MINERAL	DEPOSIT OR FIELD	MINE OR WELL
Coal		①
Petroleum and Natural Gas		②
Gold		③
Alluvial Gold		④
Copper		⑤
Sulphur		⑥
Mercury		⑦
Manganese		
Phosphorous		
Iron Ore		
Nickel		
Salt		
Oil Anticline		

NAUTICAL MILES
STATUTE MILES
KILOMETERS

NO. 3360
15 MAY 1944

COMPILED AND DRAWN IN THE BRANCH OF RESEARCH AND ANALYSIS, OSS
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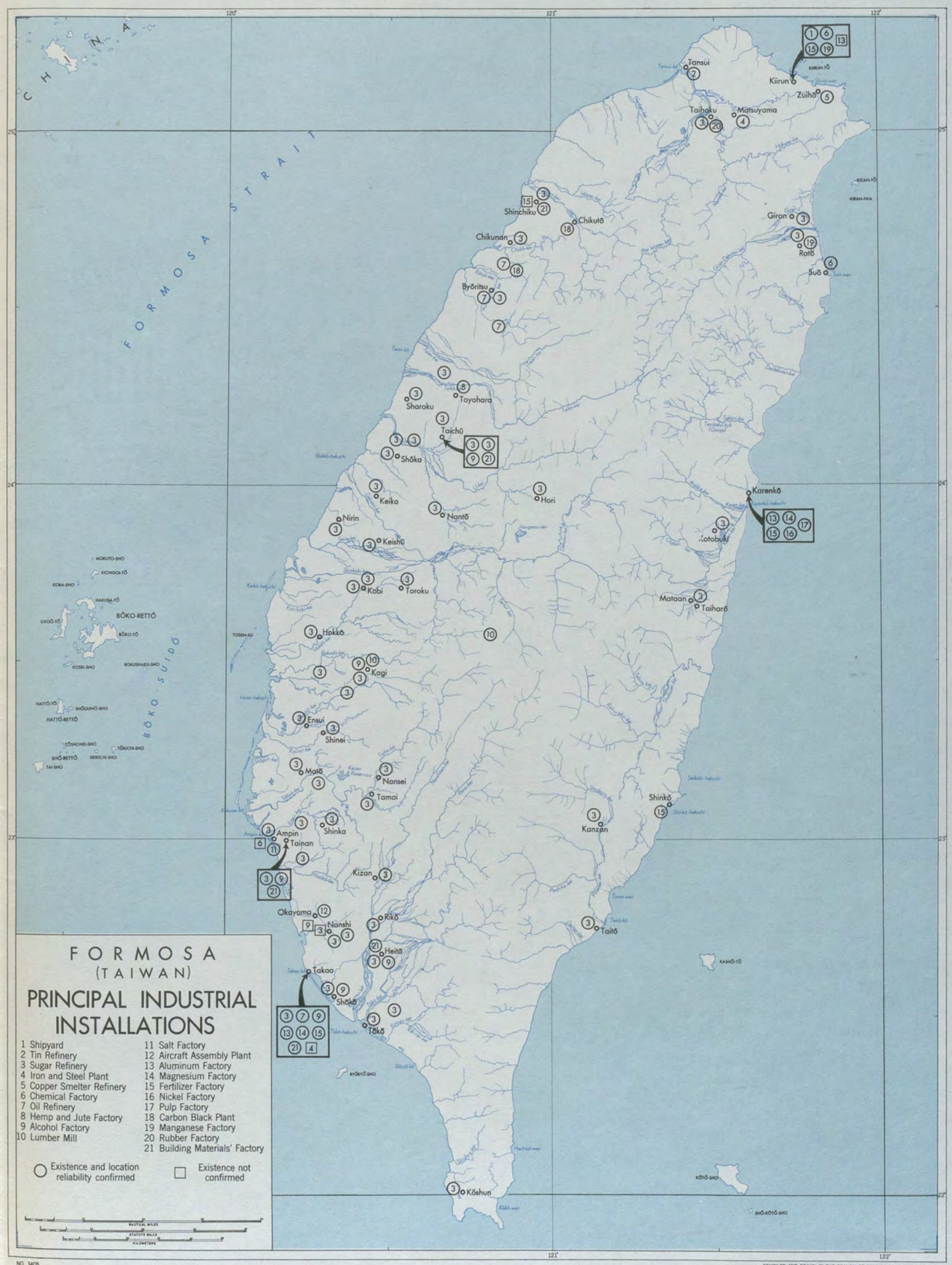
FIGURE IX - 76. *Formosa.*
Map of mineral resources.



FORMOSA
(TAIWAN)
PRINCIPAL INDUSTRIAL INSTALLATIONS

1 Shipyard
2 Tin Refinery
3 Sugar Refinery
4 Iron and Steel Plant
5 Copper Smelter Refinery
6 Chemical Factory
7 Oil Refinery
8 Hemp and Jute Factory
9 Alcohol Factory
10 Lumber Mill
11 Salt Factory
12 Aircraft Assembly Plant
13 Aluminum Factory
14 Magnesium Factory
15 Fertilizer Factory
16 Nickel Factory
17 Pulp Factory
18 Carbon Black Plant
19 Manganese Factory
20 Rubber Factory
21 Building Materials' Factory

○ Existence and location reliability confirmed
□ Existence not confirmed

NAUTICAL MILES
STATUTE MILES
KILOMETERS

NO. 3405
20 MAY 1944

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FIGURE IX - 77. *Formosa.*
Map showing location of principal industrial installations.

INDEX TO ELECTRIC POWER INSTALLATIONS

NUMBER	PLANT NAME	CAPACITY (IN KW)
	ABOVE 1000 KW	
1	Chikushimon Hydro Plant	1,950
*2	Dakusui Hydro Plant	1,500
3	Domon Hydro Plant	23,200
4	Doryuwan Hydro Plant	3,100
5	Enzan Hydro Plant	16,300
6	Hatsune Hydro Plant	1,600
7	Hokuzanko Hydro Plant	1,800
8	Jitsugetsutan No. 1 Hydro Plant	100,000
9	Jitsugetsutan No. 2 Hydro Plant	43,500
10	Jitsugetsutan No. 3 Hydro Plant	23,100
11	Kagi Steam Plant	3,000
12	Kiirun Steam Plant	38,000
13	Kiyomizu No. 1 Hydro Plant	7,000
14	Kiyomizu No. 2 Hydro Plant	5,000
15	Matsuyama Steam Plant	5,500
16	Musha No. 1 Hydro Plant	21,400
17	Musha No. 2 Hydro Plant	27,100
18	Shin Kizan Hydro Plant	13,000
19	Shosoko Hydro Plant	4,400
20	Takao Factory Steam Plant	4,500
21	Takao No. 2 Steam Plant	13,000
22	Takkiri-Kei Hydro Plants	80,000
*23	Tenrei Hydro Plant	98,000
24	Tensopi Hydro Plant	8,600
25	Toyohara Hydro Plant	70,700
	BELOW 1000 KW	
26	Byöritsu Diesel Plant	100
27	Chikunan Diesel Plant	60
*28	Tomizato Thermal Plant	Unknown (less than 500 kw)
29	Boko Diesel Plant	210
30	Horin Hydro Plant	25
31	Karenkō No. 1 Hydro Plant	200
32	Karenkō No. 2 Hydro Plant	400
33	Karenkō Thermal Plant	Unknown (less than 500 kw)
34	Kizan Hydro Plant	750
35	Kori Hydro Plant	960
36	Köshun Diesel Plant	50
*37	Nankyo Hydro Plant	200
38	Nānsho Hydro Plant	7½
39	Sharyokaku Hydro Plant	900
40	Shirin Hydro Plant	500
41	Taihoku Steam Plant	500
42	Tainan Steam Plant	660
43	Taito No. 1 Diesel Plant	50
44	Taito No. 2 Diesel Plant	110
45	Takao Steam Plant	120
46	Tamazato Gas Plant	30
*47	Taparoku Hydro Plant	110
48	Tōen Steam Plant	132

*Location not shown on map

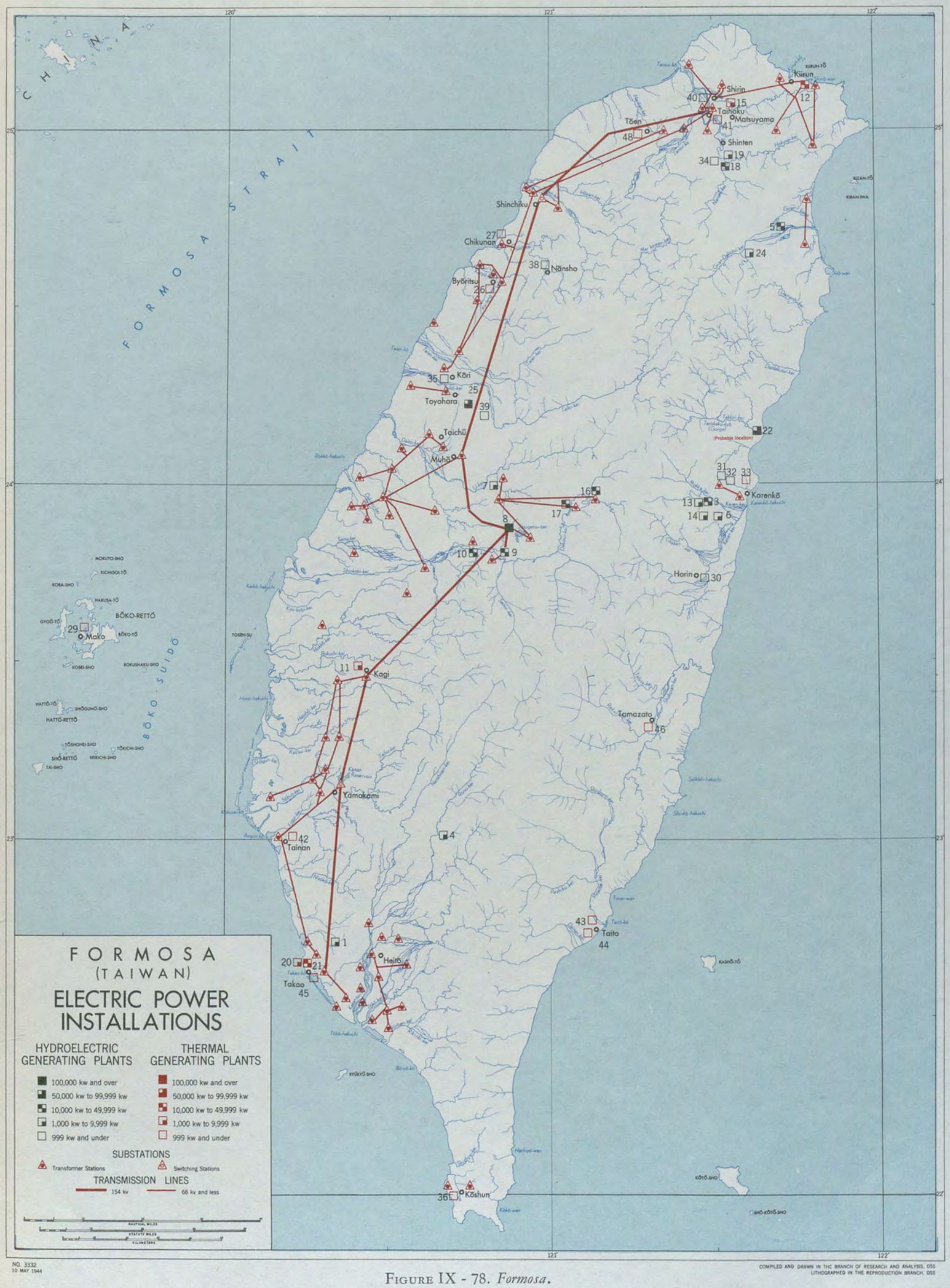

FIGURE IX - 78. *Formosa.*
Map showing electric power installations.

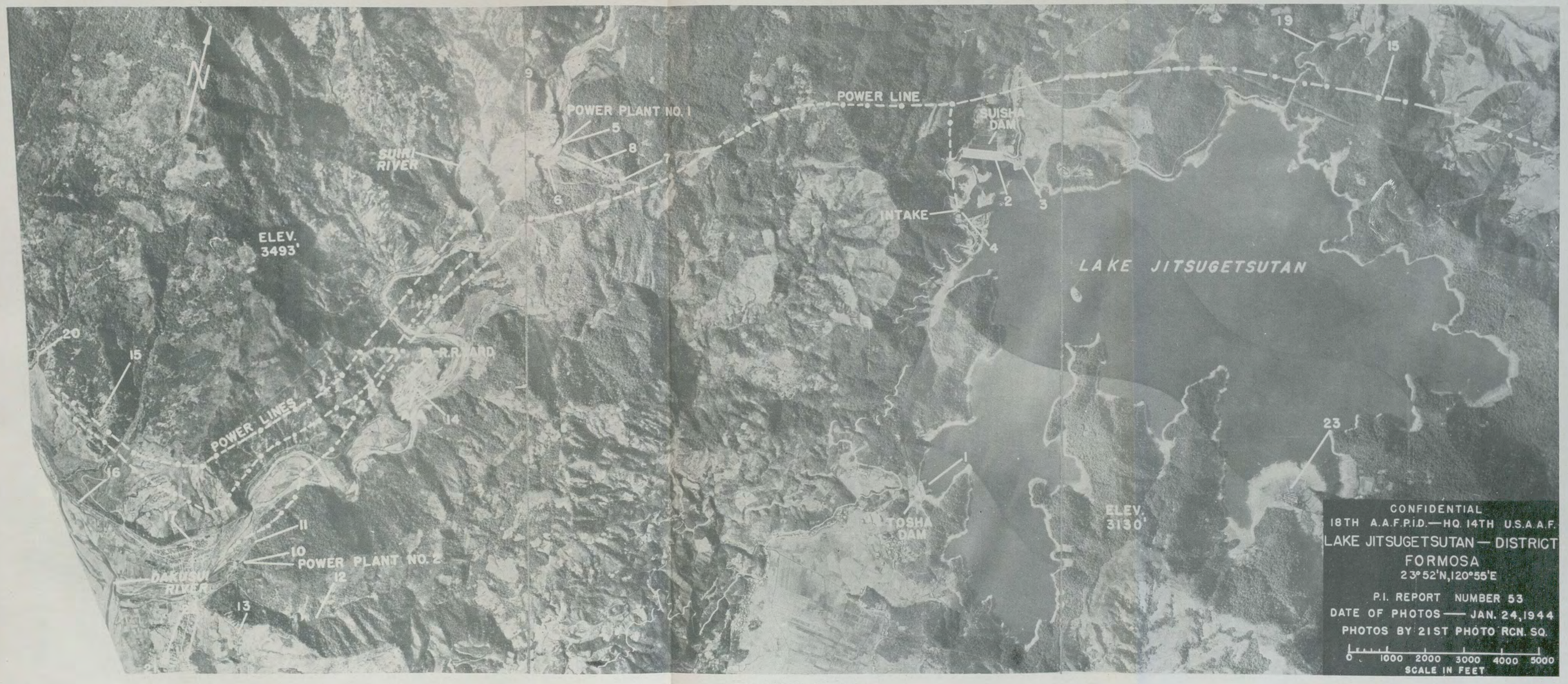

FIGURE IX - 79. *Jitsugetsutan*
Electric power installations.

1. Tosho Dam
2. Suisha Dam
3. Depth gauge station
4. Intake station
5. Power Plant #1
6. Transformer and switching station
7. Surge tank
8. Penstocks
9. Living quarters
10. Power Plant #2
11. Transformer and switching station
12. Small lake and dam
13. Living quarters
14. AA batteries
15. Power transmission lines
16. Electric railroad
17. Suirikō railroad yard
18. Gaishatei railroad yard
19. Road to Hori
20. Road to Shūshū
21. Road south
22. Barracks and storage

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