REPORT ON
PRELIMINARY SURVEY FOR MINERAL RESOURCES IN THE UNION OF BURMA

OCTOBER 1971

prepared for

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

by

JAPANESE TECHNICAL SURVEY TEAM FOR MINERAL RESOURCES

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PREFACE

The Government of Japan, in compliance with the request of the Government of Union of Burma, entrusted the Overseas Technical Cooperation Agency (OTCA) the preliminary survey for mineral resources in the Union of Burma.

In view of the importance of the project, the OTCA organized a survey team consisting of five geological and mining experts headed by Dr. Hokuichiro OHMACHI, chief of Mineral Deposits Department, Geological Survey of Japan, Ministry of International Trade and Industry, and dispatched it to Burma in May, 1971.

The Team carried out field survey for about three weeks on the copper deposit in Monywa, the lead-zinc deposit in Bawdwin Mine, the antimony deposit in Natsan Mine and the tungsten-tin deposits in Kanbauk Mine.

After its return to Japan, the team made further studies on data and information, and the results were hereby compiled into the present report for presentation.

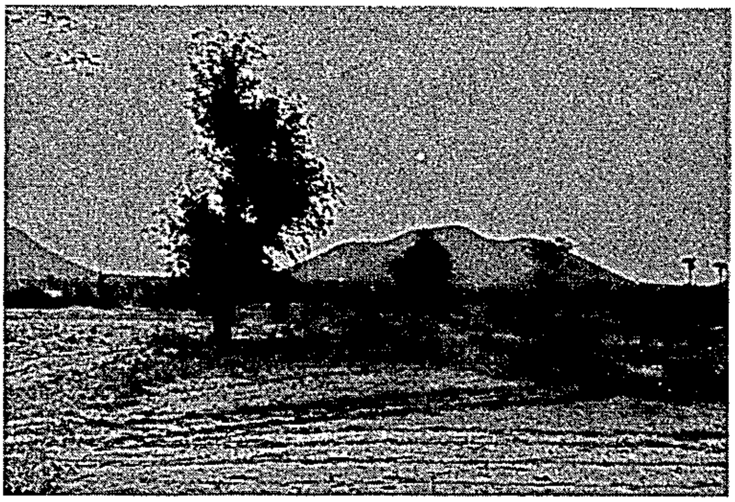
It is our sincere hope that this report will prove to be useful in contributing to the development of mineral resources in the Union of Burma and at the same time contribute to the promotion of goodwill between our two countries as well as the cementing of technical and economic relations.

Finally, I would like to take this opportunity to express my sincere appreciation and gratitude to the officials of the Government of the Union of the Burma and organizations concerned.

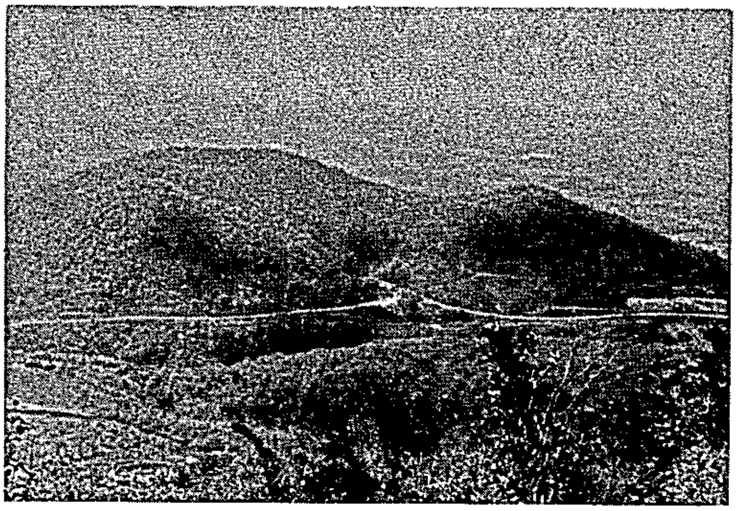
October 1971

Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency
Tokyo, Japan

Monywa copper mine

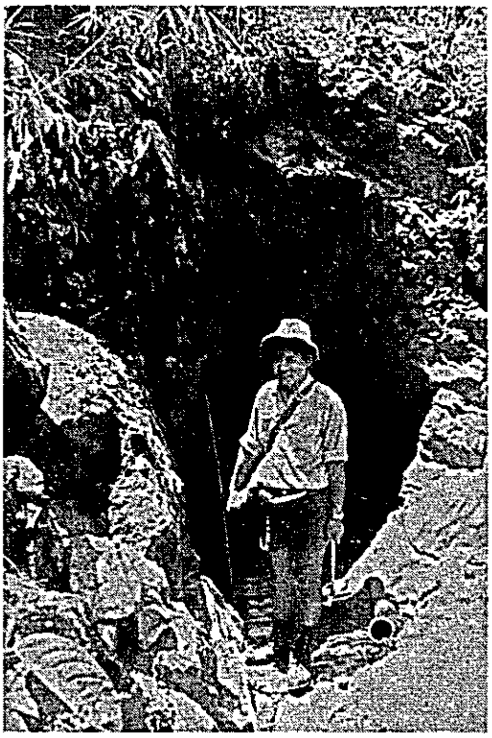


A view of Sabedaung ore deposit in Monywa copper mine (under prospecting)



A view of Kyisindaung ore deposit in Monywa copper mine (after prospecting)

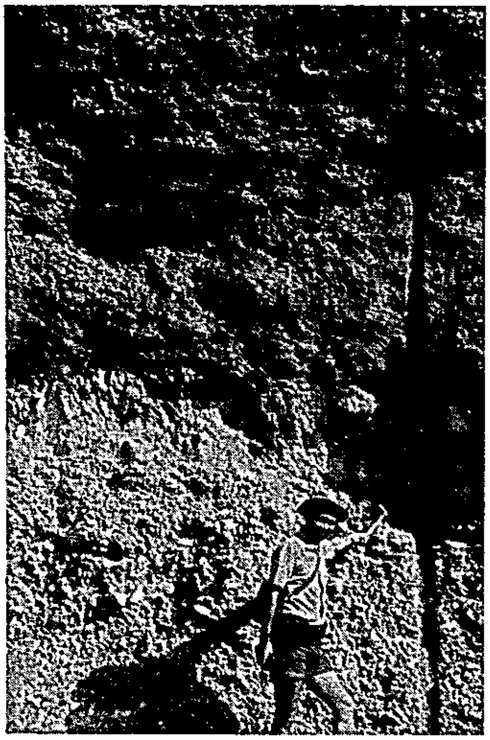
Nat San mine



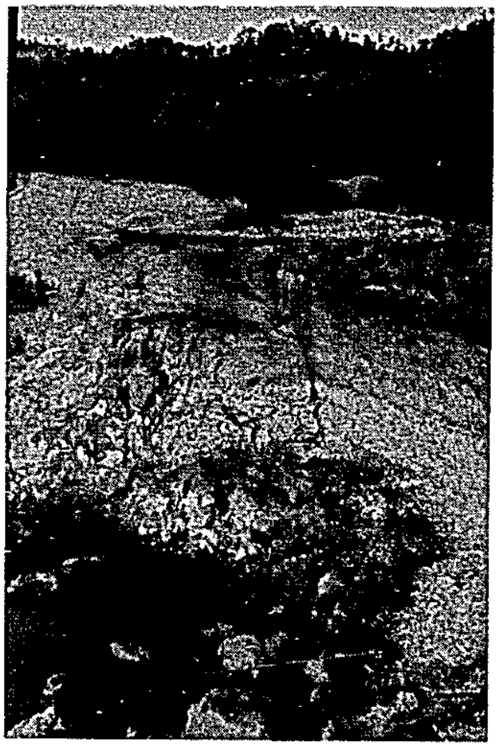
Adit of Natsan antimony mine

Stock-piled place of Natsan antimony mine

Kanbauk mine



Working face of gravel deposit
(tin-tungsten deposit) in Kanbauk mine



Mining place of gravel deposit
(tin-tungsten deposit) in Kanbauk mine

Contents

V. Survey on Mineral Resources in Burma

1) Monywa Mine

1. Location and Transportation (Fig. 5)

Monywa Mine is located at the west bank of the Chindwin River flowing the west side of the city of Monywa situated at about 134 km along the road to the west of Mandalay which is the key town of the Central Burma.

Monywa deposits occurs at the three dome shaped hills named respectively Letpadaung, Kyisindung and Sabedaung. Letpadaung is situated in lat. 22°04' N. and long. 96°06' E., and about 5 km southwest of the City of Monywa. The hills of Kyisindaung and Sabedaung are near to each other, with Sabedaung standing on the east of Kyisindaung, the greater one, across a valley to form twin hills.

The connection of the City of Monywa to the City of Rangoon is made by a railway (730 km in length) and a paved road (800 km in length). Railway charges of this section are 942 kyats per freight car of 14-ton capacity, or about 67.3 kyats (about U.S. $14) per ton.

The transportation by barge costs rather high as compared with that by rail when the Chindwin River is used to Monywa via the Irrawaddy River from Rangoon; besides, such transportation seems to be difficult due to considerable falling off of the rivers for a half year in the dry season. The size of ships which can enter the Port of Rangoon is limited to 8,000 or 10,000 tonner with the standard draft of 26 ft. at the maximum.

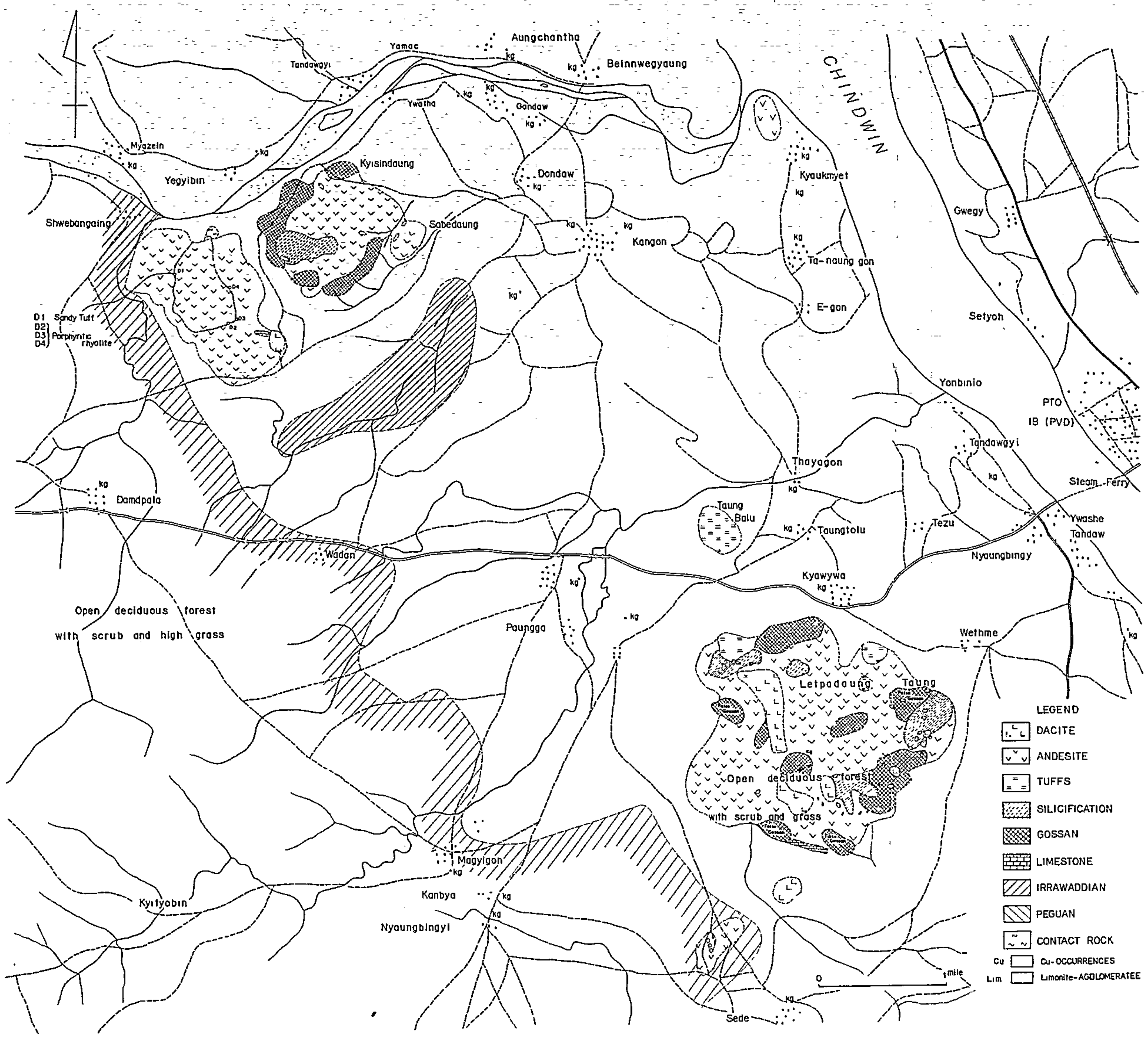
For the transportation of ores from the mine to the railway terminus in the City of Monywa it will be necessary to build a bridge over the Chindwin River which is crossed crossed by means of local ferryboats at present or to construct a pipeline to carry the ores being slimed.

2. Topography and Climate

This region is rather arid and the temperature is hot in the summer season from March to July rising to about 48°C at the highest. The annual precipitation is around 762 mm, with the rainy season continuing from June to October. In the monsoon there is flood sometimes and even the hill area is inundated.

Letpadaung (1,057 ft. in height), Kyisindaung (about 1,000 ft.) and Sabedaung (about 600 ft.) form the dome shaped hills heaped up on the flat land which lies around them with an altitude of about 300 ft. and is used for farming although it is sparsely populated and poorly developed.

Fig. 5 Geological Map Around Monywa Mine



3. History

The copper deposits in this area were discovered in fairly olden time and the oldest records about them are in Mineral Resources in Burma by H. L. Chibber and Mineral Deposits of Burma by E. L. G. Clegg. Some remains of old slag are still found there.

In 1930, a leaching treatment of oxide ores was planned by Jamal Brothers, an Indian firm, but the mine was closed after only small amount of output and processing had been carried out.

A recommendation on the necessary of detailed survey of the region for mineral resources was made in the report on a reconnaissance survey conducted in 1955 by Yugoslavian and Burmese geologists. In accordance with the recommendation, the Mineral Resources Development Corporation (M. R. D. C.) of Burma made a contract with Geoistavanza of Yugoslavia to undertake the investigation of the region. On the Monywa mine, geological survey, sampling and geophysical prospecting (S. P.) were conducted by M. R. D. C. from April to August of 1957.

In 1959, under the forcible recommendation above-mentioned, core drilling was started with the purpose, in particular, of checking the remarkable anomalies obtained by the S. P. method.

In 1960, Mitsui Mining & Smelting Co., Ltd. of Japan who accepted the offer of M. R. D. C. for the joint development of te mine sent two engineers to the site for the investigation. At that time, the drillings had been completed for about 40 bore-holes and an ore reserves of about 15 million tons was expected in the Sabedaung area and its surroundings, of which fact stimulated an interest in the prospecting and development of this mine.

Later, a negotiation was entered by the above company and M. R. D. C. for the joint development and a provisional contract was made between them; however, a new regime which took power in 1962 refused to permit the development by joint method, ending in the rapture of the negotiation.

The new government reorganized the former M. R. D. C. as Mineral Development Corporation (M. D. C.), under the jurisdiction of which the Monywa mine has continued the drilling operation intermittently within the extent of budget allocated to it.

4. Geology

The cone hills of Letpadaung, Kyisindaung and Sabedaung projecting on the western plain which lies on the opposite side of the City of Monywa across the Chindwin River are mainly consists of young volcanic rocks and sedimentary rocks at their basal rocks.

The sedimentary rocks of this region are chiefly consists of sandstone belonging to Pegu and Irawaddian Series. The Pegu Series, the oldest formation in this region, is composed of sandstone and limestone and distributed in the hill of Letpadaung. Although the exact age of this series is unknown, it is believed to be Miocene and Oligocene or Eocene. The Irawaddian Series which is mainly composed of sandstone and conglomerate overlies the Pegu Series and distributed also in the area between Letpadaung and Kyisindaung.

Igneous rocks which are chiefly composed of volcanic rock such as biotite dacite or biotite andesite, etc. and was intruded into the sedimentary rocks; tuff, volcanic breccia and agglomerate are also developed. These volcanic rocks consists of the main part of the dome shaped hills of Letpadaung and Kyisindaung. Usually, dacite forms the central part of the hill which is surrounded by andesite.

5. Ore Deposits

The country rock of ore deposits is the volcanic rock especially silicified biotite dacite.

The ore deposits consist of stockworks filling up the small fissures, with some disseminated parts. The principal primary ore minerals are pyrite, marcasite and chalcopyrite; the secondary ore minerals are chalcocite, bornite and covellite, with green copper minerals occur in the oxidized zone.

Usually, these veins are ranging from one inch in width to hair crack and, show steeply dipping. Under the microscope, tetrahedrite and sphalerite are found but no molybdenite. A small amount of Au and Ag is contained.

In the case of Sabedaung where the prospecting is most advanced, the most part of the principal ore body is composed of chalcocite, chalcopyrite and bornite, with covellite contained partially, on the estimated cut off copper grade is 0.5%. Copper grade of the primary zone beneath the secondary enrichment zone is sharply dropped below 0.5%.

Alteration of the country rock is silicification with some sericitization.

6) Prospecting (Fig. 6, Fig. 7 and Figs. 8 - 1, 2, 3 and 4)

As a result of the electric prospecting by S.P. method conducted by the Geoistravanza (a state-owned prospecting company) of Yugoslavia, remarkable anomalies were detected at six sites (240 acres in total) at Letpadaung, one site (90 acres) at Kyisindaung and one site (45 acres) at Sabedaung.

Diamond core drilling was started in 1959 at the sites and the prospecting drillings were carried out for 15 bore-holes at Letpadaung, 5 bore-holes at Kyisindaung and 8 bore-

Fig 6 Map of Pilot Boring Position, Monywa Mine

Fig. 7 Map of Boring Position, Monywa Mine and Kyisindaung and Sabedaung Deposits

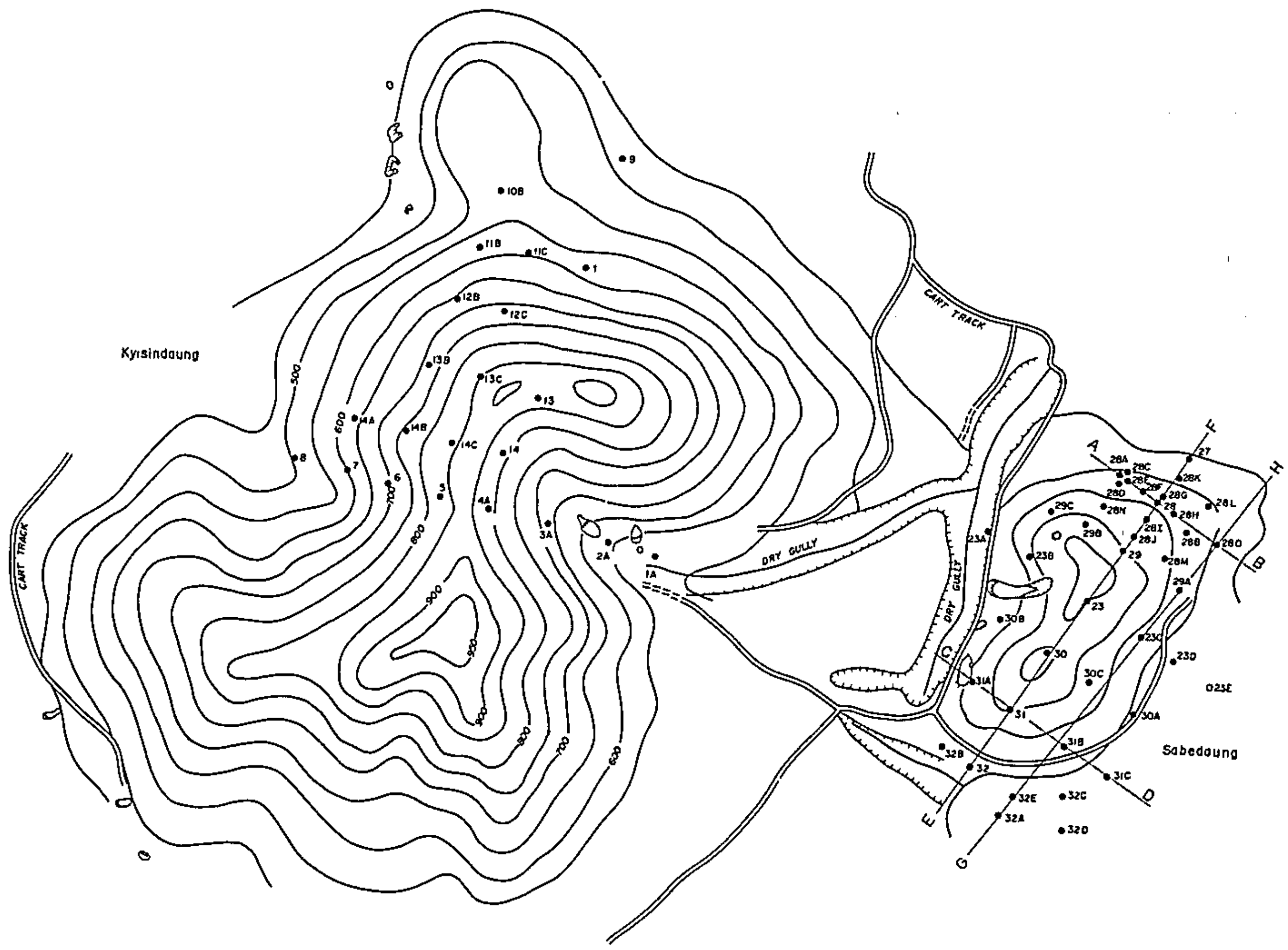


Fig 8-1 Vertical Section of Boring Positions, Monywa Mine and Sabedaung Deposit

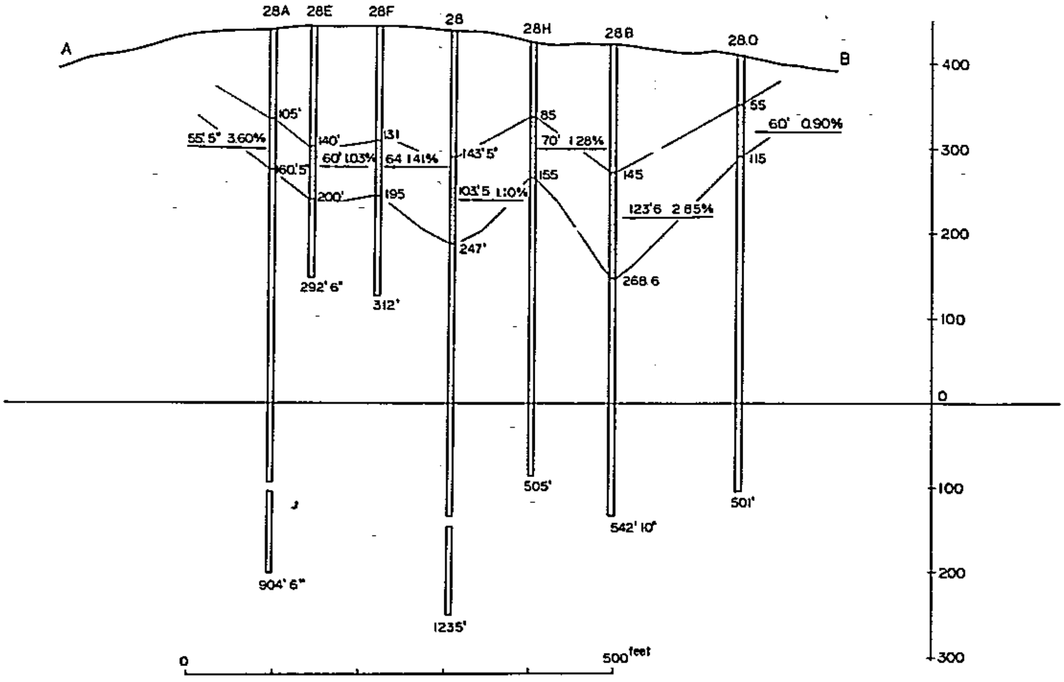


Fig 8-2 Vertical Section of Boring Positions, Monywa Mine and Sabedaung Deposit

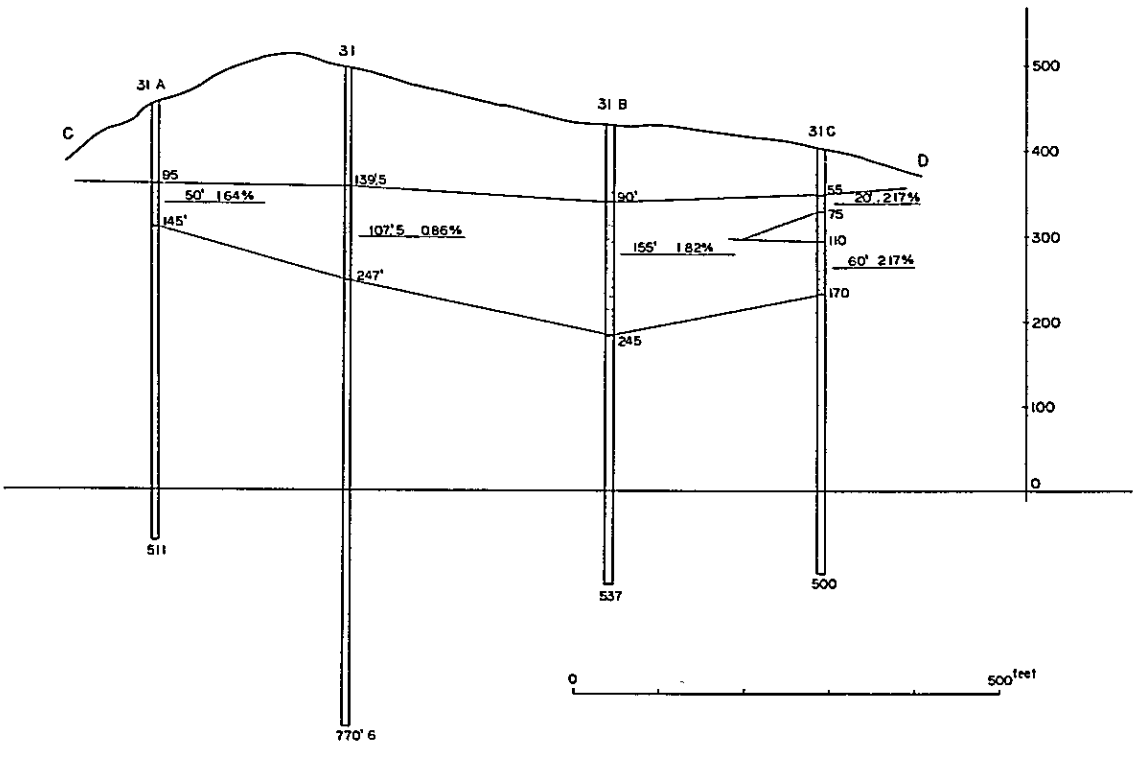


Fig. 8-3 CROSS-SECTION ALONG G~H

Copper Deposit Sabedaung Hill

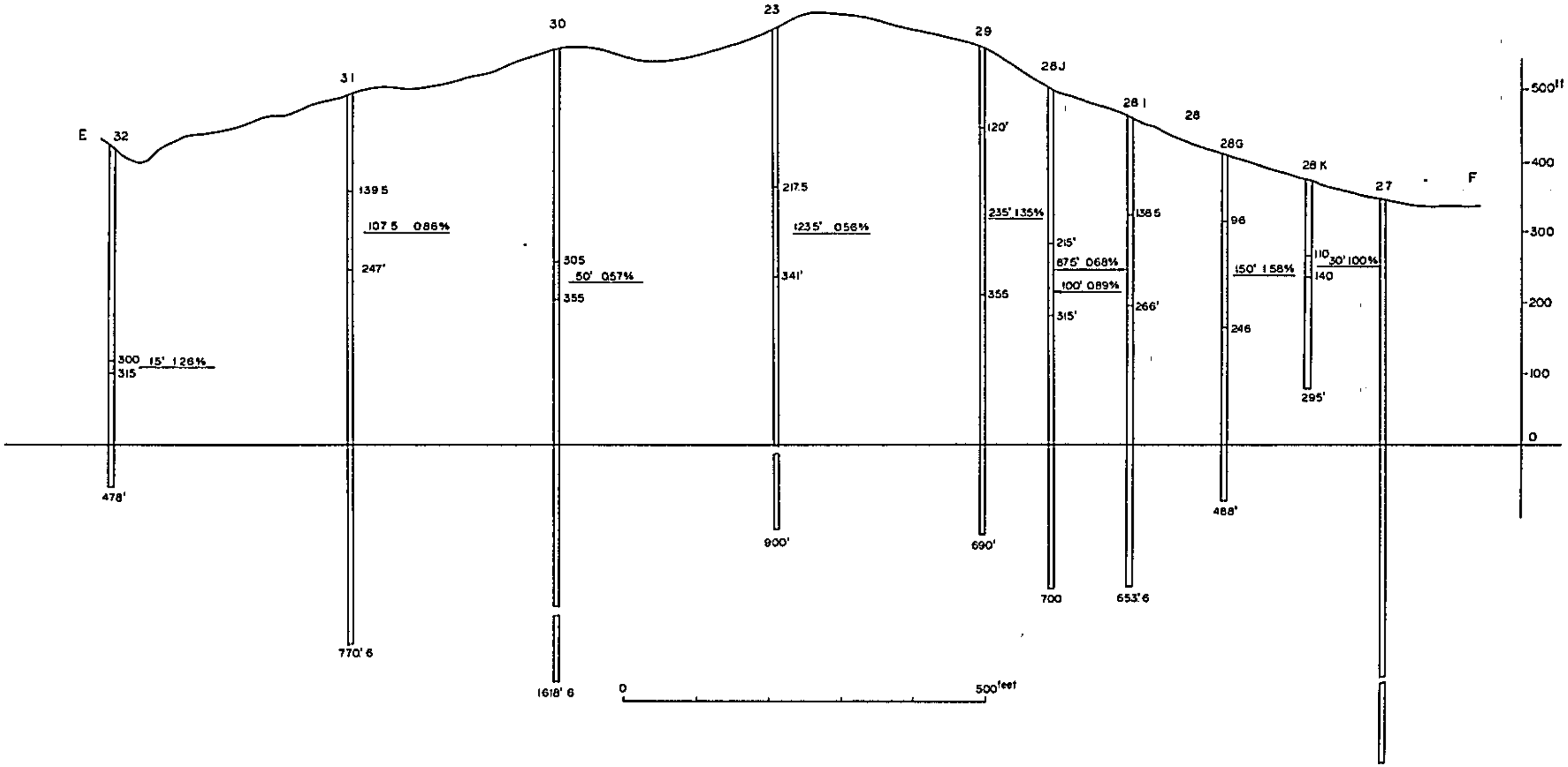
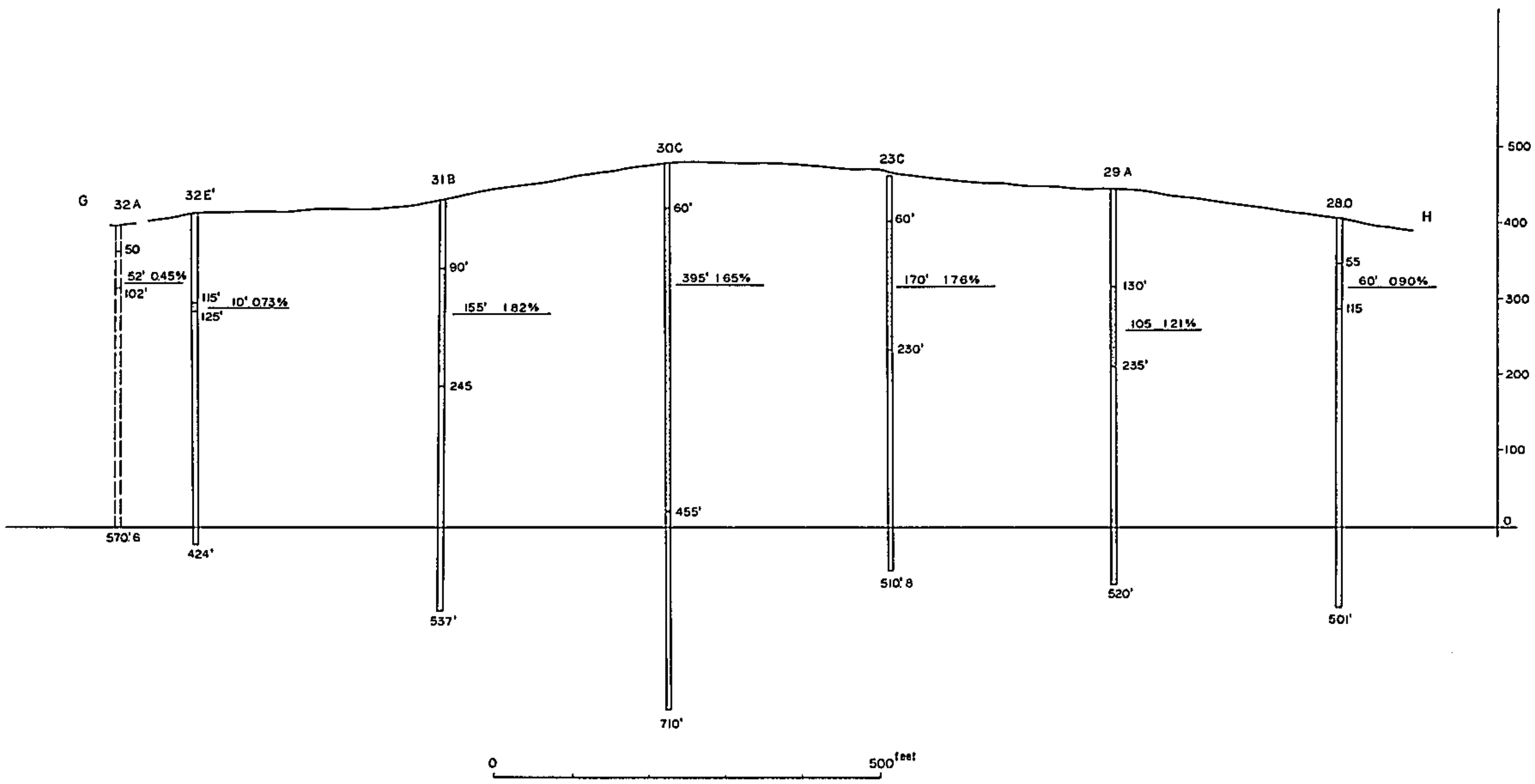


Fig 8–4 CROSS – SECTION ALONG G~H

Copper Deposit Sabedaung Hill



holes at Sabedaung; as a result of which the existence of ore deposits was confirmed at each area. At Sabedaung, among others, as a well sizable ore body was discovered, it was planned to conduct a gride drilling of 200 ft.x 300 ft.with the purpose of carrying out further exploration and the exploratory drilling for 41 bore-holes has been completed already (about 25, 3000 ft.in total length).

As for Kyisindaung, the drilling is now under operation on 300 ft.x 300 ft.grid and so far it has been completed for 22 bore-holes in total.

For the future it is planned to conduct the exploratory drilling for 27 bore-holes (37, 000 ft.in length) at Kyisindaung and 70 bore-holes (63, 000 ft.in length) at Letpadaung, or for 107 bore-holrs in total (100, 000 ft.in length). This project of which completion is expected to require about four years is incorporated in the Four-Year Plan for Mine Development of Burma.

Recently, under the assistance of Colombo Plan, an aero-magnetic survey (by means of proton prepared by Barringer Co. of Canada) was conducted over the area of about 2, 100 square miles shaped long in E-W and a little shorter in N-S; as a result of which tectonic line running north-south and that running east-west were discovered and anomaly detected between Letpadaung and Kyisindaung. For this anomaly, a ground magnetic survey and E. M. survey by means of E. M. gun made in Sweden are being conducted at intervals of 100 m, with geological survey. As a result of geological survey no ore indication has been discovered and, any plan is not established for exploration.

The grid drilling at Sabedaung has been nearly completed and its results are shown in Table 8. The drilling was made for 41 bore-holes inttotal, or 25, 286 ft.in total length, and ore deposit were found at all bore-holes except 4 bore-holes; it is calculated that the average thickness of ore bodies is 108 ft.and the average copper contents are 1.5%.

A noteworthy fact here is that core recovery is poor in general and it is estimated to be 30% in some cases and possibly about 50 - 60% in average. The analyses of ore are conducted at every 5 ft.and each weight of core and sludge of a 5 ft.section is measured to work out weighted average value which is regarded as the grade of that section. Recovered sludge which is first put through a wooden sluice of 5 ft.long to deposit coarse grains for removal is then put in three or four drums together with a small amount of lime to settle its fine grains to be used as sample. Thus, as the grade is greately affected by the quality of sludge it may not be said that the reliability is quite unquestionable. Furthermore, as any core and sludge could not been recovered at not a few holes it is necessary to check thoroughly the continuity and grade of ore bodies in the future.

At Kyisindaung, the grid drilling is under way. Among 22 bore-holes for which drillings have been completed, ore bodies were discovered at 7 bore-holes including Nos. 2A, 3A, 10B, 10C, 11B, 12B and 14.

In No. 2A bore-holes an ore body has more than 100 ft. thick at the depth about 200 ft; in No. 3A bore-holes that of more than 200 ft.thick at the depth of about 30 ft; in No. 10B bore-hole, two ore bodies were discovered of which one extending from the depth of 105 ft.to 117 ft.and another being 62 ft.thick from the depth of 252 ft.to 314 ft;

Table 8. Results of Drilling of Ore Deposits at Sabedaung

Sr.No.	Drilling No.	Depth ft.	Ore Body		Ore Source ft.	Average Grade Cu%	Remarks
			From	To			
1	DHS23	900	217.5	341	123.5	0.56	
2	" 23A	535	80.5	105.5	25	2.02	
3	" 23B	511	135 320	145 330	20	0.51	Two ore body
4	" 23C	$510^{8''}$	60	230	170	1.76	
5	" 23D	$514^{6''}$	-	-	-	-	
6	" 23E	514	-	-	-	-	
7	" 27	896	-	-	-	-	
8	" 28	1235	143.5	247	103.5	1.10	
9	" 28A	$904^{6''}$	105	160.5	55.5	3.60	
10	" 28B	$542^{10''}$	145	268.6	123.6	2.85	
11	" 28C	1200	67.5	125.5	58	0.65	
12	" 28D	330	75	140	65	1.14	
13	" 28E	$292^{6''}$	140	200	60	1.03	
14	" 28F	312	131	195	64	1.41	
15	" 28G	488	96	246	150	1.58	
16	" 28H	505	85	155	70	1.28	
17	" 28I	$653^{6''}$	138.5	266	87.5	0.68	
18	" 28J	760	215	315	100	0.89	
19	" 28K	295	110	140	30	1.00	
20	" 28L	551	70	196	126	0.70	
21	" 28M	601	82.5	256	173.5	1.53	
22	" 28N	650	115	210.5	95.5	1.65	
23	" 28O	501	55	115	60	0.90	
24	" 29	690	120	355	235	1.35	
25	" 29A	520	130	235	105	1.21	
26	" 29B	502	165	180	15	6.50	
27	" 29C	$445^{6''}$	230	370	140	1.04	
28	" 30	$1618^{6''}$	305	355	50	0.57	
29	" 30A	941	89 705	606 745	557	2.10	(-50°) Two ore body
30	" 30B	520	75	165	90	1.57	
31	" 30C	710	60	455	395	1.65	
32	" 31	$770^{6''}$	139.5	247	107.5	0.86	
33	" 31A	511	95	145	50	1.64	
34	" 31B	537	90	245	155	1.82	
35	" 31C	500	85 110	75 170	80	2.17	Two ore body
36	" 32	478	300	315	15	1.26	
37	" 32A	$570^{6''}$	50	102	52	6.01	
38	" 32B	520	70	220	150	1.41	
39	" 32C	$519^{6''}$	135	185	50	0.90	
40	" 32D	$365^{6''}$	-	-	-	-	
41	" 32E	424	115	125	10	0.73	
Total Average		25,286			108	1.5%	

in No. 11B, also two bodies are discovered with one of 340 ft.thick extending from the depth of 109 ft.to 449 ft.and another of 120 ft.thick from the depth of 514 ft.to 634 ft; in No. 12B, an ore body of 137 ft.thick at the depth between 571 ft.and 708 ft; in No. 14, an ore body of 173 ft.at the depth between 159 ft.and 332 ft. The copper grade, of which detailed data could not be secured, is estimated at 1.3 1.4% by the Burmese authorities.

At Letpadaung, the exploratory drillings are being conducted for 25 bore-holes in all, but one of them being making over the real number is 24 bore-holes. The ore bodies discovered are shown below.

Name of hole	Depth of drilling (ft)	Reached from to	Thickness of ore body (ft)	
92	855	(380 ~ 410 510 ~ 708)	(30 190)	2 bodies
104	763	80 ~ 260	180	
158	1,005	150 ~ 460	310	
168	970	345 ~ 665	320	
181	681	160 ~ 180	20	
188	885	170 ~ 658	488	
192	1,040'6"	120 ~ 180	60	

7. Grade and Ore Reserve

The ore reserve estimated by the Burmese authorities based on M. D. C. data is as follows:

	LT	%
Sabedaung (semi-proved)	11,000,000	1.5 (cut of grade 0.5%)
Letpadaung } (expected)	7,900,000	1.2 - 1.4
Kyisindaung } (expected)	7,800,000	1.3 - 1.4
Sub-total	15,700,000	
Total	26,700,000	

The results of estimation for the ore reserve shown above need to be reviewed closely in the future because of the facts that some questions arise as to the accuracy in processing the drilling data, that the core recovery is poor as aforesaid, and that some doubt exists about the determination of extent and grade of ore deposits; however, the estimation of ore reserve for Sabedaung seems to be reasonable in the main.

The ore reserves in the areas of Letpadaung and Kyisindaung cannot be accepted at the present state of affairs and the entire picture will be given by the results of grid drilling. As for the copper grade, the value of 1.5% is deemed too high. It seems reasonable to put it at 1.0 1.2% judging from the research data prepared by Mitsui Mining & Smelting Company and based on the feeling obtained from the core logging.

8. Comments

Judging from the results of prospecting carried out so far, 12 million m.t. of ore body having copper grade of 1.0 1.2% at Sabedaung and at least several million m.t. of it at Kyisindaung adjacent to Sabedaung are being comfirmed to make up about 20 million m.t. in total. In view of the condition of ore reserve the present project is presumed to be feasible, although a precise feasibility study is of course required to be made on the basis of checking of grade and ore processing test, etc. in the future.

As a potentiality for the future, it is possible to expect that the ore bodies will be further developed at Letpadaung and Kyisindaung areas, flat land area and, in particular, the areas to the west and the east of Sabedaung ore body. It is also possible to expect the discovery of new ore deposits beneath the flat land, and there is a strong probability that production can be started at a scale of 5,000 m.t./day. Therefore, this report concludes that this mine is worth developing and an appropriate prospecting should be promoted further.

For the future exploration, it is contemplated to complete first the grid drilling under way at Kyisindaung and then to proceed to the grid drilling at Letpadaung. This will be well acceptable as a basic policy; however, in carrying out the plan not only any existing data of drilling should be course be utilized to determine the order among the drilling works but a flexible operation be attained by such measure as rearrangement and revise of the grid.

The grid drilling at Sabedaung has been generally completed but the areas west, southeast, southwest, northwest, and northeast to Sabedaung are not explored as yet and it is necessary to conduct an additional drilling at these areas. In particular, the ore deposit in the area west of Kyisindaung has a possibility to continue to Kyisindaung. Therefore, the development of vertical or inclined shaft should be started at Sabedaung at the time when the drilling has been completed or along w th it. After ore body has been reached, it becomes necessary to construct and operate a pilot mill (capacity of 20 30 tons per day) for conducting the strict checking of grade and quality of ore by a cross-cut running into the ore body lieing north and south. In this way, it is possible to collect all basic data such as the actual state of ore grade, the extraction of dressed ore and the grade of concentrate necessary for the feasibility study of the present project, including other pertinent data needed for the planning of dressing plant.

One more suggestion on prospecting is that there is an enough possibility to confirm the extent of the known deposits and discovering new deposit by carrying out I.P. survey which seems effective when applied to the flat land zones surrounding Letpadaung, Kyisindaung and Sabedaung.

9. Conclusion

It is desired that the present project to develop the Monywa Mine as copper mine which is much expected by all persons shall be provided with the assistance and encouragement of the Burmese and Japanese authorities who place much hopes on it in accordance with the following stages:

(I) First Stage (First year)

(A) A mining geologist having experience in the exploration of mineral resources will be sent to Burma who will instruct the engineers at the site about the proper compiling and processing of drilling data and complete the review and compilation of data collected so far. In particular, it will be necessary to undertake and complete grade evaluation of ore, grade evaluation of blocks of ore based on the presumed operation, and estimation of ore reserve; to calculate ratio of waste: ore when open cut method is adopted; and to estimate the grade of minable ore reserve.

(B) An experienced drilling engineer will be sent to instruct the engineers at the site how to imporve the present state of core recovery and the drilling process. As it is required to introduce wire line method and drilling md, a grant of equipment necessary for them will be made.

(II) Second Stage (2nd year and thereafter)

It is most desirable to implement the drilling by the Metallic Mineral Exploration Agency of Japan for the promotion of drilling program which is most hoped by the Burmese authorities and constitutes the greatest bottleneck in the economic field. The measure to be taken by all means is to conduct I. P. exploration of the plain (of about 10 km x 20 km) around the known ore deposit, since such exploration which may lead to discovery of new ore deposit, is believed very effective in confirming the extent of the known ore bodies.

2) Bawdwin Mine

1. Location and Transportation

Bawdwin Mine which is under the control of Myanma Bawdwin Corporation (M. B. D is in Northern Shan States (see Table 6).

Bawdwin, the mining center, is situated in a steep ravine with an altitude of about 945 m which is suggestive of the Kamioka mine in Hida Mountain Land of Japan , at about 96 km to the border of Yunnang Province, China, and is reached by the railway of about 960 km to the noth from Rangoon which is the capital as well as the shipping port of ores.

The ore dressing plant, smelting plant (of lead-smelter), general office and workshop are situated at Namtu town 7. 2 km southeast downward of Bawdwin, and at 672 km from Lashio. There is a hydroelectric power station at Mansam Falls 448 km southeast of Namtu.

Ores and materials are transported by the Burma State Railwaysfrom Rangoon to Namyao on Rangoon side of Lashio via Mandalay and by the mine's railway of narrow gage (61 cm) for 54. 4 km from Namyao to Namtu. This narrow gage railway runs another 19. 2 km from Namtu to Bawdwin.

A paved road extends from Lashio to Namtu via Hsipaw and Namtu where there is an airport is 15 minutes flight from Lashio by light airplane.

Since the road between Namtu and Bawdwin is not fully opened for traffic the narrow gage railway is the only means for transporting materials, persons and concentrates.

2. History

Bowdwin Mine has a long history and the oldest record shows that it was put in production by Chinese to silver output in the time of Min dynasty (1412 A.D.). After beginning prosperous production particularly from the late eighteen century to the mid-nineteenth century, it was abondoned in 1868 A.D. and much remains of lead slag is still noticed. The amount of mined ores in that period is estimated at about one million tons.

Since the object of mining was to take out silver the slag above-mentioned still contained much lead (40% - 60%), and Europeans who became to pay attention to this fact in the early twentieth century planned to refine this slag. In 1908, Burma Mines Ltd. built a small scale smelter in Mandalay and a narrow gage railway was constructed over 72 km between Namyao Station the way from Mandalay to Lashio and the mine of Bawdwin.

The smelting plant started operation in 1909 but it did not pay because of high cost added with railway transportation expense over 260.4 km from the mine to Mandalay.

In 1911, a new smelting plant was built at Namtu and along with the processing of 200,000 — 300,000 tons of old plag (40 60% Pb), prospecting and mining was commenced chiefly at the Chinaman ore deposit.

It was during three years since the new arrival in 1913 of Mr. Herbert Hoover who was a graduate of Stanford University and once the president of America when the bases of modern mining operation covering mining, prospecting and ore dressing were established for the first time.

After that, although there were some changes, the production increased gradually to grow up into a prominent lead and zinc mine in the world.

The production is as follows (as crude ore).

1910 - 1919	262,420 t
1920 - 1929	4,630,570
1930 - 1940	4,569,330

The grade is estimated at as high as 28% with lead and zinc (around Pb 18%, Zn 11% and Cu 0.4%).

During World War II, Office of Army Bawdwin Mine was opened by the former Japanese Army; Mistui Mining & Smelting Co., Ltd. took charge of mining, concentrating and smelting of lead and Nippon Mining Co., Ltd. took charge of copper smelting. The mine was in production for about two years from 1942 to 1944 with about 240 persons in total sent from Japan, but its operation was interupted frequently by ceaseless bombing of U. S. Air Force.

The working of ore dressing plant was first planned with a target of 300 t/day which which was increased to 600 t/day as from September, 1943, and the days operated was not more than 360 days in aggregate.

As for ore production from underground, about 30 tons per day were produced from the main working level for the first 6 months because it was necessary to repair the galleries; the output for the next twelve months was 200 – 250 tons per day (Pb + Zn 28%), and that for the last 6 months was 400 tons per day (Pb + Zn 22%).

Although the amount of ores mined by the Japanese firms during the war was estimated at about 200,000 tons by the Burmese authorities, the actual amount was presumably 140,000 – 150,000 tons (Eventually, any ton of concentrate never arrived Japan).

The mine when reopened by Englishmen after the war was under such unfavourable conditions that it had sustained a serious damage by the bombing during the war and in particular its lead and zinc flotation plant having had a capacity of about 1,355 t/day was completely destroyed two months before the end of the war and that No. 6 level and so on had been submerged in water for a long time due to the flasting of power transmission line. However, the rehabilitation of the mine made slow progress because of a conservative attitude toward the investment of a great sum needed for it. Eventually, this caused the Burmese Government to intervene in the affairs in 1915 and a joint adventure of Burmese Government and Burma Mines Ltd. was agreed to set up Burma Corporation Ltd. with each party owing respectively 50% of it.

Burma Corporation was wholly nationalized as of January 18, 1965, by a new name of People's Bawdwin Industry and, since then, is under the control of Myanma Bawdwin Corporation (M.B.C.).

The production of ore since 1952 is shown in an attached table, which reveals that both the amount and grade of ore have trended to decline since 1962.

The total production of ore in the past is estimated at about 13 million tons and the grade of Pb + Zn is 28% or more.

Table 9 The Results of Production, Bawdwin Mine (1952 - 1970)

ORE		ASSAY				Antimonial Lead Tons	Refined Lead Tons	Silver Ozs.	Gold Ozs.	Zinc Concentrates Tons	Nickel Spoiss Tons	Copper Matte Tons	REMARKS
Year	Tons	Ag Ozs.	Pb %	Zn %	Cu %								
1952/53	38284 *	13. 6	15. 5	11. 6	0. 24	166	3740	405914	42	5000	171	65	
1953/54	83990 *	12. 7	15. 6	10. 0	0. 21	96	9081	863085	26	9558	160	154	
1954/55	99769 *	13. 9	17. 2	11. 6	0. 24	376	11513	1036813	167	13021	527	297	* Milled Tonnages.
1955/56	111170 *	14. 1	17. 2	11. 2	0. 24	530	14885	1358513	124	13953	492	379	
1956/57	118301 *	13. 6	16. 6	10. 9	0. 26	291	13892	1238259	178	14922	298	369	
1957/58	120147 *	15. 5	19. 3	12. 5	0. 24	237	13577	1206339	113	17772	264	259	
1958/59	126738	16. 4	20. 4	13. 1	0. 12	544	20823	1831724	190	20520	546	381	
1959/60	124365	16. 0	19. 3	11. 9	0. 21	496	16929	1530693	307	18287	275	344	
1960/61	128356	14. 0	17. 1	9. 8	0. 24	486	15564	1379686	306	14549	396	314	
1961/62	153063	12. 7	15. 8	8. 6	0. 20	376	16615	1436955	177	14225	520	354	
1962/63	204078	12. 3	15. 4	8. 3	0. 21	492	21769	1832384	287	18286	559	498	15 months.
1963/64	160221	11. 6	15. 7	8. 2	0. 19	530	16525	1395183	220	14125	398	378	
1964/65	163508	10. 8	13. 6	8. 0	0. 19	561	15693	1204130	208	14131	265	370	
1965/66	164889	8. 7	11. 9	6. 4	0. 17	508	14534	1190084	136	11487	160	215	
1966/67	150850	7. 3	10. 4	5. 2	0. 14	400	13163	1022310	145	9812	126	181	
1967/68	153885	6. 0	9. 06	4. 89	0. 13	279	9390	801045	147	8223	114	151	
1968/69	175560	6. 9	8. 93	4. 89	-	356	9986	827406	-	9734	98	186	
1969/70	159951	6. 08	8. 49	4. 69	0. 13	284	7517	553447	-	6968	83	195	

Rangoon, Dated 6th May, 1971
AP/nb(8).

3. Geology and Geologic Structure (Fig. 9)

The Bawdwin region mainly consists of Paleozoic Strata and the rock formations ranging from those of the older to those of younger age in order from the east to the west and dip to east generally.

These strata are shown, in descending order, as follows:

Stratigraphy	Age	Thickness
Namyan beds	Jurassic	1,000 ft.at the min.
Platean limestone	Dev-Carboniferous	3,000 ft.at the min.
Nam Hsim Sandstone	Silurian	2,000 ft.at the min.
Panphsapye Graptolite bed	Silurian	several ft.
Naung kangyi bed	Ordovician	several hundred ft.
Pangyun Series	Ordovician	several thousand ft.
Chaung Magyi Series	Cambro-Ordovician	several hundred ft.

Chaung Magyi Series

This series is the basement of this region and distributed in the west part of Bawdwin Mine. Chaung Magyi Series was intruded by the Tawnpeng granitic batholith In the mining district this rock occurred in the lower part of Pangyum series.

Chaung Magyi Series is composed of slaty shales, graywackes, and phyllites. In the western part, the Tawnpeng granite occur at the base of this series. Some geologists considers that the granite is basement and is covered uncomformably by Chaung Magyi Series, while many geologists believe that the granite intrudes into this series.

Pangyum Series

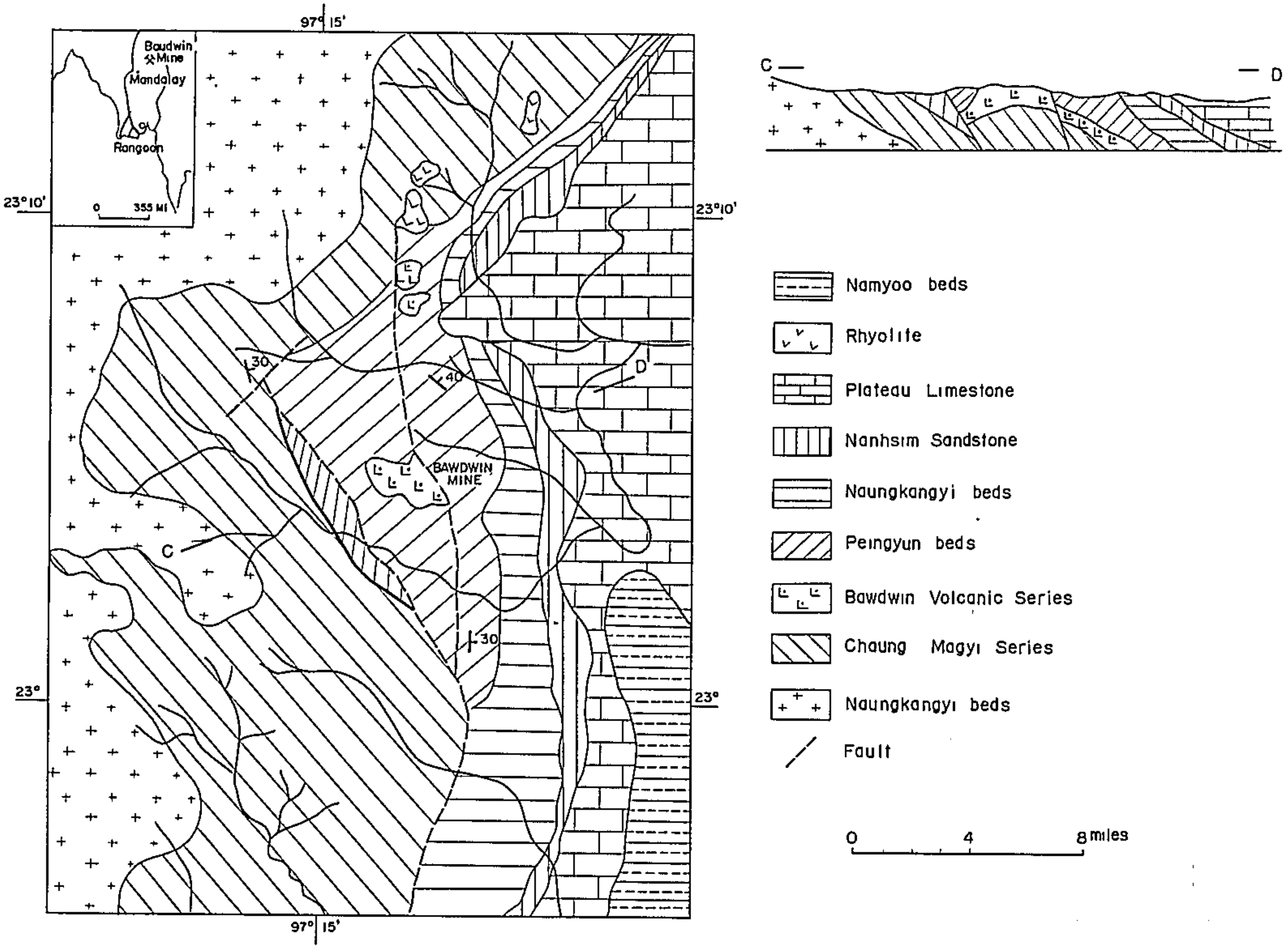
Pangyum Series is the country rock of Bawdwin ore deposits and in this mining area it consists of alternation of this bands of quartzite and shaly slates.

In the northern part of the mine it consists of alternation of coarse arkose sandstone, grits and conglemerates.

In the northeastern part of the mine, Nam La Sediment is developed which consist of same as Pangyum Series, associate with quarts porphyry and much ferryginous cement and shows interfinger with Pangyum Series seemingly, as if it shows the lacal center of volcanic activity.

According to Coggin Brown (1917) Bawdwin rock of ore deposits are distributed in 38 km from north to south and S. 3 km from east to west along the anticline of Bawdwin, while this tuff is not volcanic tuff but is hydrothermally altered Rangyum Series and it should be called pseudo-tuff.

Fig. 9 Geological Map Bawdwin Mine



The pseudo-tuff is an aggregate of secondry quartz, sericite, clay minerals, and carbonate but its original structure altered completely and it is gradually changed into Pangyun sediment.

The original rock in which some tuffaceous debris is recognized only in a limited extent. Main parts of this sediment is composed of slits, mudstone, sandsone, grits and conglomerate in areas.

Naungkangyi Series

Black thin carbonaceous graptolite bearing shale is developed in upper part of this series. While the fossil of graptolite is not so good preserved, it is determined to belong to Landovery age (the lowest part of Siluvian).

The Naungkangyu Series is conformably overlaid the Pangyun Series. According to Coggin Brown, this series is composed of brownish or chocolate colored sandy mudstone, shale and marl. The age of this series is determined from its fossil bed as Ordovician.

Namyan Beds

Namyan beds is covered unconformably the plateau limestone and is mainly composed of sandstone, associated with dolomitic limestone near their bases and clay in the upper parts.

Geologic Structure

In the Bawdwin Mine Area, an anticline of more than 80 km in length runs from the vicinity of Tiger Camp (adit of main gallery leading to No. 6 level) to the Mt. Herschel and beyond. The ore deposits located at the west flank of this anticline and there are developed many faults, accompanied by this fold as well as the dislocation of deposits by younger faults.

Bawdwin zone lieing in the northwestern direction is itself a fault zone in the early period and is in parallel with the axis of fold from which it is at a distance of abbut 0.8 km to the west. Small folds are extremely disturbed by this fault zone.

Hsenwi thrust fault represents this fault zone.

Tawnpeng fault runs on the east side of this fault zone in parallel with it. As the dislocation of the said fault zone was caused by Yunnang fault running approximately north - south, Hsenwi fault is dislocated by about 23.74 m.

It is presumed that Hsenwi and Yunnang faults are of past early lead-zinc mine-alization and partially pre-mineralization of copper-nickel-cobalt ore.

The fault of the east-west system is the latest and cut the all other faults.

Loi Mi Quartz Porphyry

Loi Mi quartz porphyry occur at the Bawdwin ore zone as a small stock, sills, and irregular masses, In particular, it occupies the crest of Bawdwin anticline which is developed at the foot wall side of ore deposits and is distributed widely in the northwestern vicinity of the anticline near Mt. Herschel and it seems that it intruded into Nam La Series (Pangyun Series).

This rock constitutes the country rock partially, besides it forms the outer hole zone with mineralization.

The age of intrusion is unknown; perhaps, it may be comparatively younger.

Alteration

Hydrothermal alteration is developed widely along the anticline in the area ranging from the Tiger Camp district to Mt. Herschel and further in the north west. It is recognizable to the depth of 906 m in the underground and possibly it continues further depth.

It may be that the alteration took place caused by the diffusion of hydrothermal solution or gas which ascended through fault, fracture and joint in the crushed rocks in the Bawdwin shear zone.

Dike of porphyry which is found in the lower part of the alteration zone may have ascended through the same passage. Both of them may have been originated from the same magma which would have existed in the lower part of the Bawdwin anticline.

Pangyun Series (including Nam La Series) and Loi mi quartz porphyry are hydrothermally altered and sediment changes to "pseudo-tuff" at one time and lump of clay without any characteristic at another time.

When the massive fragments of rock with fractures or cracks which had become powdery or granular were leached by hudrothermal solution or gas a great volume of silica, feldspar, and ferromagnesian minerals should have been destroyed. Thus, relict quartz is corroded seriously; feldspar is replaced by clay minerals, sericite, and silica; and ferromagnesian is chloritized.

Grains and fragments crushed partially are in the central part are surrounded by secondary silica, potash feldspar and other alteration products.

4. Ore Deposits (Fig. 10, Figs. 10-1, -2, -3, -4, and -5)

The ore deposits extend along the Bawdwin shear zone of NW direction in parallel steeply dipping to the west.

They occurs in a permeable zone of intensely crushed and altered Pangyun Sediment and porphyry.

The ore deposit consists of composite veins or mass and Stonework.

The size of the main ore body is 7 m - 50 m in width, 1,000 m in length and 400 in depth.

Most ore minerals fill up the open spaces of shear zone and replacing the rock fragments intensely. Local pod and bunch are developed adjoining to each ore body due to halo diffusion, besides some dissemination took place. The halo ranges from several ten cm to several ten meter.

The ore deposits is divided into threeloges by faults; Shan lode in the northern part is dislocated 30.3 m by Yunnang fault and Miengtha lode in the southern part dislocated 37 m to the southeast by Hsenwi fault. The central part called Chinaman lode is the champion ore deposits that have produced the largest amount of ore.

The major mineralization of Pb-Zn took place before both of Yunnang and Hsenwi faults while in some case the mineralization of Cu-Co-Ni occurred after the fault. Halo-mineralization is found in the base part of ore body and the outer, in particular, foot wall side of Pb-Zn ore body.

Important ore minerals occur in the early mineralization include galena, sphalerite, pyrite, chalcopyrite and tetrahedrite, and with small amount of other minerals such as boulangerite, loellingite, bismuthinite, and pyrargyrite.

The ore minerals occur in the later mineralization includes gersdorffite, cobaltite, chalcopyrite, sphalerite, galena, bournonite and pyrargyrite.

The principal gauge minerals are quartz, calcite and sericite. Chinaman lode being situated in the central part and the largest in width has a high ratio of Ag/Pb which decreases as approaching to the end part with the ratio of Pb/Zn increasing on the other

Fig.-10 Distribution Map of ore Deposits Bawdwin Mine

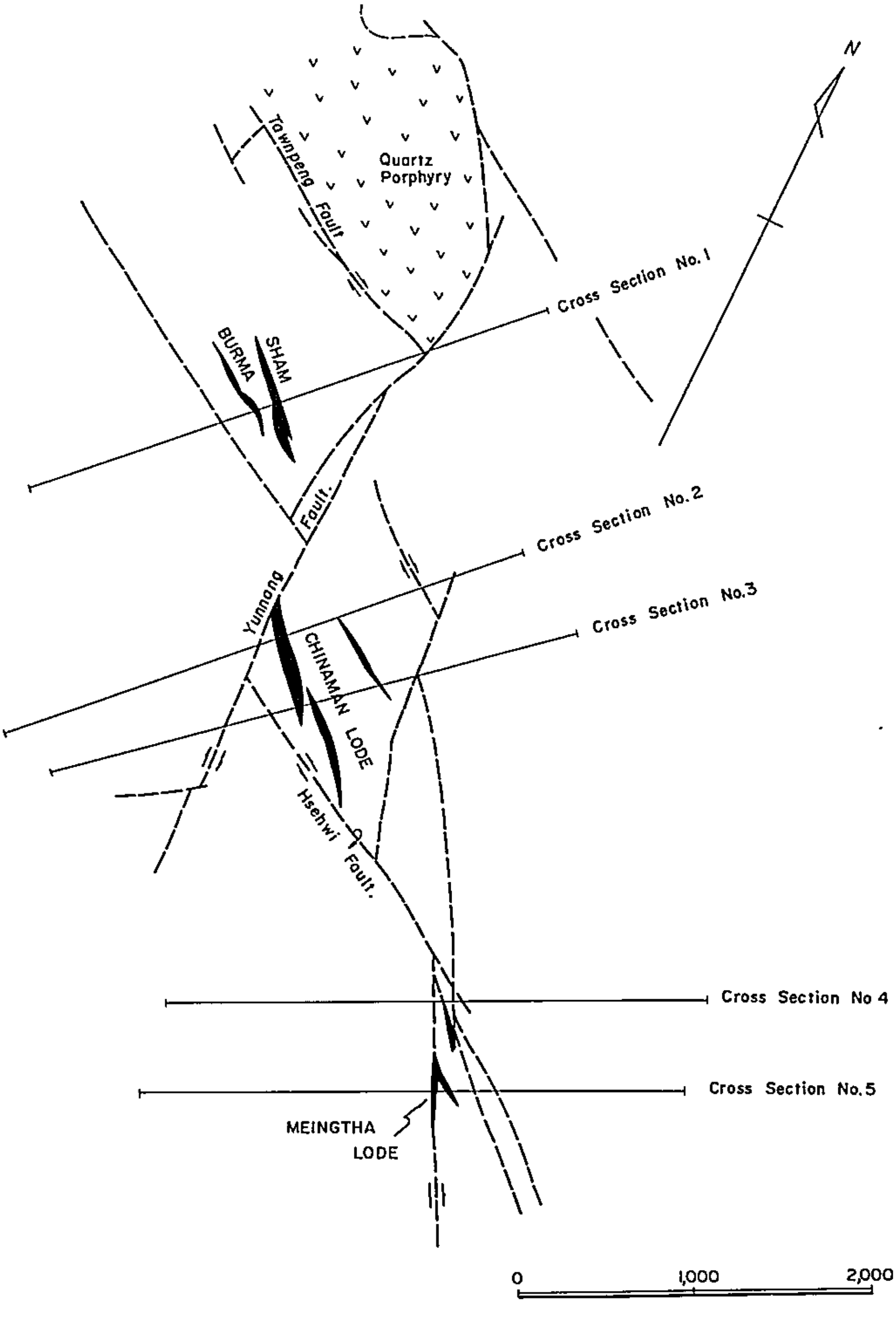


Fig.10-1 Cross Section No.1

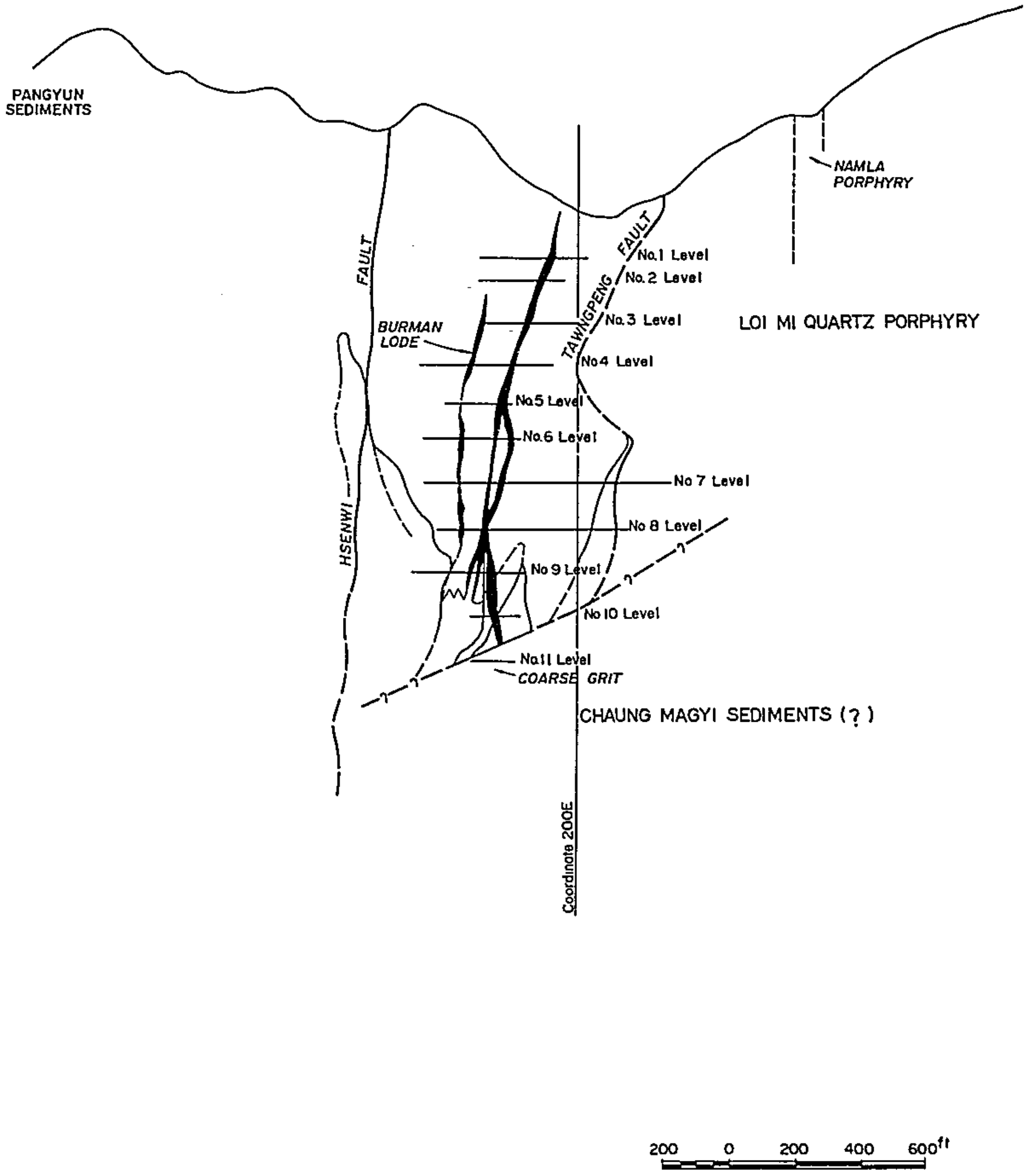


Fig.10-2 Cross Section No.2

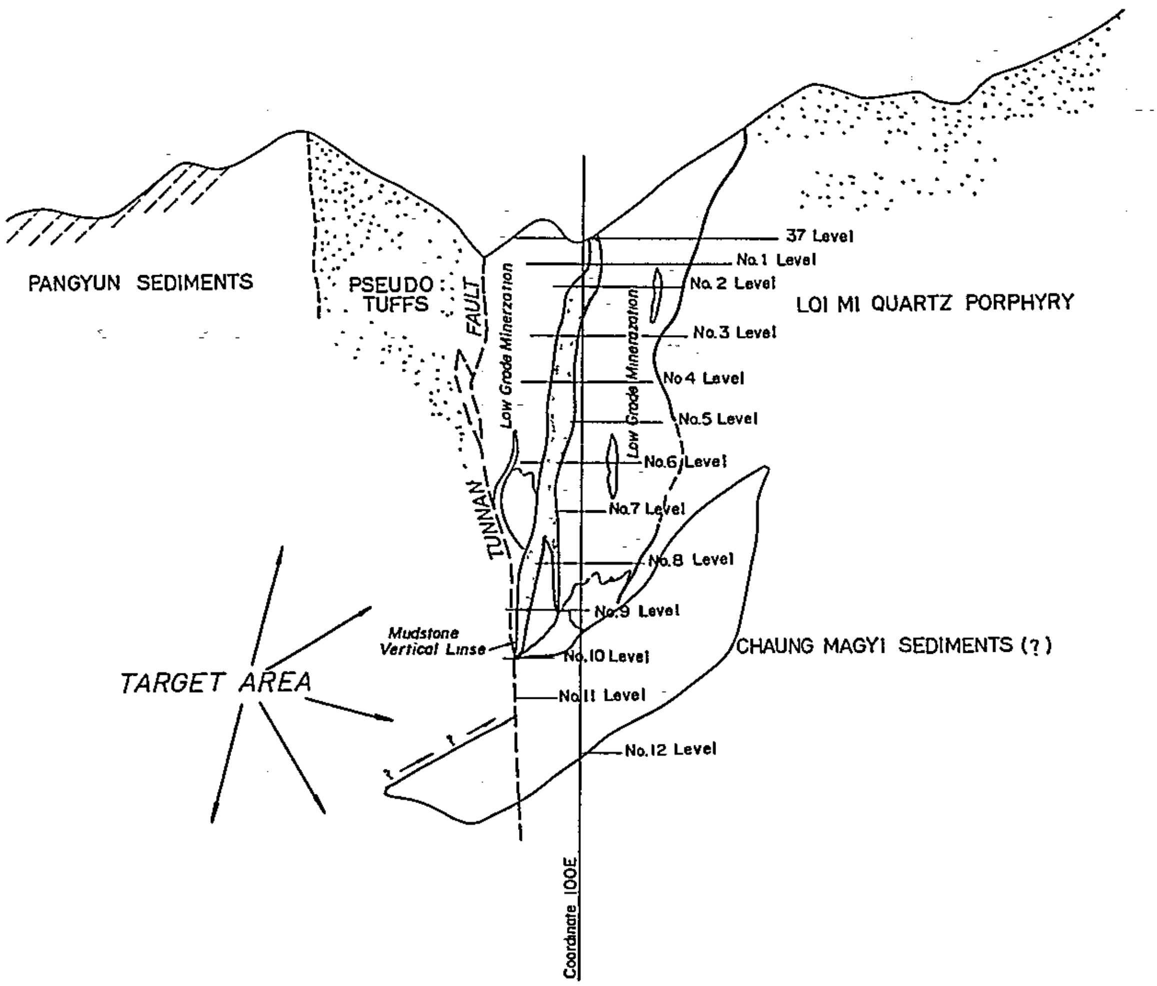


Fig. 10-3 Cross Section No. 3

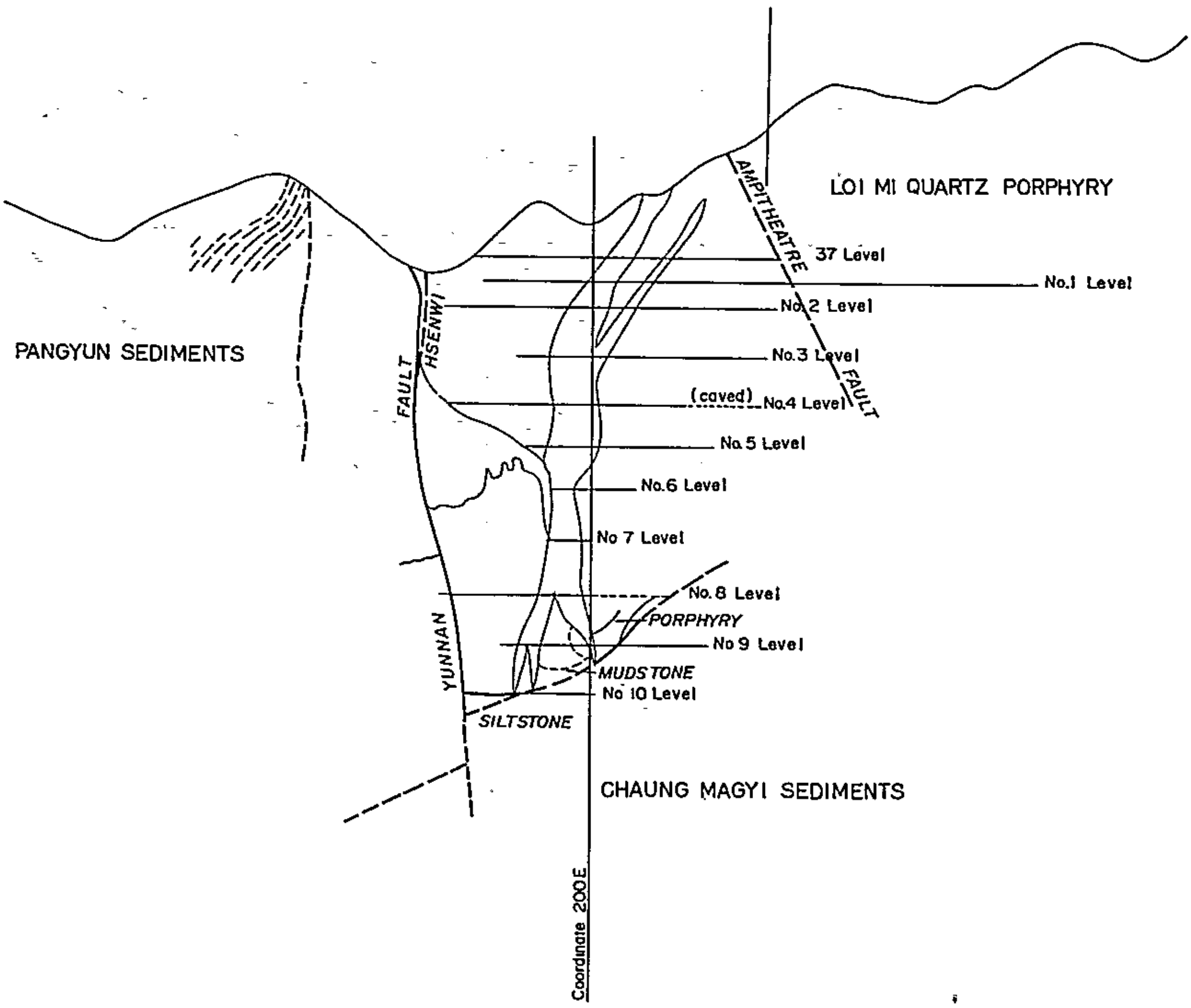


Fig.10-4 Cross Section No.4

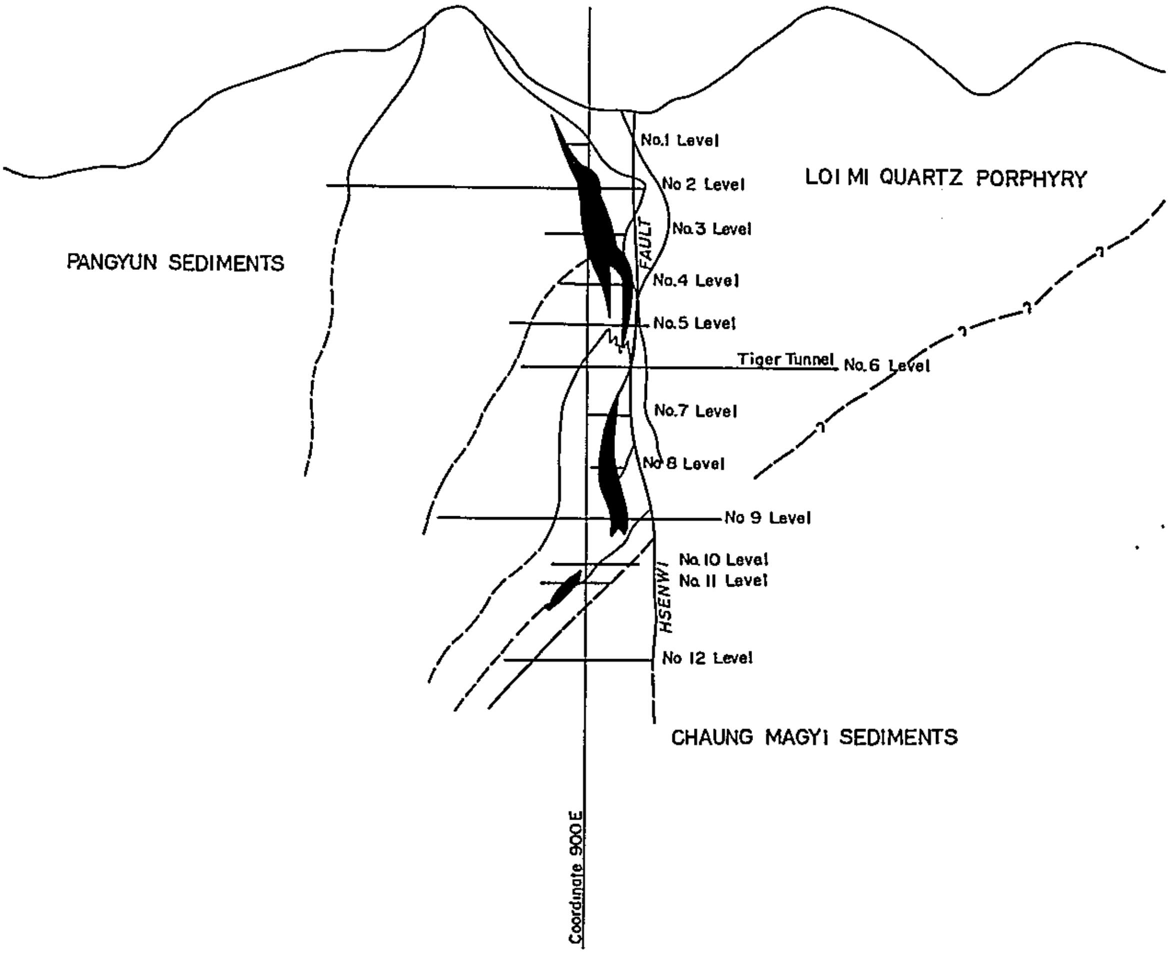
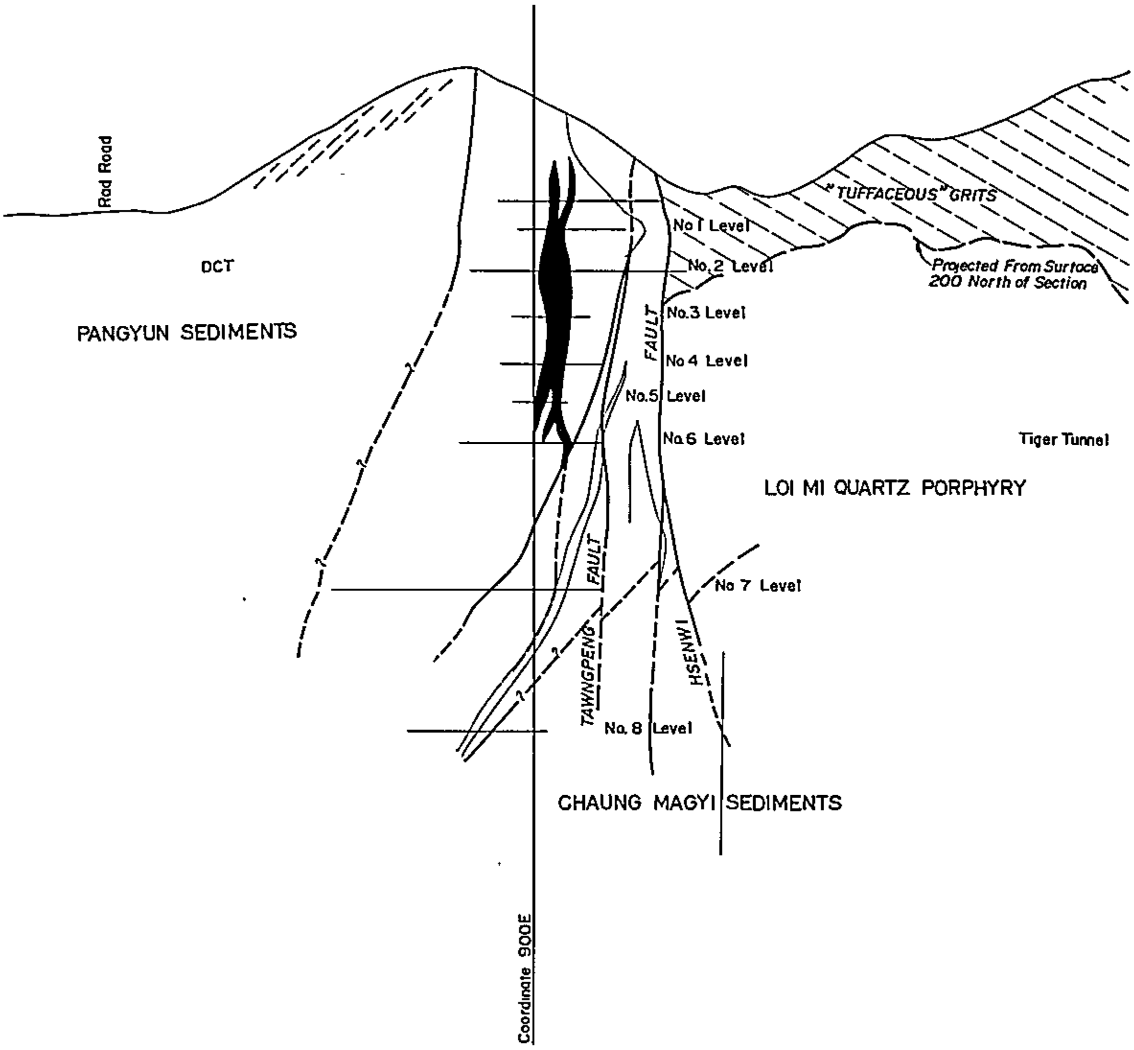


Fig. 10-5 Cross Section No. 5



hand. Galena accompanied by chalcopyrite of later stage has a high Ag content; this galena is accompanied by Ni and Co minerals.

The lower part of ore body pitches toward the west and seems to be cut by a compact sediment with some alteration. Porphry dike found in that lower part also has no root in this sediment. It may be that the ore deposit and this dike rock as well should have ascended from the pseude-tuff in Pangyun Series affected by intense alteration and crushed which distribute in the west.

5. Ore Reserves

The ore reserve estimated based on the results of detailed survey made by the consultants under the assistance of the United Nations Special Fund(1963) is as follows;

Ore reserve (ton)	Ag (oz/t)	Pb(%)	Zn(%)	Cu(%)
6,072,495	7.8	11.2	5.6	0.3

Cut off grade (Pb + Zn) 13%

Provided that; 9% (Pb+Zn) for the object ore of glory hole

Besides this, presuming cut off grade of 20%, a considerable quantity of ores is included as filling material as the ores were used for filling up in the past. Also, a seizable quantity of remaining ores lies on the fringe of ore shoot where mining was discontinued. Therefore, if the mining m thod is changed in the future to adopt block caving method partially, this can be applied to some places. For example, the block caving can be applied to the level of No. 5 - plus 6 m of Chinaman and about 8 million tons of ores may be expected only in this area of 3,965 m in length and 60 m in width.

Furthermore, a considerable quantity of remaining ores can be anticipated from Shan lode where not accessible since World War II, as the ore production from its No. 5 level and above was limited in the past because of high content of copper.

Similarly, the upper part of Meingtha involves much remaining ore and the caving method can also be applied to it.

If these facts are taken into consideration there will be a remarkable increase in the estimated resources for the future by the prospecting of region not yet explored.

6. Prospecting

At present, except the open cut (glory hole) applied partially, the underground mining is adopted chiefly. The galleries are developed from the top level in the order of +6m, 11m, No. 1, No. 2, No. 3 .... No. 12 level, i.e. to the 14th level, with the intervals of approximately 30 m.

One main shaft named Marmion Shaft passes through from No. 1 to No. 12 level.

No. 6 level is the gallery which is main haulage level and reach to the adit for Tiger Camp 315 m to the southeast from the shaft (this level is called Tiger Tunnel).

Mining Method

The underground mining is made by square set method which started from the Hoover time, with the length of stope being 30 m.

Except the glory hole method applying open cut partially, the square set method is adopted generally in the underground. One unit of square set of 5.5 ft x 5.5 ft x 7.5 ft is assembled with 12 pieces of hard wood timber and the mining which is done by every 1 or 2 units is proceeded in a horizontal direction. After having completed 1 floor (31 m in length) and filled up open space, the mining is proceeded to the lower floor by underhand or to the upper floor by overhand according to the place. There are 17–20 floors floors between each level in general and of 75–80 stopes 75% are for the production of ore and 25% are for filling up.

Drilling and Blasting

Holman's silver thirty rock drill is used with rod of 7/8" hexagonal drill steel and bit of 1-1/2" detachable tapered W.C. (cross edged). The excavation of gallery is done by wedge cut or pyramid cut method and the mining done by parallel drill method.

The detonator is of "gelignite" (42% nitroglycerine), 1" in diameter and 4" in length.

No. 6 detonator and safety fuse are used and the consumption of explosive compound is about 250 lb/day.

Filling Up

Lump rocks mined by open cut is used to fill up the pit.

Transportation

The underground transportation is conducted by hand trucks of 1/2-ton capacity and 10 units of 3-1/2-ton battery locomotive in total are used in four levels including No. 7, No. 8, No. 9 and No. 10.

Marmion Shaft is equipped with a pair of cage and 3-ton skip with 6-strand steel rope of 1-3/8" in diameter, which rope is renewed about every three years. A 126 h.p. hoist is used to operate the cage and a 365 h.p. hoist to operate the skip.

It is said that the center of the shaft is dislocated by about 6 – 10 m due to the movement of ground because a part of the shaft passes through the ore body. Since No. 6 level is the gaugeway for transportation, the ores mined below this level are wholly hoisted to it.

In No. 6 level (Tiger tunnel) 10 t olley-locomotives are used to haul trains, each of which consisted of 10 mine cars of 2.5-ton capacity. The rail gage in this No. 6 level is 24" but in all other levels it is 20". The ore train is further hauled by the said trolley-locomotive from the adit of tunnel to Wallah Gorge where there is the ore bin for storage.

The ores are transported from the Wallah ore bin to Namtu Ore Dressing Plant for about 3 miles through the mining railway of 6 m gage by steam locomotive and 20-ton hopper car. This transportation by rail is said to cost about 72 kyats/ton/mile.

Drainage

The amount of water drained from Tiger Tunnel is 100,000 gal/hr. and about a half of it is that pumped up from the lower levels through three stages of pumping up.

Ventilation

The temperature in the underground being 80° 93°F and the humidity as high as 80 - 90% the conditions are very bad; this is due to insufficient ventilation of the tunnel and, in particular, the heat generated by corrosion of mine timber (for square set method) and oxidization of sulphide ore. Four suction fans having total capacity of 10,000 ft^3/min are operating but they are not enough.

Timber

The consumption of timber is great amounting to 8,000 t/month or 32 board feet per ton of ore. The mine is considerably devastated due to that a selective mining has been continued hap-hazardly for a long time and that as the filling up is made with waste open spaces are not perfectly filled up and the filling up is extremely delayed thus resulting in ground subsidence and sliding in various places.

There is no indication of geological survey and detailed exploration made in any way in the mine and, therefore, any planned mining is quite impossible in the present state of affairs.

The stopes are scattered in various places due to temporizing plan and it is far from any concentrated mining.

At present, 45% of output is mined from the upper levels of No. 6 level and other 55% from the lower levels than it. The working faces are excessively scattered in each level and the production of ore is in the from-hand-to-mouth condition.

Therefore, the production of ore has trended to decrease year by year and the grade of ore mined sharply dropped in recent years.

A violent disparities by days are noticed in the grade of ores mined which is impossible to control and this makes it very difficult to attain a stabilized operating of the mill.

7. Ore Dressing (Tables 10 and 11)

Before the World War II there was a flotation plant combined with gravitational concentration (jig and table) at the place called Mile 32, 2.4 km from Namtu Station which, at that time, was operating with a capacity of 1,300 l.t/day.

It was destroyed by the bombing during the war and, after which, the present concentrating plant was organized under the former system by repairing and expanding the dressing plant to process copper ores which located adjacent to the lead smelter and had been fortunately saved from the bombing, and its present capacity is 600 l.t./day.

The dressing system is entirely modeled after that of the former concentrating plant. Since, in rehabilitation, a literally patch-work expansion was made by remodelling the old concentrating plant and repairing old machines sustained the bombring, there are many problems to be reviewed at present.

Under the present concentrating system, gravitational dressing and flotation systems are used jointly as shown in the annexed flow sheet, which have been prepared concisely by the general method because the sheet supplied at the site is very complicated and hard to understand.

Although it is not shown in the flow sheet, in cleaning floated lead, copper is floated by controlling lead to recover copper concentrate. In floating lead, So_2 gas is used.

The present results of processing are as follows:

Crude ore	Quantity	500 600 l.t./day
	Grade	Pb 8.7%, Zn 4.5%
Lead concentrate	Grade	Pb 60%, Ag 14%, Zn 8 10%
	Extraction ratio	70–80%
Zinc concentrate	Grade	Zn 52 54%, Pb 5%, Fe 4 6%, Cd 0.3%
	Extraction ratio	50–60%

Table 10 Flow Sheet of Nomtu Concentrating Plant

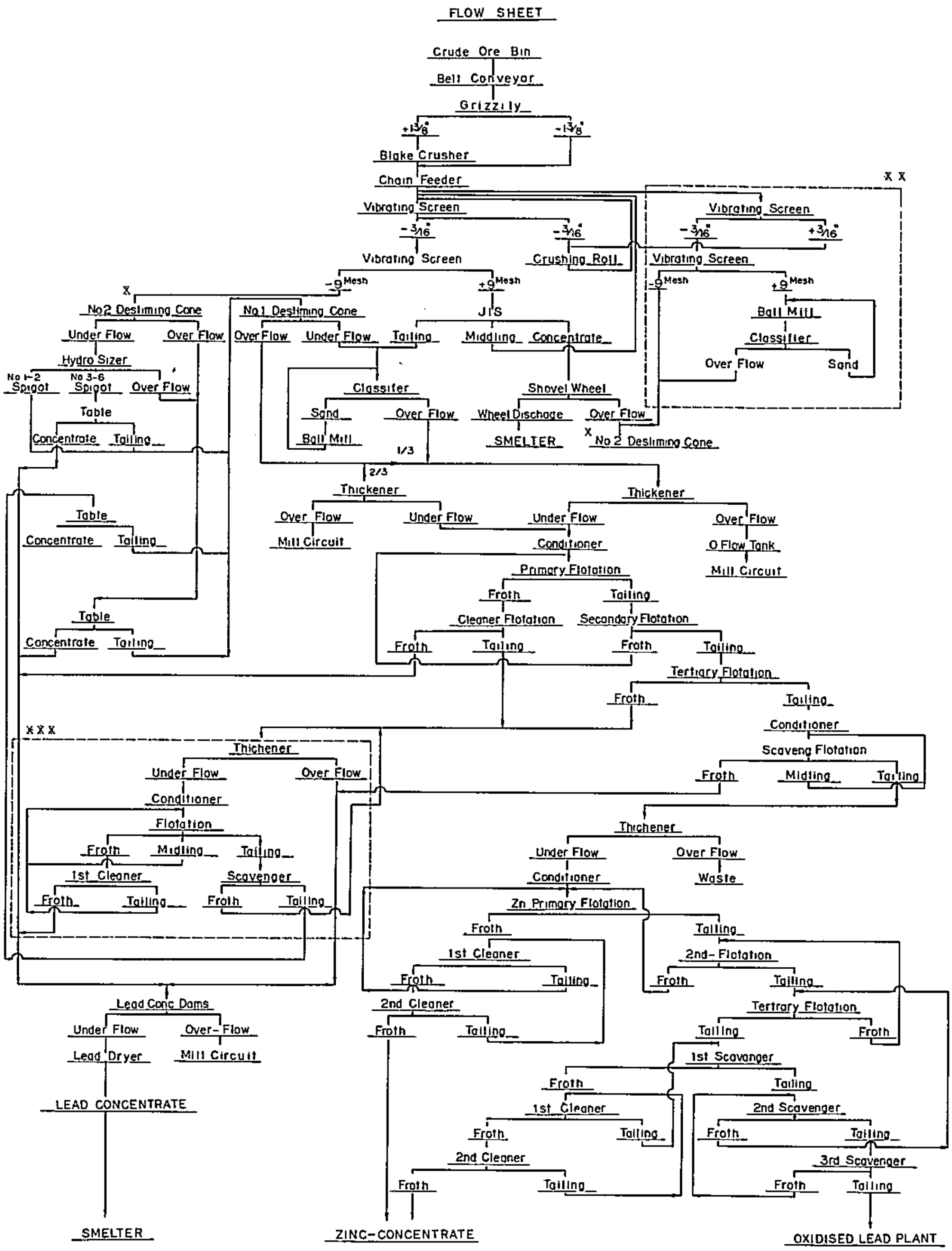
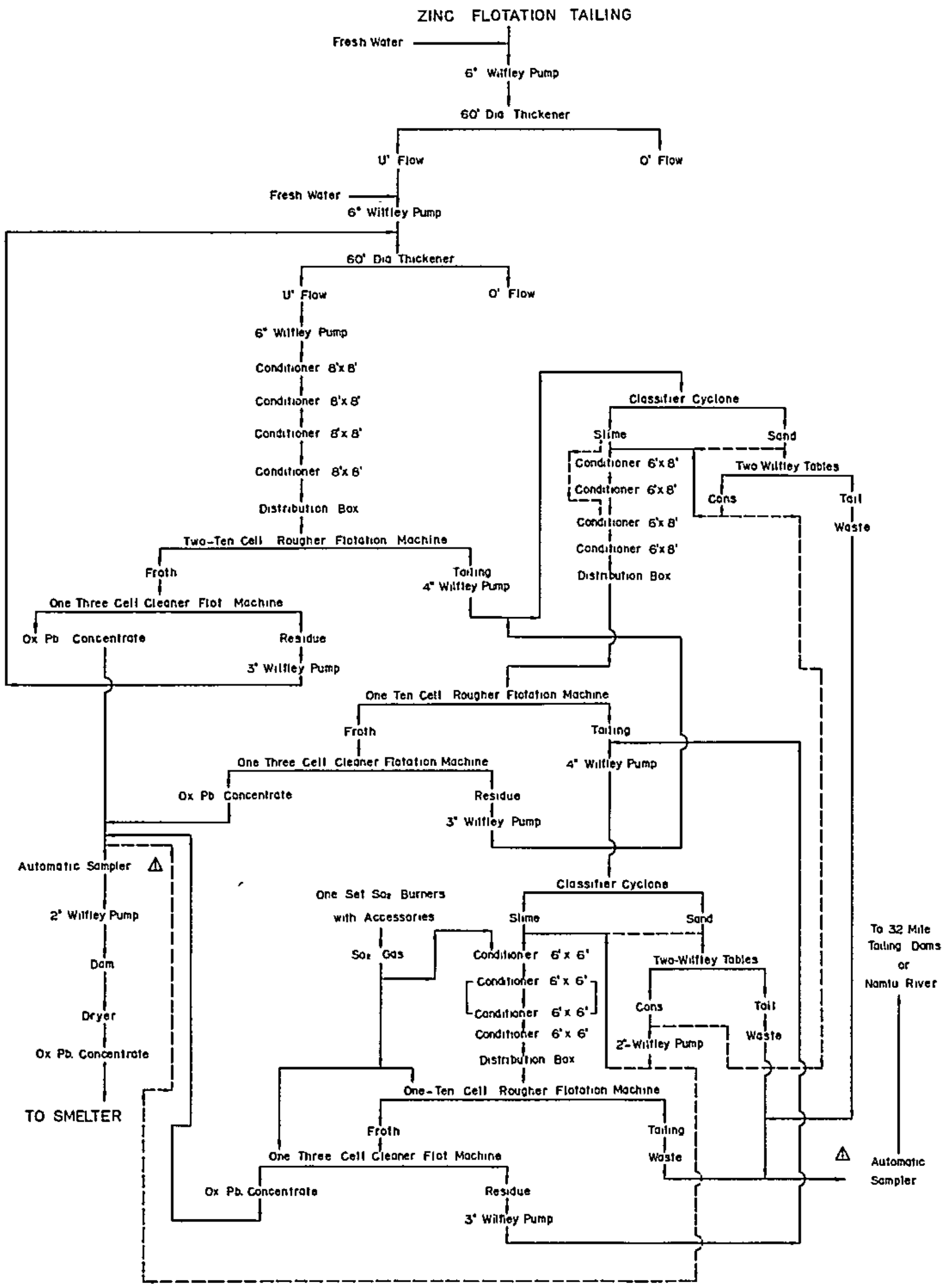


Table. 11 Flow Sheet of Oxidized Lead Plant, Nomtu Concentrating Plant



Copper concentrate	Grade	Cu 10 – 15%, Ag 17 – 18 oz/t
Mill tailing	Grade	Pb 2% (about half is lead oxide), Zn 0.8 – 0.9%

The production at present is 50 – 60 tons per day of lead concentrate, about 100 tons per month of copper concentrate and about 8,000 tons per year of zinc concentrate.

The reason why the results of concentration cannot be said good as seen from the above is that oxide ores such as cerrusite, anglesite and pyromorphite are contained in the crude ores and it is difficult to recover them in the lead-preferred floation circuit; thus a part of them escaping into the zinc-flotation circut and the most part into the milltailing of zinc flotation.

This problem will be solved to some extent by the near completion of oxide lead circuit now under construction on the recommendation of U. N. Survey Team.

The gravitational dressing process which is inserted in the first stage of concentrating flow cannot work with a satisfactory effectiveness with crude ores of grade of this degree and also the flow is not set up orderly. It seems that these facts have a bad influence not only on the process of gravitational dressing itself but on the subsequent process of flotation.

An important problem to be solved, though difficult technically, is that the quality of crude ore itself is composed of complicated aggregation of various fine minerals.

It seems that the hardship of operation is intensified by the difficulty of acquiring materials and machines in the domestic market.

The examination of the present operating system based on the attached flow sheet reveals that the part enclosed in dotted line (marked with **) seems to be added temporarily to supplement insufficient capacity. In this part of flow, as different from other flows, only the table is used to process ore milling by the ball mill without processing through the jig, but it seems more advantageous to unify the flows.

However, it is believed that, in the present state of crude ore grade, the recovery of lead ore should be confined within the extent of preventing the flotation recovery from declining due to over-grinding of lead ore itself, by the use of mineral jig or unit cell instead of ordinary jig. The general practice of concentrating by jig and table which uses a great amount of water unevenly and disturbs the stabilized operation of subsequent flotation should be discontinued as far as possible, so that the recovery of most lead ores be made by flotation.

The part with *** marks enclosed in the dotted line is the process to clean floth collected in the last rougher and scavenger in the Pb flotation. As many of middling of lead-ores seemes to be contained in it, it will better to carry out upgrading flotation after the remilling having been made with a new ball mill to be installed.

As for zinc flotation, one reason for many of lead ore mixing in zinc concentrate may be that a part of lead oxide ore unable to be recovered through the lead-preferred flotation circuit floats and mixes in it. However, since the existence of middling of lead ore is presumed in most cases, it is deemed preferable to devise to decrease lead-ore mixed in zinc concentrate by remilling the froth of this circuit as well as to upgrading of zinc concetrate and to recover lead ore mixed in it.

As referred above, the flotation circuit for recovering lead oxide ore is now under construction in compliance with the recommendation of the United Nations and this circuit should be sufficient for the above purpose.

Dehydrating (e. g. by a filter) and tailing treatment of zinc concentrate are the matters which demand deliveration.

The essentials of the United Nations' recommendation are as follows.

(1) While the dressing operation by the present combined system of gravitational flotation concentration is anyway working, it is necessary to carry out 200 mesh milling to effect good separation of lead ore, zinc ore and gangue mineral in order to improve further the results and for this all-slime flotation should be applied.

(2) The present transportation cost of ore by rail will be substantially reduced if the crushing and milling are conducted at Wallah Gorge by the adit of gallery leading to Tiger Tunnel of the mine and slimed ore is transported by pipeline.

(3) Speaking generally, all-slime flotation system has an advantage that it requires smaller area of plant site than that for combined gravity- flotation system.

(4) New lead oxide circuit should be constructed to carry out the recovery of lead oxide ores. (As already referred, this plant now under construction is nearly completed.)

Based on the above, it is recommended that a new concentrating plant should be built in the Mile 32 area where the former dressing plant stood and be equipped entirely with new and modern machines adopting all-slime flotation system.

Regarding to a new crushing and milling plant to be constructed at Wallah Gorge in particular, it is emphasized that in order to prevent various troubles to occur in the secondary and third crushing of the crude ores which contain much water and clay mixed with at an inconstant ratio, an autogenous mill should be installed to omit such crushing process.

Although the above recommendation of the United Nations' survey team seems very reasonable, the use of autogenous mill involves much trouble in adjusting the size of grinding media properly and also it may be difficult in terms of operating technics in view of the conditions at the site. This leads us to recommend to install a rod mill.

8. Smelting (Tables 12 and 13)

The traditional smelting of lead is continueing for more than half century even since 1910.

Lead concentrate and a small amount of copper concentrate turned out from the concentrating plant are processed into the ultimate products such as refined pig lead, refined silver, copper matte, nickel-cobalt speiss, and refined antimonial lead. The details are shown in the attached flow sheet of smelter and refinery.

Lead concentrate and some quantity of iron ore (hematite), limestone, crushed slag, copper ore and cokes, each having been weighed, are piled up in the bedding bin (13 bins each having 500-t capacity) layer by layer and after having been blended are processed by sintering.

After sintering, done in two stages of primary and secondary, the material is processed by the blast furnace (two units are in service at present) to turn out hard lead, copper matte, and nickel cobalt speiss.

The sintering temperature is 800°C, and it is said that the components of ore after the primary sintering are made up of, in approximation, Pb 47%, Zn of 8.4%, Cu 0.7%, and S 6 8%, and those after the secondary sintering include Pb 48%, Zn 8.8%, Cu 0.8%, Ag 35 oz/t, and S 2 3% on the average.

Hard lead turned out from the blast furnace which has the components of Pb 94 96%, Cu 0.5 0.8%, and Ag 80 86 oz/t is fed to the refinery processing.

The first step in the refinery is to remove Cu, Ni, Co and As by using two furnaces and the next step is to remove very small quantity of Cu still contained by using five kettles with sulphur added. In the third step, two furnaces are used to remove Sb by blasting compressed air into them.

Further in the next step, three kettles are used for remove gold-silver by adding metallic zinc. In the subsequent step, removing zinc is made by the vacuum method after which the final refining is made using two furnaces to produce refined lead.

The intermediate products in the adove-mention are treated by a very laborious method; the last refining is conducted in the silver refining plant and lead-antimony

Table 12 Smelter Flow Sheet, Namtu Refinery

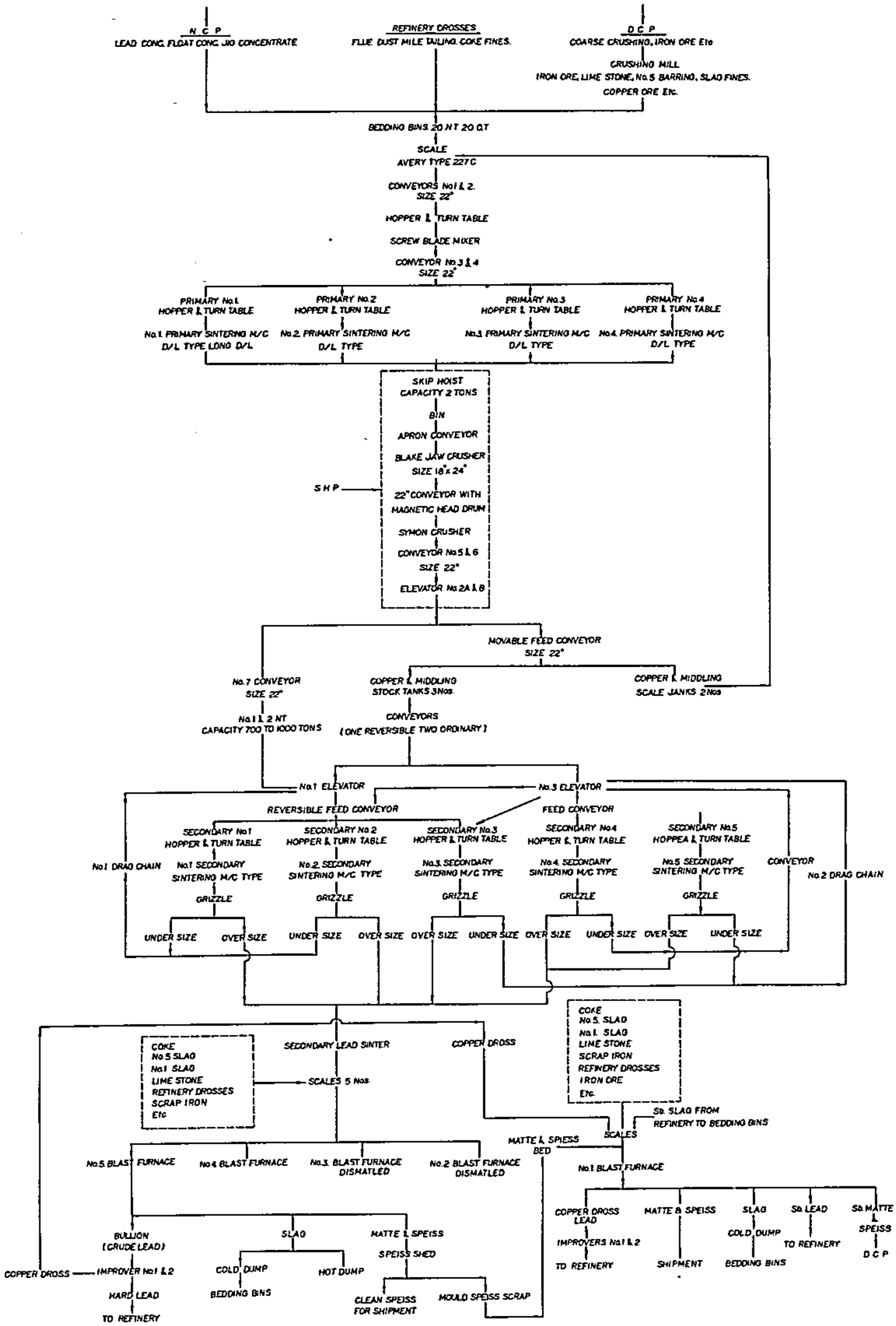
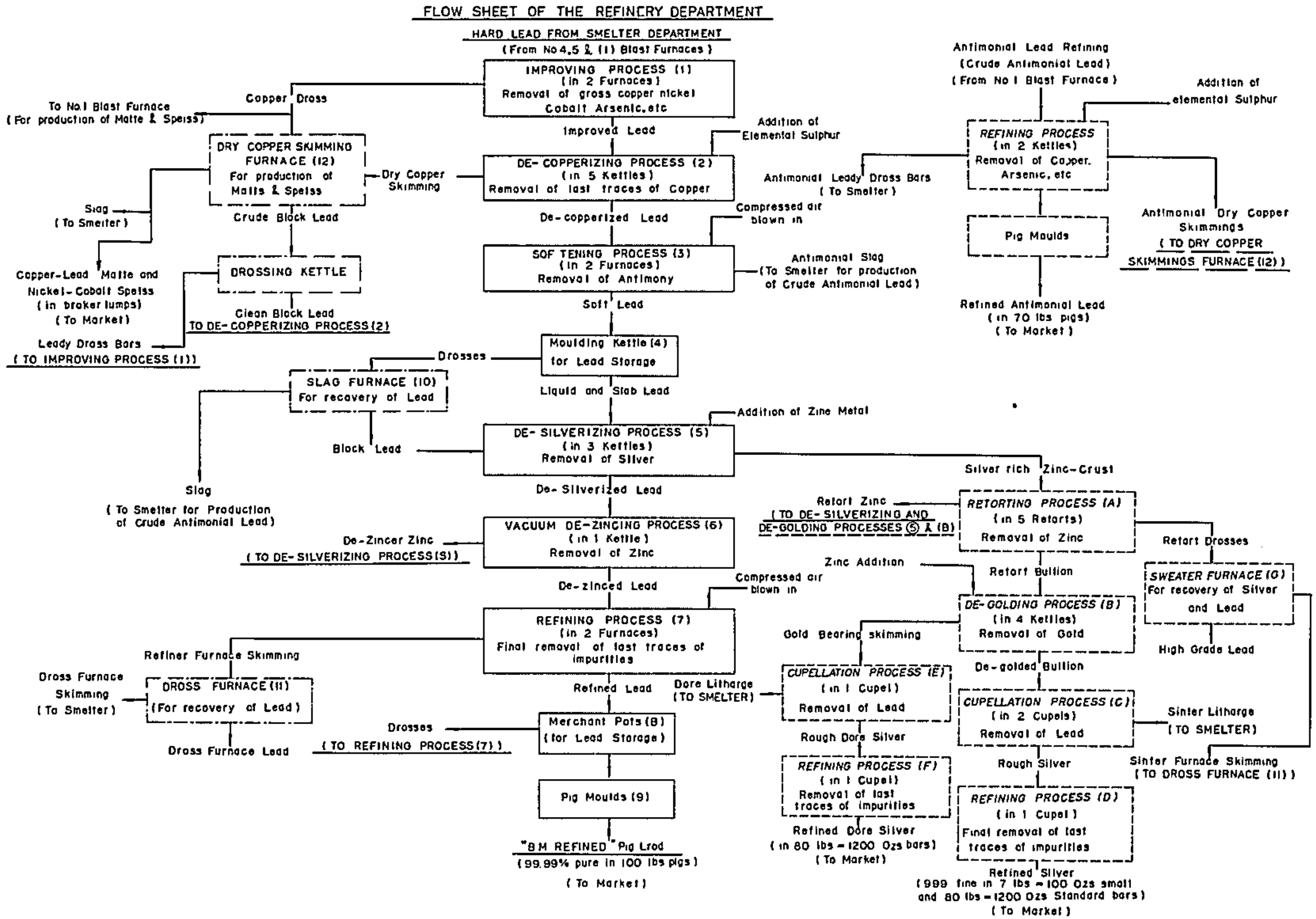


Table.13 Refining Flow Sheet, NAMTU Refinery



plant respectively to produce refined silver and refined antimonial lead.

Gold which was produced in a small quantity in the past is not produced at present.

Lead grade of the refined lead is 99.99%; Silver-grade of refined silver is 99.9%;Cu-grade of copper matte is 45% (with high ratios of Pb and Ag contents); Ni-Co speiss has Ni, 24 - 25%, Co, 3 - 4%, Cu 20% and, besides, the ratios of Pb and Ag contents are high. The antimonial lead is of Pb 85% and Sb 12 - 13%. The production of Cu concentrate being small or about 100 tons per month as aforesaid, it is stock-piled until a certain quantity is accumulated on which time the blast furnace is operated to produce copper matte.

The production is shown in the table attached to Chapter 3.

In connection with the lead refining, it should be mentioned especially about the slag generated from the blast furnace and piled up at Namtu since the plant was put in operation in 1910, of which quantity being estimated at 3 - 3.5 million tons. Of this slag the content of oxide zinc accounts for 19% and that of zinc metal 15% (that of Pb is 1.0 - 15%) and this presents a problem.

In this the examination and study of two methods are under way by the United Nations' survey team as one of the objects of feasibility study for advisable processing of the said slag. One is the use of Waelz furnace to process cold slay and other is the fuming treatment of hot slag.

The processing of cold slay needs to use cokes and low volatile coal, of which quantity being 25% in weight of slag, but the fuel consumption will be naturally lower for the treatment of hot slay; in any way, the fuel cost is as high as 75% of total operation cost. Therefore, it is emphasized that the conclusion is solely dependent on the price of zinc and the availability of low cost coal and that the matter should be decided on the bases of precise cost accounting and anticipated price of zinc.

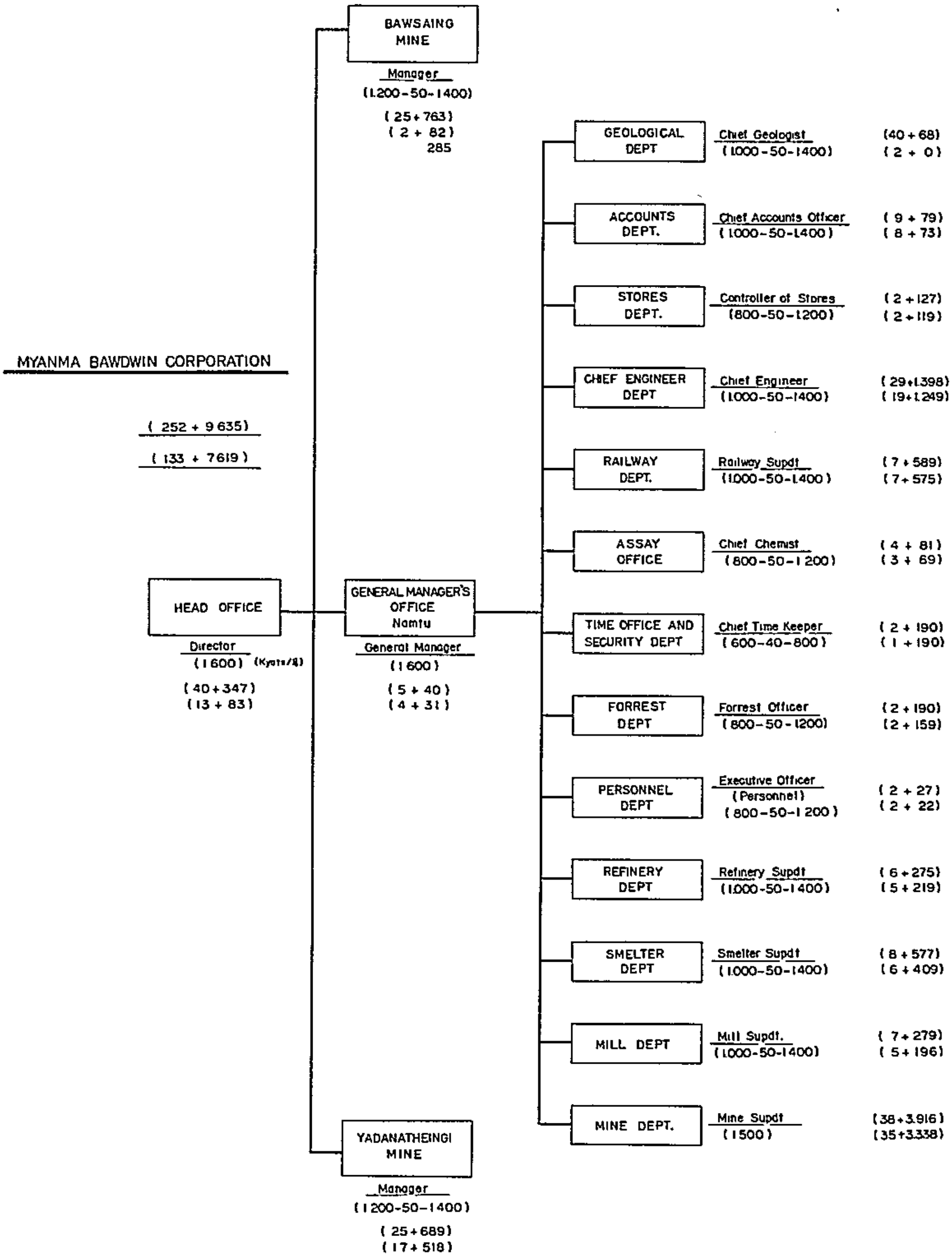
Without going to seek any opinion of the United Nations' survey team, a serious consideration should be made on the disposition of this great volume of slag.

A conceivable measure for the moment is to make a feasibility study on the fuming method (which uses blown dust coal or heavy oil) and the advisability of upgrading by flotation ofter slag having been crushed and milling in a preparatory processing, instead of using Waelz furnace, that is, it is necessary to conduct a strict examination applying the advanced technics in the latest time.

9. Personnel and Organization (Table 14)

The general organization of management, number of persons and wages of Myama

Table . 14 Organization of Bawdwin Mine



Bawdwin Corporation, with Bawdwin Mine and Bawsaing and Yadanatheringi Mines under prospecting included, are shown in annexed Table 14.

In the said table, "Chief geologist (1,000-50-1,400)", for example, shows the wage meaning that monthly salary is 1,000 kyats which will be increased annually by 50 kyats in monthly amount until the ceiling of 1,400 kyats per month is reached.

The wage of general worker is about 130 kyats per month which correspond to about US$100/month.

As the table reveals, the total personnel of M.B.C. is consisted of 133 staff and 7,619 workers and this great number of personnel is supported by only one Bawdwin Mine.

10. Report of U. N. Survey Team and Its Recommendation

The Burmese Government who became to worry about the decline in the production of Bawdwin Mine in recent years and, in particular, recognize seriously the decrease of mine life caused by the selective mining of high grade ore requested the United Nations to provide it an aid under the special fund in order to thoroughly examine the possibility of raising the production of lead-zinc ore in Burma up to the level before World War II with Bawdwin Mine operating as the nucleus, as well as to devise any measures for it.

The United Nations adopted the resolution to accept the request of Burmese Government and an agreement was made between them in November, 1961. It decided to send a survey team to conduct investigations with the objects -

a) To investigate the possibility of increasing the production of lead and zinc in Burma.

b) To make a feasibility study on the construction of zinc smelter:

c) To prepare recommendations on the improvement of the present technics of mining, dressing and lead smelting at Bawdwin Mine and on the economic development of low grade ore:

d) To examine the feasibility of recovering zinc from the slag produced from lead smelting and piled up in great quantity at Namtu:

e) To examine the possibility of processing zinc ore brought from Lough Kengh Mine when a zinc smelter has been constructed:

The making up of survey team was completed in mid 1962 and the organization of project team finished in March, 1963. The compositions of these teams are as follows:

A. Project Staff

D. C. Deringer	Project Manager (U.S.A.)
C. H. Richards	Asst. Project Manager (U.K.)
S. R. Steinhauser	Geologist (U.S.A.)
R. R. Basserman	Mining Engineer (Canada)
J. Dziemsiwi	Mill Engineer (U.K.)

B. Consultant

E. R. Borcherdt	Mining Engineer (U.S.A.)
R. H. Carpenter	Geologist (U.S.A.)
J. H. Reimers	Metallurgical Engineer (Canada)
K. Pranich	Hydroelectric Power (Thailand, ECAFE staff)

C. Contractor

Colorado School of Mines, Research Foundation	Concentrating test (U.S.A.)
O. W. Walvoord Inc.	Mill layout of cost (U.S.A.)
Cerro de Pasco	Electric zinc smelting test (Peru)

Others

The report by technical items of the survey team was prepared in 1964 and the general report completed in 1966.

In essence, the report definitely states that the life of the mine can be increased by an efficient management and a modernization and increased production plan, and that it can be rehabilitated as a mine which can raise sufficient revenue.

The program for modernization and increased production is scheduled to carry out in two stages; that for mining, concentrating and subsidiary section is to be implemented in the first stage and the construction of lead or zinc electrolyzing plant is to be undertaken in the second stage. The outline of the plan is as follows:

1. Investment

In the first stage, the investment of about $11,300,000 is needed for the program for modernization and increase production.

In the second stage, about $5,700,000 is necessary for the construction lead electrolyzing plant or $7,600,000 for zinc electrolyzing plant.

In the second stage, about $5,700,000 is necessary for the construction lead electrolyzing plant or $7,600,000 for zinc electrolyzing plant.

2. Management

In implementing the program for modernization and increased production, it is necessary to invite a management team having adequate experiences during the initial 4 5 years, and the Burmese personnel should receive proper instructions by them. The necessary cost for it is estimated at about $1,000,000 – $1,200,000, which is included in the investment above-mentioned.

3. Mining

While the present square set method which is costly and old-fashioned should be replaced entirely by the overhand or underhand cut and fill method using sand, it is emphasized that this change in the mining method is the most urgent problem. If this measure is delayed the ground subsidence of ore deposit is further aggravated to make it unable to mine marketable ore, resulting in the decrease of mine life and the impossibility of production increase.

4. Milling

The existing combined gravity-flotation mill is wholly abandoned to construct a new all-flotation concentrator with processing capacity of 350,000 tons per year.

5. Smelting

The examination on the construction of electrolyzing plant for lead or zinc is conducted at the time point when the production increase in mining and concentrating has been completed to make any decision on the matter.

6. Electric Power

It is necessary to build a hydroelectric plant with an output of 8,000 KW at Kon Yaung Folls. Also the construction of a diesel power plant w th an output of 2,500 KW to provide an auxiliary capacity in the dry season. On the one hand, it is required to study whether it is feasible to secure a sufficient water reserve in the dam during the dry season when the work is done w th this purpose, on the basis of detailed topographic surveying of the dam site.

7. Transportation

The present rail transportation of ore from the adit to the concentrating mill should be changed to use the pipeline transportation of slimed ore and the steam locomotive for the transportation of materials be replaced by diesel locomotive.

8. Prospecting Planning

It is most essential to work out and implement both the short-term and long-term plan for prospecting of extension of the present working face and for discovering new ore body.

According to the conclusion of the survey team, a geological possibility of discovering the new ore reserve as much as existing ore reserve is accepted according to geological conditions in Bawdwin area.

These are the essential points of the report of the United Nations' survey team and it will be necessary to make more detailed description of the prospecting and mining which are the most basic and urgent problem.

1. Control of Ore Reserve

a) The estimation and control of ore reserve and grade by blocks are necessary. It is desirable to prepare a inventory as of October, 1962, based on the ore reserve estimation by blocks made by the United Nations' project team, and to keep this inventory up-to-date by making proper additional entries.

b) There are two important sources conceivable for the potential increase of ore reserve. One is to estimate accurately the quantity, grade and location of submarginally low grade ore which can be put to economical use if a proper measure is adopted to reduce mining cost, and the other is to discover some new ore reserve by a prospecting program which is to be examined deliberately.

As a result of the investigation by the present Survey Team it was proved that the two sources above referred can be expected much.

That is, it was ascertained that, in addition to the known ore reserve, a great quantity of submarginal ore is deposited around it. Also, it was known that the old filler is of fairly high grade.

c) Therefore, it is strongly desired to undergo a systematic sampling of low grade ore deposit around the high grade ore body and that of old filler.

Upon the actual condition having been catched, the application of the block caving can be examined so that the recovery of low grade ore including the old filler might become feasible thanks to the low cost mining by means of the block caving.

2. Prospecting

a) Short-range Prospecting

The underground prospecting extending to about 1, 700 m, the core drilling of about 1, 500 m and the percussion drilling of about 9 km were carried out by the United Nations' project team.

As a result of the prospecting, much significant information was obtained and, in particular, it was revealed that a ore body is developed at the hanging wall about 60 m below the known ore body of Shan lode and a new ore reserve of about 255, 000 tons was discivered, of which Ag-grade is 5. 5 oz/ton, Pb-grade 11. 2% and Zn-grade 0. 5%.

Besides, the prospecting of favorable host rock around each known ore body is strongly recommended as it is especially important.

b) Long-range Prospecting

The common idea in the past was that the country rock of ore deposit is tuff and sediment below it is not a favorable bed. However, it has been clearly ascertained by the present survey that the country rock is not tuff but Pangyun sediment which is influenced an intensive alteration along the Bawdwin shear zone; and as this country rock is likely extending downward considerably to the west at the base of the present ore zone, much is expected from the prospecting for deeper part of the western part.

Therefore, it will need to have some experienced mining geologists stayed at the site for several years in the future, and for that possibly about three mining geologists should be invited from abroard for the establishment of prospecting program and the supervision of work.

3. Mining

a) Adoption of Underhand or Overhand Cut and Fill Method

As the present square set method which is very inefficient and accompanied with ground subsidence and sliding due to lump rocks being used for filling, it should be replaced by cut and fill mehtod and sand filling be adopted as soon as possible.

By this, cost can be reduced, production be increased and ground subsidence be eliminated. Also, the heat generated in the underground due to the corrosion of timber may be prevented to some extent.

When the cut and fill method is adopted, the mining and output can be made in units of 12 ft. width x 9 ft height x 50 ft length.

In the case of overhand cut and fill method, rock bolt can be used in place of timbering and after the mining of a unit having been finished a per ect filling up can be effected with the use of sand mixed with water, thus any ground subsidence be prevented.

The underhand method which uses more mine timbers than the overhand method and consequently is more costly cannot be but adopted in a zone with many cracks due to ground movement. Presumably, the cutting and filling of one quarter of whole stopes can be done by the underhand and the rest by the overhand.

b) Glory Hole Method

For the low grade ore of the upper Chinaman above +20 level, it is desired to adopt open cut mining by the glory hole method. In implementing the plan for production increase of 350,000 t/year, 25% of the total output will be mined by glory hole method, 55% by overhand cut and fill method, and another 20% by underhand cut and fill method for the first 7 10 years.

c) Block Caving

The introduction of block caving which enables the recovery of low grade ore and low grade filler should be seriously examined, and probably this may be possible.

Before applying the block caving method to a wide area, it is preferable to conduct a small scale test mining at some place where has no influence on the existing working face. By this test mining, one can be experienced in this method and at the same time can know about the quality of ore.

The recommendable site for this test is upper part of Meingtha lode. This test mining should be made under the conductance of an mining engineer experienced in block caving.

It needs to carry out a detailed sampling for the examination of applying a large scale block caving to No. 5 and upper levels of Chinaman lode, and this sampling ought have been finished by the end of the third year of the program for increased production.

d) Internal Shaft

The ores mined from No. 6 level (Tiger tunnel) constituting the main haulage level and its lower levels are hoisted through the main shaft, or Marmion shaft, and one auxiliary shaft. Both of the shafts being in the ore body are subjected to the ground movement due to which, in particular, the center of Marmion shaft is dislocated by 2 3 ft and the auxiliary shaft is too small. Therefore, the excavation of new internal shaft is required for which a preferable site is at S 2,000 and E 950 and at least it should reach No. 9 level (the position should be perfectly into the foot wall). It is desired that the shaft is further extended to the lower levels at need.

The excavation of new shaft is indispensable to increase the production and its cost is included in the investment.

e) Order of Ore Production

Any selective mining of high grade ore must never be done at the places to where the block caving is applicable until the sampling is finished and all conditions grasped.

The average grade of ore to be mined hereafter should not be higher than that for the estimation of ore reserve in 1968. If a selective mining of high grade ores is made during the early years of production increase, the plan will naturally go wild.

It is necessary to comply with the planned order of ore production which has been prepared based on the ore reserve by blocks estimated by the project team. The outline of this plan is as follows:

i) The output from the known ore reserve should be made maintaining the average grade for a fixed period of years.

ii) Mining from the levels between No. 5 and No. 1 of Upper Chinaman must not be made until the completion of sampling.

iii) The ores to be supplied to the existing concentrator should be mined from the levels below No. 6 level, adopting the cut and fill method. Filling is to be done with mill tailing until the sand preparation plant is completed to enable a perfect sand filling.

iv) The working faces now scattering over a wide range should be concentrated and the endeavor should be made to rationalize management and to reduce maintenance cost by means of the block caving of which adoption may well be feasible the output of at least 2,000 t/day will become possible, and this will mean that the capacity of mill can be more than doubled leading to the increase in production, on the basis of only the ores from the known reserve.

f) Ventilation

The following measures were examined to improve the ventilation.

(1) To excavate cross cuts, drivers, and raises by the conventional method to improve the ventilation and, at the same time, to provide with suction fan at proper place.

(2) To install air conditioner in the underground

Based on the comparative study of the above measures, it is recommended to adopt measure (2) rather than measure (1) which is more costly. That is, it needs to equip with two units of carrier air conditioner designed to use in the underground, with one of 600 t/day in capacity installing for Chinaman and Shan lodes and another one of 300 5/day in capacity for Miengtha lode. This is more economical in terms of capital and operating costs than the first measure and the cost needed to install the air conditioners is included in the investment.

11. Conclusion

Although the present survey was carried out in an extremely limited period of time, we have found that the problems described in the report of the United Nations' survey team are quite convincing.

We are impressed by the fact that the rehabilitation plan prepared by U.N. is quite right. However, a long period of time and a huge amount of cost are required for the implementation and completion of the plan, with the instruction by skilled engineer with experience constituting an indispensable factor.

On the one hand, especially in the field of mining, not only any geological map of the underground are not prepared but any prospecting is scarecely made and the mining is done in a from-hand-to-mouth condition without any definite plan, declining gradually. Therefore, it needs now to take a radical measure and, for that, the most fundamental problem to be solved urgently will be the rearrangement of working faces and the early replacement of the present mining practice by the cut and fill method.

In this it is deemed necessary to take the temporary expedients as described below.

First, some experienced mining geologists should be sent to the site who will undertake the preparation of underground geological map and its arrangement, the compilation and analysis of these data, and the planning and implementation of detailed underground prospecting and, at the same time, will instruct the indegenous staff on these works. The use is recommended of the short boring machine which is convenient to bring in the underground and functions well, in executing the prospecting into details. It will improve the efficiency of prospecting, significantly contributing to the collection of ne needed data.

Second, some experienced mining engineer should be sent to the site who will cooperate with the above-mentioned geologists to undertake the compilation of data and early establishment of concrete plan necessary for the rearrangement of working faces and the planned mining, so that the replacement by cut and fill method can be effected smoothly as soon as possible.

These are the most urgent and fundamental problems to be solved for the rehabilitation of Bawdwin Mine. The implementation of the above expediments which is pressing now will take at least two or three years. They should be implemented for the time being and at the same time the way be laid for the production increase referred to in the report of the United Nations.

Although one should say that this mine in the present state of affairs is a fairly serious case, there seems to be no doubt that the rehabilitation of the mine is quite feasible in the future if an endeavor is made to solve the urgent and fundamental problem above-mentioned through the collection of data, replacement of mining method and rearrangement of working faces. Japan will also benefit from this in that it should constitute a dependable source of zinc supply to it.

3) Nat San Mine

1. Location and Transportation (Fig. 11)

This mine is situated to the southeast of the city of Moulmein, in lat. 16°23' N a and long. 97°41' E.

It is linked to the village of Naunglon by a mountain path extending about 3 km westward from that village situated at about 19 km southward along the road running from Moulmein to

It can be reached by about one hour drive (by Jeep) from Moulmein to mine.

2. Topography and Climate

The topography around the mine is featured by a gently sloped hill extending north and south with the shrubs grown dispersedly and a plain sparsely dotted with farms. The Nat.San ore deposit located at the plain to the east of the hill.

The climate of this region is of monsoon type with annual rain fall of 3,800 mm and the rainy season continues from June to October. The temperature rises to 37°C at the highest.

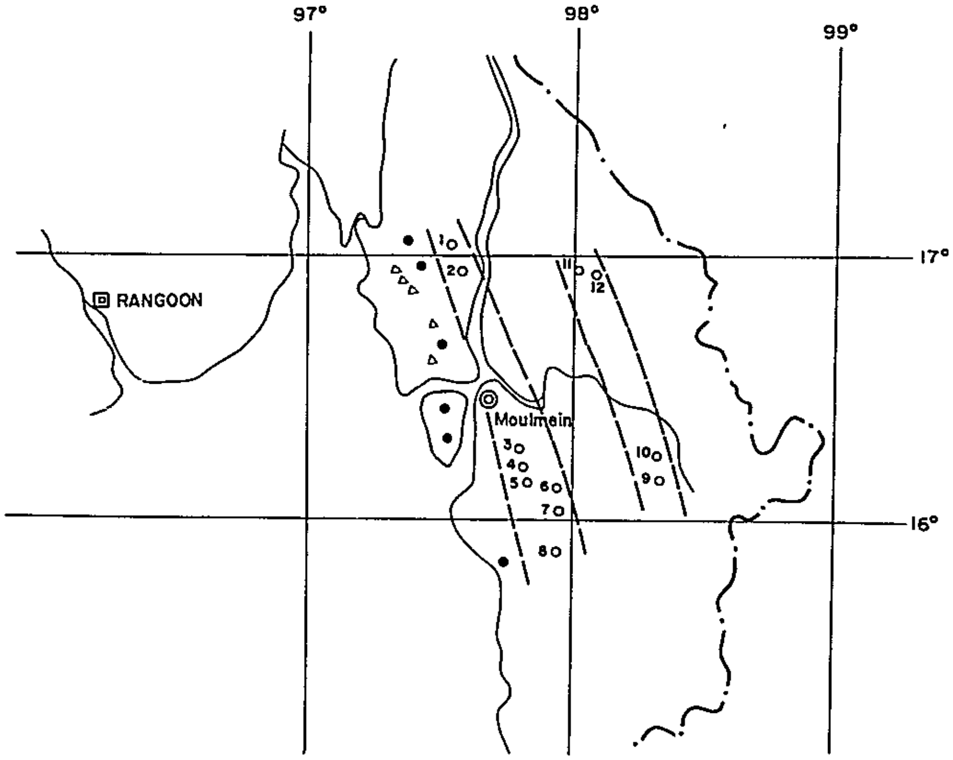
3. History and Production

Nat San Mine was discovered by E. L. G. Clegg before World War II and since then a small scale prospecting and mining had been made by villagers until it was taken over by M.D.C. under which the mining is operated in a small scale at present.

Meanwhile, a survey of this ore deposits was made by M. Muraoka[1]. (Described as Naunglon ore deposit)

1) Makoto Muraoka (1962), Mining Industry in Burma. Especially, on Antimony Deposits; Mining Geology, Vol. 12, No. 54, pp. 229 235.

Fig. 11 Distribution Map of Ore Deposits in Moulmein Region



o Antimony • Tin △ Tungsten

1. Kyank Yedwin 2. Kadaik 3. Talegyaung

4 Nat San 5 Karun 6. Pangon 7 Naing Lon

8. Paung Sein 9. Thabyu 10. Mipaya 11. Larger 12. Tangaw

There is not so much production of
was produced in past. Ores are sorted out into lump and fine concentrates by hand picking; grade ofllump concentrate is 63% Sb and that of ine is 62.89% Sb, the content of arsenic of these concentrates being 0.04%.

4. Geology and Ore Deposits

The geology in the vicinity of the mine is consisted of Paleozoic sandstone and quartzite. General strike and dip. of Palaeozoic formation is N-S and E respectively.

The ore deposit is a epithermal replacement type of stibnite along the fissures of altered siliceous sandstone. The fissures of about N 30°W system and NS N35° E system are developed in the Paleozoic sediments and the Nat San deposit is a massive deposit formed as a bonanza at their intersection.

5. Prospecting

At present, drifting of this ore body is under way simultaneously with output, and also the pittings were made at three localities in the vicinity. The drifting was conducted in the inclined shaft an angle of 15° and, in the direction of N 30° W, toward the lower part of outcrop of small stibnite veins along the fissures of NW system, and a bonanza was discovered at the intersection of these fissures with those of NS system, about 15m from the adit.

At present, the driftings are made toward the west and the north and either working faces show a good ore condition.

The pittings are conducted into the southern extension of this ore body, with two pits (No. 1 and No. 2) of 2 3 m depth pitted at about 300 m to the southwest of the adit and one pit (No. 3) at about 100 m to the north of No. 1 pit.

The fissures of N W system are developed in No. 1 and No. 2 pits, and the thin veins of stibnite (2-3mm) are found in a small quantity along these fissures. And some spots of stibnite are disseminated in siliceous sandstone.

6. Conclusion

In view of the geological condition, the Nat San ore deposit being of weak mineralization and poor continuity has few possibility to develop in a larger extent. However, the Moulmein region including Nat San deposit is one of the area where there are many small antimony deposits distributed and thus there are much possibility of discovering large scale deposits by conducting a systematic survey over a wide area in the future.

4) Kanbauk Mine

1. Location and Transportation (Fig. 12, 13)

This mine which is undercontrol of M.D.C. is situated to the north-north-west of the city of Tavoy, one of the centers in Southern Burma, in lat. 14°35' N and long. 98°00' E.

The mine is at a distance of about 19 km by a mountain path running northwest from the village of Kalein Aung about 72 km to the north from Tavoy through a paved road of 6 m wide.

Motorbus is operating from Tavoy to the town of Ye via Kalein Aung, from where jeep can be used to reach the mine, taking about 4 hours and 30 minutes in total.

2. Topography and Climate

Kanbauk Mine is in the catchment area of Tin Ye flowing into Heinze Basin from its south side. The topography of the vicinity is characterized by gently sloped mountains formed by the widely dissected mountain mass of the older rocks, and Kambauk Mine is located in the flat ravine with mangroves grown thick, surrounded by mountain mass.

The altitude of the ravine is about 15 m and that of the mountain mass is 150 m 300 m.

The climate of this region is of monsoon type, and the rainy season accompanied by monsoon continues from mid-May to mid-October, falling in a tropical climate.

The annual precipitation is 4,600 mm, of which 90% fall in the rainy season.

The temperature rises higher than 39°C in the wet season but it exceed 39°C only in a few days in the dry season.

3. History

This mine has a long history of development, and since 1911 it was operated by the High-Speed Steel Alloys Mining Co., Ltd.

At the beginning, the objects of the operation were the W- vein deposits and Sn-placer deposits, but in 1919 the mining of W- vein deposit was closed due to a fall in the price of tungsten.

Fig.12 Geological Map Showing Deposits
— Kanbauk Mine —

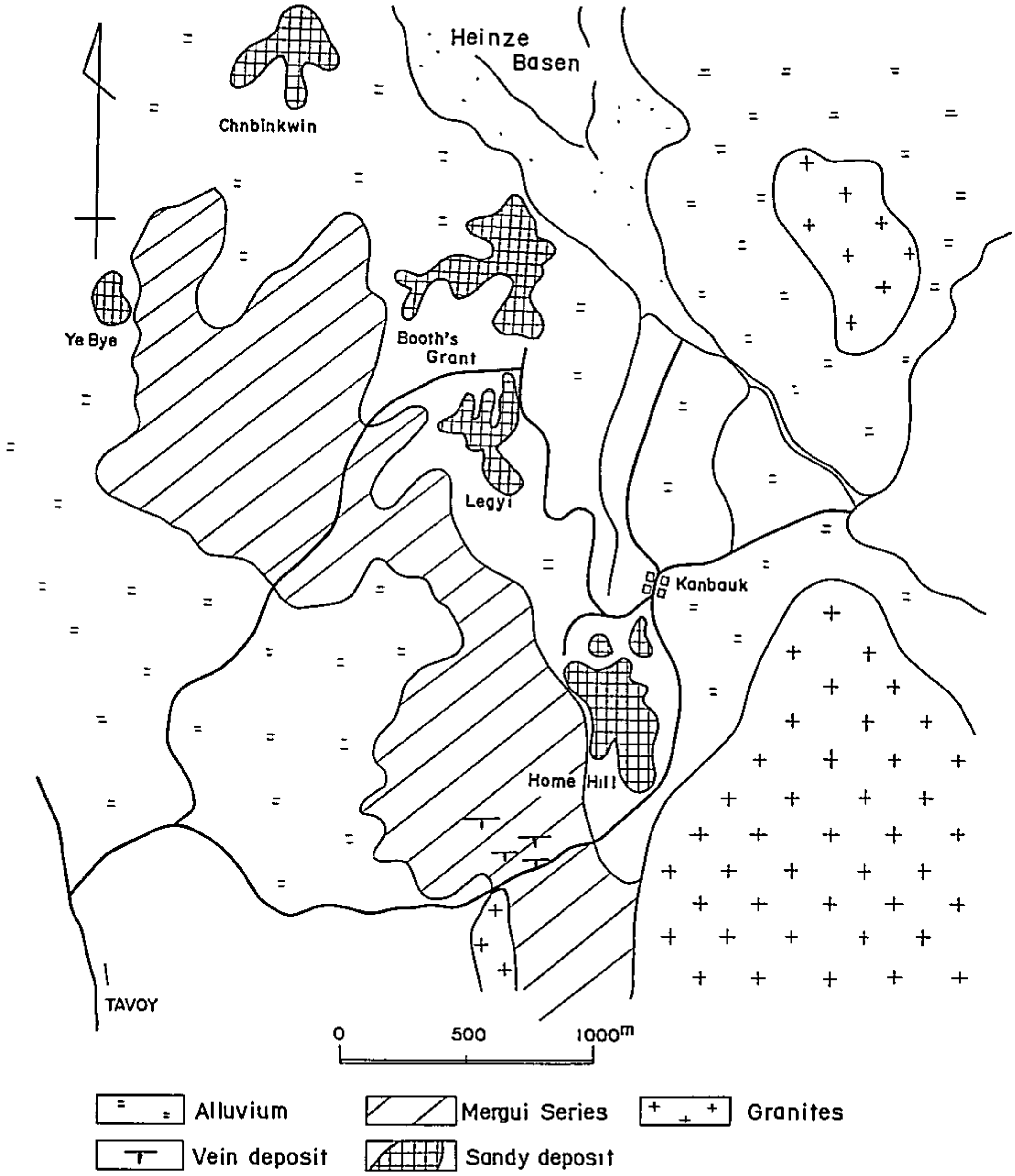
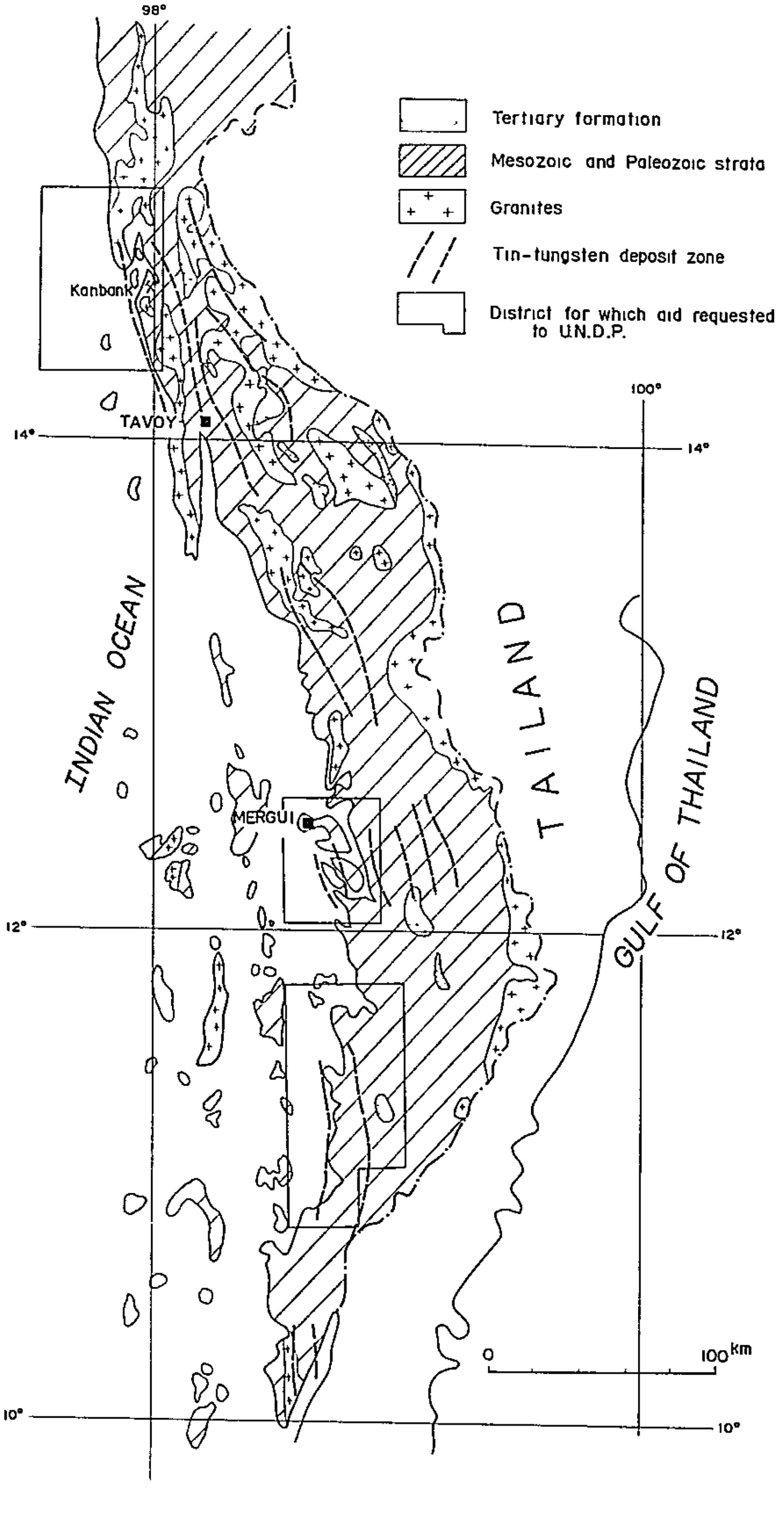


Fig. 13 Geological Map Showing Deposits of Tenasserim Region



After that the mine was transferred to Kanbauk Mining Company and 155 l.t. of tin concentrate, 177 l.t. of tin-bismuth concentrate and 212 l.t. of tungsten concentrate were produced in 1938.

Since June, 1943, the mine was operated by Mitsubishi Mining Co., Ltd. of Japan and the tungsten concentrate was produced at a rate of about 18 l.t. per month until it was closed in May of 1945.

The mine was taken over by M.D.C. thereafter, and at present the only placer deposit is under operation. A total of 3,288.37 l.t. of tin and tungsten concentrates were produced from 1945 to 1969.

4. Geology and Ore Deposit

The geology around the mine is composed of Mergui Series (early Palaeozoic) as basement, and granites (Cretaceous) intruded into Merqui series, further thick sand and gravel bed covering the ravine.

Mergui Series is composed of argillite, lime stone and quartzite.

The ore deposits are consisted of veins which is genetically related with granite and and placer deposit derived from the former.

The vein deposits are consist of several parallel veins in Mergui Series near contact with the granites. These veins have general strike in E-W and 60^{o}S in dip. The principal ore mineral are wolframite and cassiterite, accompanying with sulphides of iron, copper, lead and zinc and native bismuth. The accompanied ore minerals occur in the lower part of the ore vein in a very small quantity except pyrite.

The placer deposits occur in sand and gravel beds filling the ravine and there are five deposits such as Chnbinkwin, Ye Bye, Booth's Grant, Legyi, and Home Hill distributed from north to south.

Each deposits occur in the depressions of bed rock having mainly N-S direction and subordinately NW direction. They show a lenticular form and in many cases covered by surface soil or laterite of 2 3 m thick.

The thickness of placer deposit is comparatively varied, being 10 m 15 m in average with the maximum of 20 m.

The main ore mineral is cassiterite associated with small amount of wolframite.

5. Mining and Production

At present, the placer deposit is underworking.

Hydraulic mining is applied, in which the placer deposit is mined with a compressed hydraulic power jetting from the monitor to make the mixture of gravel and water which is transported to the paron by the gravel pump.

The paron is a kind of specific gravitational concentrator; wooden sluices of about 2 m wide are arranged in series or in parallel, and sheetings of about 50 cm high are provided in them at intervals of about 1 m 2 m to deposit the ore minerals by means of regulating the velocity of water.

The operation is continued for six months of the rainy season from June to November, during which average output of tin concentrate (SnO_2-grade of 70%) is 20 l.t. per month.

There are two working faces and the principal mine facilities are as follows:

Reservoir:	Storage capacity of 80,000,000 ft^3
Hydroelectric generator:	1 unit of 400 KW
Gravel pump:	2 units of 110 HP
Monitor:	1 unit
Paron:	2 sets
Indoor sluicing facilities:	3 units
Workshop and others	

Besides, tin-tungsten ores produced by the small mines in the vicinity are bought by Tanbauk Mine throughout the year, and they are processed through the indoor sluicing facilities to produce tungsten concentrate (WO_3-grade of 65 72%) and mixed tin-tungsten concentrate.

The recent production are as follows:

Production of Concentrate, Kanbauk Mine (1969-1970)

Month	Tin	Tungsten	Mixed	Total
	T..C. Q.LB	T.C. Q.LB	T.C. Q.Lb	T. C. Q.LB
October	22-13-0- 3	3- 1-2-17	0- 8-2- 4	26- 3-0-24
November	8-13-3-11	0-13-3-24	0- 2-1-13	9-10-0-20
December	8-10-2- 0	1-10-3-25	0- 0-2- 3	10- 2-0- 2
January	3- 0-0- 4	4- 2-0-23	0- 0-1- 5	7- 2-2- 4
February	2- 3-2-26	6-15-1-26	0- 1-0-19	9- 0-1-15
March	2- 1-0-26	9-10-1-21	0- 0-2- 8	11-12-0-27
April	1- 5-3-17	7-19-1-13	0- 0-2-25	9- 5-3-27
May	0- 7-1-17	6- 0-2-14	0- 3-1-15	6-11-1-18
June	8-17-2- 8	3-10-1-10	0- 1-3-21	12- 9-3-11
July	20-11-2- 5	3-16-0- 2	0-15-3- 1	25- 3-1- 8
August	30-19-2-26	5- 7-1- 8	2-19-2-24	39- 6-3- 2
September	24-18-1- 8	6-15-3-20	3- 6-2-25	35- 0-3-25
Total	134- 2-3-11	59- 4-1- 7	8- 1-2-25	201- 2-3-15

Production of Concentration, Kanbauk Mine (1970 - 1971)

Month	Tin	Tungsten	Mixed	Total
	T. C. Q.LB	T.C. Q.LB	T.C. Q.LB	T. C. Q.LB
October	21-13-2- 2	8-12-3-25	2-14-0-15	33- 0-0-14
November	14- 5-1-25	6-12-3-14	0-16-2-16	21-14-3-27
December	16- 3-1- 8	13- 6-1-4	0- 6-1-11	29-15-3-23
January	0-15-2- 8	15-12-3-10	0- 5-3- 7	16-14-0-25
February	0-16-1-17	26-11-0-19	0- 6-0- 0	27-13-2- 8
March	0- 7-3- 4	26- 5-2-21	0- 7-3- 9	27- 1-1- 6
April	0- 5-0- 2	21- 4-1-22	0- 4-2-20	21-14-0-16
Total	54- 7-0-10	118- 6-1- 3	5- 1-1-22	177-14-3- 7

Note: T: English ton C: 1/20 English ton Q: 1/4 C LB: 1/28 Q

6. Ore Reserve

The ore reserve of tin placer deposit is as follows:

	Area (ft^2)	Quantity of concentrate, SnO_2-grade of 72% (l. t.)
Peoved reserve	2, 939, 100	875
Probable reserve	4, 286, 325	1, 421
Possible reserve	6, 841, 622	585
Expectable reserve	19, 698, 000	1, 099
Total	33, 765, 047	3, 980

7. Prospecting

While almost no prospecting is conducted at present, it is planned to undertake a geophysical prospecting (seismic prospecting, SP method) from October to November in 1971.

8. Conclusion

Kanbauk Mine inspected in the present survey has the representative Sn-placer deposits in the principal producing region of tin in Burma.

In Burma, the tin-tungsten deposits are chiefly distributed in the Tensserim District in the south. These deposits are composed of the primary deposits of Sn-W pegmatite veins or Sn-W quartz veins genetically related with granites which intruded into Mergui Series of the early Paleozoic during the Cretaceous period and the debris deposits and placer deposits formed by errosions of primary deposits.

The tin-tungsten deposits distributed in this region may be divided into three groups of coastal, central and frontier mountain ranges.

An aid was requested to the United Nations (U. N. D. P.) from M. D. C. in November, 1970, for the exploration and development of placer deposits (four districts) in the coast area to which dredging is to be applied, among those distributed in the coastal mountain range. *

* United Nations Special Fund Project for prospecting and evaluation-drilling for on- and offshore tin tungsten places suitable for dredging.

Of the cost needed for this project, US$120,000,000 is to be provided by the United Nations and US$190,000,000 to be borne by the Burmese authorities.

In this the development of Heinze Basin is desired to be undertaken by Japan.

In the event of the project not being adopted by the United Nations, the Burmese Government has an intention to entrust the exploration and development of the said district entirely to Japan.

On the one hand, the survey of the Heinda Tin Mine in the Tavoy region is now under way with the technical co-operation of West Germany and is scheduled to complete by August of 1971. It is believed that, following the completion, the government of West Germany will propose to co-operate for the development under its loan, based on the recommendations of the West German experts, and the Burmese Government is prepared to accept it.

This is the actual state of the prospecting and development planning for the zone of tin-tungsten deposits developed in this region. However, as the aid plan of the United Nations is limited for the coastal zone and that of West Germany limited for one mine, it will be necessary to undertake a co-operative basic survey of the zone of mineral deposit distributed in the central and frontier mountain ranges.