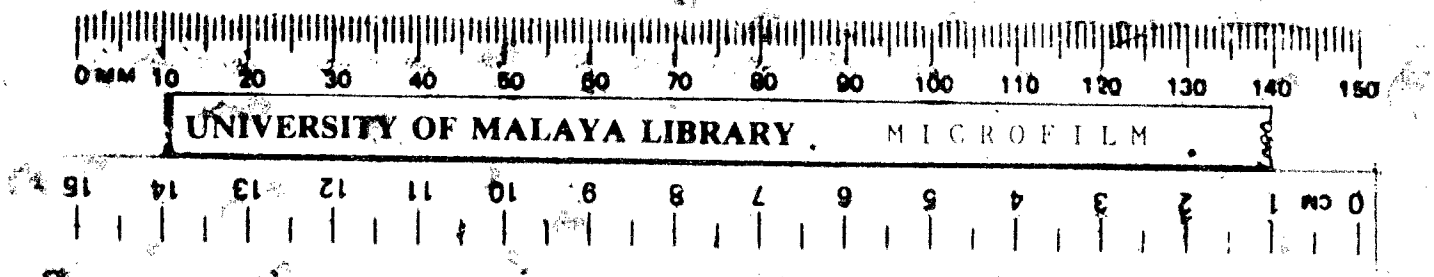
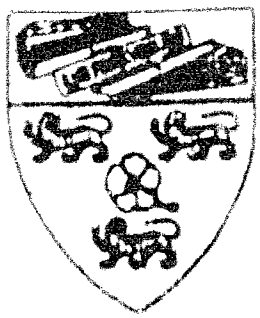




MULA

A STUDY OF THE SOURCES AND NATURE OF CREDIT IN CHINESE TIN MINING IN MALAYA

by

Tan Teong Hean

A Graduation Exercise presented to the University of Malaya in part fulfilment towards the Degree of Bachelor of Arts with Honours in Economics

PREFACE

The topic for this exercise was suggested by Mr. Yip Yat Hoong of the Department of Economics, University of Malaya.

The purpose of this study is to give a survey of the sources and nature of credit supply of the Chinese tin miners in this country from the earliest days to the present period. This is done in five chapters. Chapter I examines the early Chinese tin mining operations and the early sources of credit supply. Chapter II traces the changes in the early system of loan supply. In Chapter III, the capital requirements of Chinese mines today are examined. It is hoped that this chapter will provide the background in understanding the importance of credit in the Chinese tin industry today. Chapter IV examines the credit facilities and sources of supply available to the Chinese tin miners today. Chapter V is the conclusion.

This paper is limited only to a study of the Chinese tin industry. It excludes the European miners an important part of the tin industry in this country.

Material for this paper was obtained chiefly through interviews with the people connected with the industry and also through selected references in the Department of Mines library in Kuala Lumpur.

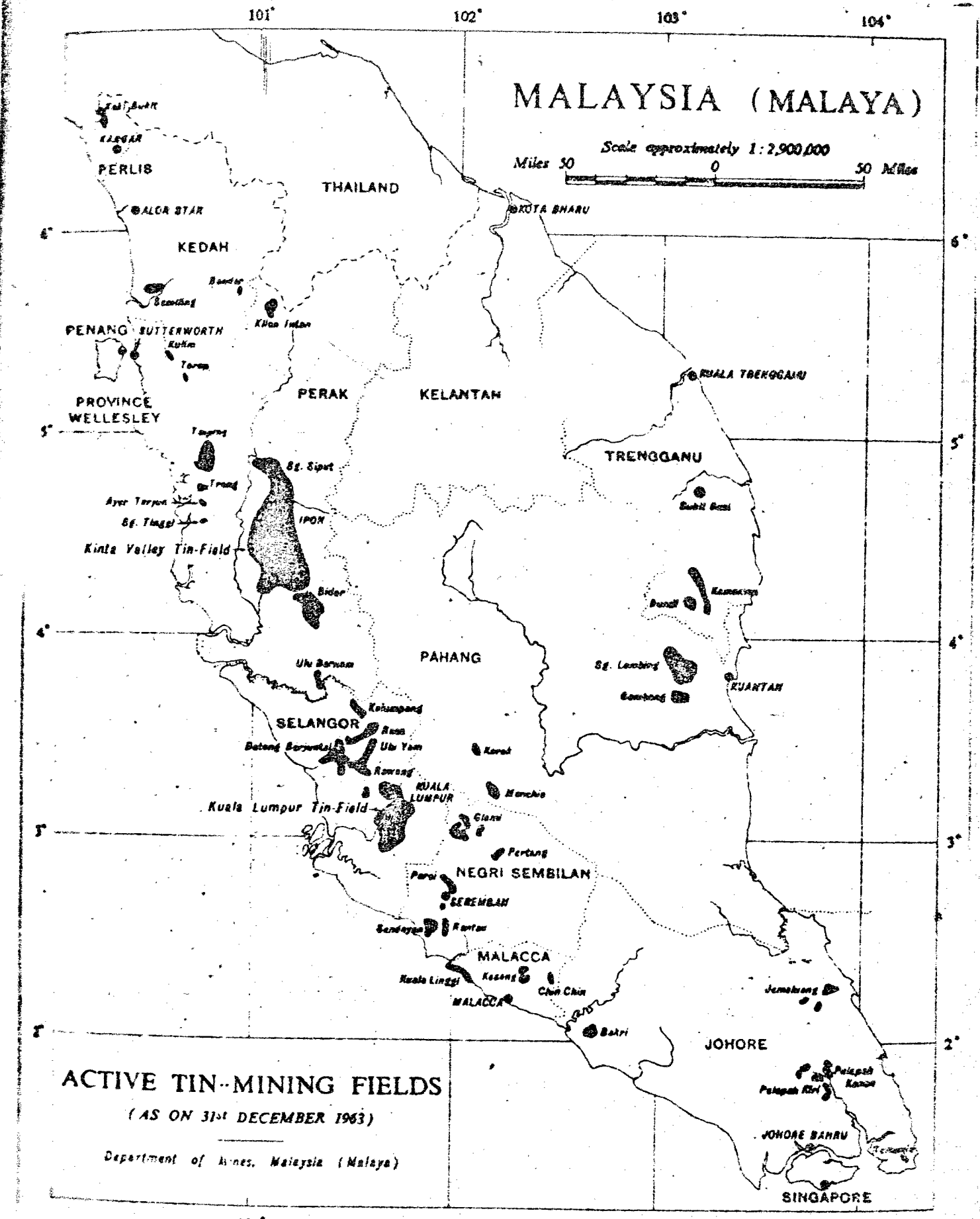
The writer wishes to record his gratitude to all those who have contributed in one way or another towards the writing of this paper. In particular, the writer is indebted to the President of the Selangor, Negri Sembilan and Pahang Mining Association, Mr. S.K. Tan for his co-operation, Mr.S.K. Wong of Senky Mining Corporation and Inche Mohammed Salleh, Chief Inspector of Mines, Malaysia for their help.

Last but by no means least, the writer wishes to express his thanks to the supervisor of this paper, Mr. Yip Yat Hoong without whose help and guidance the writing of this Exercise would not have been possible.

Tan Teong Hean

24th July, 1965.

ACTIVE TIN-MINING FIELDS IN MALAYA



ACTIVE TIN-MINING FIELDS

(AS ON 31st DECEMBER 1963)

Department of Mines, Malaysia (Malaya)

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CHAPTER I

EARLY CHINESE TIN OPERATIONS IN MALAYA

It is not known when the Chinese first started mining operations in the Malay Peninsula. The metal, however, has been known to be mined in various parts of the country from as early as the 15th century.

Until about 1909, tin mining was almost entirely in the hands of the Chinese. Many of the early miners were merchants turned tin miners when the economic importance of the metal was realised. Simple methods of mining were employed. Nevertheless, compared to the indigenous Malay miners, the Chinese were the more efficeint miners.[1]

The Chinese played a significant role in the early development of the tin industry in Malaya. The importance of these Chinese miners may be gauged from the fact that they were responsible for almost all the tin produced in the peninsula, a position which they maintained until the onset of the 20th century.

Nature and Forms of Mining

Many methods of mining were used by the Chinese in the extraction of the tin concentrates. The following account records some of the more important of these methods. It by no means exhaust the numerous methods and variations used in this early period.

The Changkol and Basket System

This is one of the most rudimentary forms of tin mining. It is also one of the most widely used methods. Tin ore was extracted by a team of coolies who dug up the tin bearing soil with the aid of hoes locally termed "Changkols".[2] The dug up material was then transferred to rattan baskets and transported

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[1] Annual Report on the Mining Industry 1947. Page 2.

[2] A broad, deep hoe of various sizes and weights.

to centres where they may be processed by a second team of labourers. The whole process was performed entirely by manual labour.

The Ma-Foo System

This is a refinement of the above method of working the soil. It has the advantage of being a more systematic method of operation. An oblong hole marks the ground to be mined. This is then divided into two sections into each labourer would work the ground by means of a hoe. The dug up material was conveyed to the surface of the mining pit with the aid of hand operated winches. Mining was almost continous with the labourers working in shifts. This method of mining was extensively used in areas where the mineral is rich in tin ore deposits.

The Tein Ping Foo[3]

This early method of mining was used in the mining of tin in wet mining grounds. Tin was mined in a manner similar to that of the Ma Foo System. The difference was that there were three compartments in the mining shaft. The central section was worked to a greater depth than the adjoining ones. Its principal function was that of a water reservoir for the ground seepage of water that soaked through its workings. This water was removed continously by a hand bucket system.

The Chin Chia[4]

The introduction of this method of extraction in the Chinese community marked a departure from the earliest methods described above. It marked the first attempts at the mechanization of the extraction process by the Chinese miners though crude as it was.

The Chin Chia adopts the use of the traditional Chinese water wheel as a water pump in the mine. A water wheel driven by water from any nearby source was used to power a rotating chain of wooden scoops, the lower end of which was sunk at the bottom of the pit to draw out water and hence permitting mining of the ore.

The Nature of Operations

Several features may be noted in all the methods used by the early Chinese miners.

All the methods with the Chin Chia as a possible exception depended almost entirely on manual labour.

All the methods were developed through a slow process of trail and error. They reflected attempts at the adaptation of mining techniques (some of which were imported from China) to

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[3]See Appendix A

[4]See Appendix B

local mining conditions.

The nature of operations were simple and crude. Nonthe-less these methods enabled the extration of ore from deeper grounds and were hence more effective and costly than those used by the Malays who mined the mineral mainly with the use of water, a process called "Lampaning"[5].

Early Sources of Credit and Credit Arrangements

The Chinese as emmigrants to the Malaya peninsular came with little belongings and almost no form of monetary wealth. The first Chinese miners were hence those successful merchants and traders who had already established themselves in this part of the world.

Those who lacked sufficient capital to start mining operations sought loans. Those were obtained from several sources. These are discussed below.

Sources of Credit

The most important single source of credit came from the rich merchants and traders. These were the financers or the 'advancers' in the early days. Often, they had a double role of merchant miners. Others preferred to stay out of the risky mining business and were content to be the creditors to the miners. It was these traders and merchants who formed the major source of credit.

In an age where no developed banking machinery existed, they served as the bankers to the early Chinese miners by virtue of their wealth.

Credit was also supplied by a class of Chinese capitalists quite different from that of the merchants and traders. These were the wealthy and influential owners of gambling dens and opium farmers. These, the products of the British administration, were able to channel part of their funds as loans to reputable miners, charging high rates of interest in return for their loans, mainly because opium farming provided a very rich source of income.

Finally, provisioners, grocerers and ore-dealers also served as advancers to the Chinese miners. They were in a position to do so primarily because miners needed large quantities

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[5]See Appendix C.

of food and provisions for the maintainence of the teams of mine coolies.

They supplied food and provisions on credit and charged exhorbitant prices on these. Many of these provisioners were also the ore dealers. The close tie between the nature of the mining operations, the methods used, and the credit source of miners can be easily recognised from a study of the account of the credit sources given above. Nowhere is this relationship more clearly exemplified than in the case of the grocerers and storekeepers. Early Chinese miners needed a large and steady supply of food and mine provisions on credit to bridge the period between the start of the mine and the sale of the ore. These factors combine to force a miner to seek a close tie with a provisioner who would satisfy his needs on a favourable credit basis. This role was aptly performed by the owners of such enterprises.

The Role of the Advancer

The principal role of the advancer to the Chinese miner was that of a creditor. In this sense, he acts as a financer.

Frequently however, the advancer's role extended beyond this evident relationship with the miner.

In many cases, the advancer was directly involved with the operation of the mine. This degree of involvement ranged from that of being purely a creditor with no direct part in the undertaking of the mine to that of a partner in the venture.

The actual relationship of the advancer to the miner and hence his status and role was determined by agreement between the two parties. According to the agreement, the advancer may thus be:-

(a) A partner of the mine.

(b) He may supply financial aid only and receive interest payments in return.

(c) He may be the sole purchaser of the ore produced by the mine.

It is evident then that an advancer had not one, but several roles. He might or might not have been directly involved in the mine. In many cases, he was not.

Terms of Credit Supply

In consideration of the capital and financial assistance rendered by the advancer's conditions or terms similar to those listed below, were frequently accepted by the miners. The

advancer, depending on the strength of his bargaining position may stipulate any or several of the following terms:-

(1) The option of buying the ore output of the mine at a price below the normal market price of the metal. This price was often four to five percent below the normal market price.

(2) The option to purchase the miner's claim (if he was the owner of the mining lease) and/or a certain percentage of the yield of the mine usually around ten per cent.

(3) A high fixed interest rate often at thirty-five percent per annum for the loan provided.

(4) To the Advancer - a sum of money equal to one tenth of the gross proceeds of the mine at the end of a convenient time period normally one month.

(5) To the Advancer - a high interest rate normally fourty percent on all articles supplied by the advancer.

Interest Rates

The interest on loans provided it may be observed, was collectable in various forms. It was payable and collectable both in cash and in kind.

The rate of interest charged by the Advancers were invariably high. An interest of thirty-five percent per annum to loan of $5,000 was not uncommon. Moreover it was levied in disguised payments of various types which the miner has to accept. One example of this may be the advancer's demand for the right of purchase of ore mined by the mine at a lower price.

Several reasons were responsible for the high interest rates on loans made by the advancers:-

(1) Loanable funds were always in short supply.

(2) The degree of risks on loans to miners were great. Little security backing was offered by the miner against loans provided. This placed the advancer under great risk of losing his money as a result of any dishonesty on the part of the miner, the miner's assets being of limited use to the advancer. There was little the advancer could do if such a situation should occur, since the loans were made entirely of trust.

Furthermore, tin mining was a risky investment particularly in these early days when bankruptcies and mine failures were rife as early operators began their operations without a form of prospecting.

(3) Finally loans were of indefinte time period. Frequently, they may stretch out over a long period of time.

Early Capital Arrangements

Capital for mining operations were mainly raised by private means. Public companies were completely unheard of in the early Chinese mining.

Mines were by and large family businesses. Sole proprietorships were a common standard.

"Kongsis" of partnerships were also to be found. Even in these partnerships the influence of family and lineage ties so strong in the culture of the Chinese had had its influence. For, most partnerships were limited to blood relatives, with the eldest of the kinsmen as the head of the enterprise. This is not to imply that partnerships between Chinese miners of different lineage and descent were non-existent. Such partnerships in fact increased in importance with the passage of time. However, they were less common than the family partnerships in the nineteenth century.

Sole proprietorships were often started with personal funds. The more enterprising of the "sinkhehs"[6] through a slow process of savings of their earnings started their own mines when sufficient money have been saved and when their contract with their employers have expired. Those who began this way were largely those mine managers or "kepala"[7], who earned about twenty-five dollars a month.[8] The common labourers were hardly

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[6] A term given to the emmigrant Chinese meaning "New Guests".

[7] A kepala is an overseer. The term means 'Head' in Malay.

[8] Annual Report Selangor. Page 41.

able to do this as they could be practically mulcted of all their earnings at the time they receive their pay.

Partners in a mining enterprise provide capital in the form of cash or capital equipment. Contributions from partners in the form of capital equipment were common with the lower income class. These were often the mine coolies who provide only their own labour and tools.

Finally, capital was also obtained in part from several credit sources already described.

General Features of the Credit System

A few important features may be noted from a study of the credit mechnism in this period.

Loans made by the advancer were for an indefinite period of time. The advancer was satisfied with the guarantee from the miner that loans with the agreed interest payments would be paid as soon as yields or profits of the mine began to show. Hence, the time period of a loan may stretch from a few months to a year or more.

Loans were made with little security-backing. They were advanced entirely on the basis of trust in the miner's honesty, integrity and his financial reputation.

The advancers however, had an effective system of penalizing dishonest debtors. This was simply to refuse future loans to known dishonest miners or debtors - a system similar to "Blacklisting" used by employers against irresponsible employees. This penal method was so effective that it was reported that it drove disreputed debtors out of the area or state as no advancer would be willing to meet their credit needs.

Conclusion

It is difficult to give a definite answer to the question "Was there enough credit to meet the needs of the miner? Or were the arrangements adequate?"

No records exist to show whether the Chinese miners were satisfied with their credit arrangements. In any case there was not much the smaller miner could do about it he felt strongly against the system.

It seems probable however, that the system of loan and credit supply sufficed the more important needs of the tin-miner. This was possible chiefly because capitalization of the tin industry as then was not great. It cannot be denied that the larger and successful miners had relatively easy recourse to

the facilities offered by the advancers.

The principal defect of the system lies in that newcomers to the trade found it difficult to draw on the resources at the dosposal of the advancers. The reason stemmed from the fact that loans were based and made entirely on the strength of a borrower's financial position. This made difficult the problem of securing funds for the new comer as advancers unwary of his reputation may refuse to accomodate him.

For the same reason, miners who had had the unfortunate experience of mine failure may find difficulty in seeking loans to tide over difficult times. The basis on which the system operated prevented the misfortunate miner from making fresh starts.

CHAPTER II

TECHNICAL DEVELOPMENTS IN THE CHINESE TIN INDUSTRY AND ITS EFFECTS ON CREDIT SUPPLY

Since the nineteenth century, a development of immense significance have occured in the Chinese tin mining industry. This was the gradual evolution from manual operations to increasingly mechanical means of operation. It is this development and its effects on the supply of credit on the Chinese miners that this chapter will be concerned.

The Evolution from Labour to Mechanical Operations

The beginnings of this process may be traced to the efforts of the British Resident, Sir Hugh Low in 1878.[1] This was his introduction of the first steam pumps in the Federated Malay States in that year. The first steam pumps were purchased by the State governments of Perak and Selangor and loaned out to the Chinese miners on a rental basis. These pumps replaced the use of the Chin Chia in the drawing out of water from the workings of the mine. As these pumps proved their usefulness however, the enterprising Chinese miners soon brought in pumps on their own account.

No information were available in the number of the steam pumps in the country. It is probable that their numbers must have been large; as greater numbers of Chinese miners adopted its use. One source estimates that by 1888 there were 50 pumps engaged in the working of Chinese tin mines in the rich tin field of Larut alone.[2]

A further development came with the adoption of Hydraulic mining by the first Chinese miner in 1906.[3] This method of

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[1] L. Wray, 'The Tin-mines and Mining Industries of Perak!' Page 15.

[2] Everitt, 'A History of Mining in Perak.' Page 65.

[3] The Ban Do Cheong Mine.

of mining with the use of water under a natural head was taken over from the Europeans who brought it to Malaya in 1892. The entrance of Hydraulic mining had a lesser impact on the Chinese miners. This was because a high initial cost in the construction of pipes were necessary while there were also long delays before operations could commence.

The most significant development in the evolution from labour intensive to mechanical operations was the development of the gravel pump in the year 1913. Gravel pumping adopted the principles used in the Suction Dredge. The Chinese miners retained the use of the gravel pump and dispensed with the use of the costly floating pontoon both of which were the standard equipment in the Suction Dredge

The introduction of the gravel pump was of great significance to the Chinese tin-mining industry. This was because it dispensed with greatly the use of labour both in the transportation and the extraction of ore processes. Water-monitors replaced manual labour in the breaking down of stanni-ferrous soil. The gravel pump itself replaced the teams of mine coolies engaged in the transportation of the tin bearing soil to the processing centre. While, the use of the palong simplified and facilitated the separation of tin concentrate from the waste.

Gravel-pumping proved to be the most economical method of mining in the rich alluvial flats of the west coast of Malaya. Because of this obvious advantage, it was widely used by the Chinese miners especially in the states of Perak and Selangor. After the initial stages there was a steady increase in gravel-pumping as against other methods of tin-ore extraction. This continued until the nineteenth - thirties when unfavourable prices of the metal adversely affected the entire tin industry of Malaya. Today, gravel-pumping is by far the most important method of operation among the Chinese miners. (See Table III, Chapter III)

Since the war, no new methods of operation have been introduced. The main methods used by the Chinese miners today are largely the same as those used in the decade prior to the outbreak of World War Two. However, after the war there was a renewed impetous in the process of technical development. It was during the post-war years that an increased use of heavy machinery and earth moving equipment were seen in the Chinese tin mines.

The desire for a greater use of machinery was attributed to three main factors:

(1) The rising cost of labour in almost all occupations in the states of Malaya as the standard of living in the country rose. The rise in

TABLE I

PRICE OF TIN, AND THE MONTHLY WAGE RATES OF WORKERS IN CHINESE GRAVEL PUMP MINES 1947-63

Year	Average Price of Tin ($) (Per Picul)	Average Monthly Wage Rates of Workers Of		
		Skilled Workers in Gravel-Pumps Mines ($)	Semi-Skilled Workers in Gravel Pump Mines ($)	Unskilled in Gravel Pumps Mines ($)
1947	218.16	92.00	78.00	34.00
1948	281.48	94.00	84.00	72.00
1949	294.48	94.00	89.00	77.00
1950	368.92	123.00	100.00	79.00
1951	526.61	163.00	125.00	110.00
1952	479.58	188.00	138.00	105.00
1953	362.72	140.00	112.00	84.00
1954	353.60	-	-	-
1955	365.00	189.00	140.00	93.00
1956	383.03	190.00	141.00	94.00
1957	373.19	190.00	158.00	102.00
1958	368.35	-	-	-
1959	396.94	167.00	131.00	82.00
1960	393.68	166.00	123.00	81.00
1961	446.00	178.00	131.00	95.00
1962.	447.00	-	-	-
1963	455.40	191.00	134.00	97.00

Source:- Annual Reports of the Department of Labour and Mines.

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Source:- Annual Reports of the Department of Labour and Mines.

labour cost were also partly due to the Korean War boom conditions which added the usual permanent increment to labour cost even after the revelant circumstances no longer apply. Finally, the rise in labour cost were also caused by the rise in the tin price of the metal. This trend of rising wages in the tin industry is shown in Table I. Rising labour cost was chiefly responsible for a greater employment of labour-saving devices and equipment.

(2) A greater use of machinery was also due to the need for a cut in the cost of production by seeking more economical and mechanical means of operation as a consequence of unfavourable prices of the metal especially during the tin-restriction period. (Especially in 1958.)

(3) The use of machinery was also forced upon the Chinese miners by increasingly difficult mining grounds and conditions. By 1896, all the important tin grounds known today, have been discovered and exploited by the miners. By the 1950's, many of these easily accessible and rich tin-bearing fields neared exhaustion. The The depletion of rich tin-bearing fields had the effect of forcing the Chinese miners to work on poorer grade land and in more difficult terrain - those where the employment of machinery would give immense advantages and without which mining would have been uneconomical if not impossible.

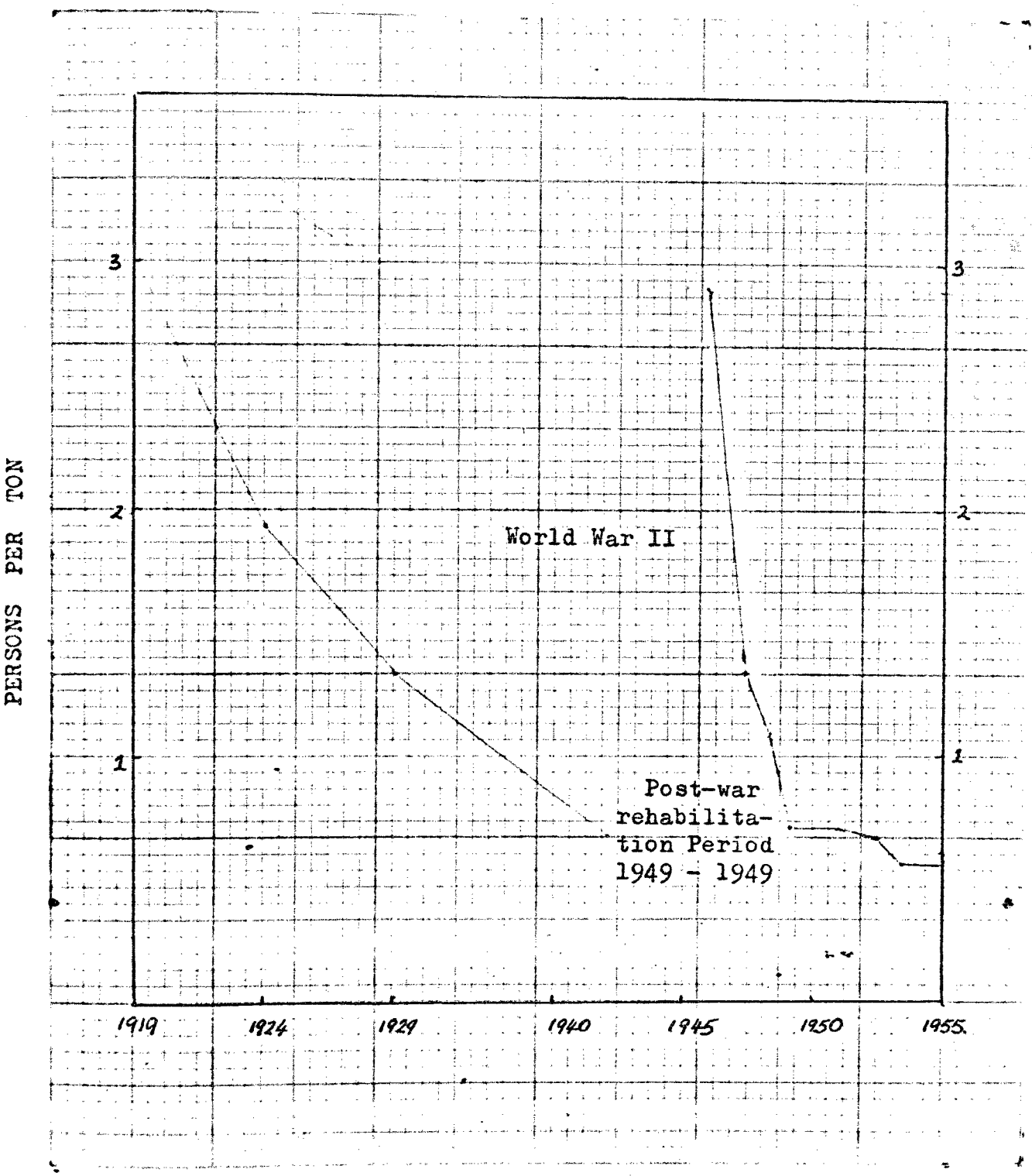
For those reasons then, a trend of a greater use of labour-saving devices and machinery resulted. This trend is still continuing today and is illustrated by Graph I. From Graph I, it will be seen that increasingly less labour is employed to produce a ton of tin as time passed. Increased mechanization in the tin-mining industry is also shown by Graph II which has been drawn to show the Horse-power employed per ton of tin-in-concentrates produced in the country from 1919 to 1955.

Despite technological developments and the use of machinery in the mining industry of Malaya, the Chinese methods of mining in Malaya today are still largely labour intensive. This may be seen from Table II, which shows the employment of labour in mines by methods. It should be noted that in gravel pumping, the principal method adopted by Chinese miners, a total work force of 18,000 labourers are employed. This is to be contrasted with the total work-force of 11,200 in Dredging which until mid-1965 was a European monopoly. It is also important to note that the Chinese also operate Hydraulic, open-cast and underground mines, so that total employment provided by the Chinese miners must be very much greater than that of the European miners.

GRAPH I

LABOUR EMPLOYED PER TON - IN - CONCENTRATES PRODUCED ANNUALLY

1919 - 1955

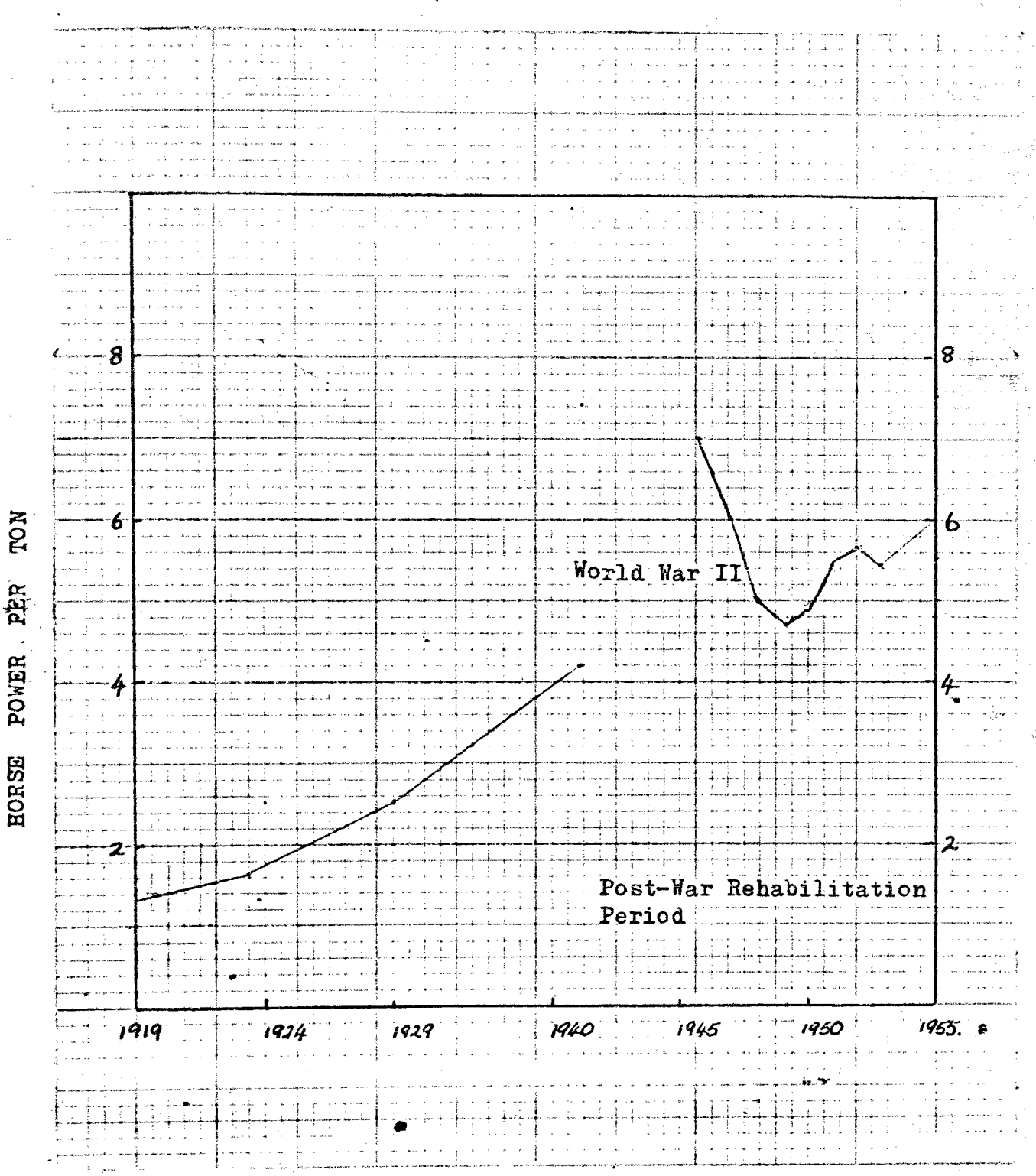


Note: Covering the former F.M.S. only, to 1941.

Source: First Quinquennial Report. Department of Mines 1955 Table 14, page 36.

GRAPH II

MACHINERY EMPLOYED PER TON OF TIN-IN-CONCENTRATES PRODUCED ANNUALLY 1919 TO 1955



Note: Covering the former, F.M.S. only, to 1914.

Source: First Quinquennial Report 1955, Department of Mines. Table 25, page 42.

TABLE II

EMPLOYMENT - BY RACES AND MINING METHODS (EXCLUDING DULANG WASHING)

Races	Dredging	Gravel-Pumping	Hydraulicing	Open-Casting	Under-Ground	Others	Total
Chinese	4,286	15,201	102	2,573	1,674	748	24,579
Malay	3,928	1,482	91	4,652	802	71	11,026
Indian	2,668	1,245	46	931	50	34	4,974
European	229	18	-	91	22	3	363
Others	45	38	-	100	1	11	195
Total at Year End	11,156	17,984	239	8,347	2,549	862	41,137

Source: Bulletin of Statistics Relating to the Mining Industry of Malaysia, 1963. Table 25. Page 4.

In other words the Chinese miners as compared to the European miners have been relatively slow to take advantage of the possibilities offered by the use of mechanical power and new technology.

Several reasons may be attributed to the slow pace at which the evolution from labour-intensive to mechanical means occured:

The Chinese a superstitious race. Superstitions pervade the entire mining kongsi. Further, the Chinese miners were tradition bound and conservative in attitude. These in part explained the reluctance of the Chinese miners to take to a rapid large-scale adoption of foreign techniques and machinery. Many preferred to continue with the older proven methods of labour-intensive dry open cast mining than to experiment with new machinery and to adopt more novel means of operations.

The chief reason why the Chinese have not taken to large scale adoption of the use of machinery was, however, economic and not social. This was their lack of capital and by implication, the lack of credit. Mining equipment and machinery are costly even today. This high initial cost of machinery and equipment deterred the Chinese miners from their widespread employment. Chinese commercial organisations, particularly the mining kongsi, were also unequal to the tasks of meeting heavy capital expenditures involved in the purchase of machinery. A large number of Chinese mines are run on a sole proprietorship or partnership basis. It was not until recently that limited liability companies, modelled after the western corporation, made its appearance (The Selangor Dredging Company).

In the earlier stages at least, Chinese miners faced a shortage of trained personnel and services essential for the maintenance and the operation of machinery. In the early stages too, mechanization in the Chinese mines were slowed down by a lack of good communications and inadequate transportation facilities.

Bfeakdown of the Early System of Loan Advancement and Changes in the Sources of Credit Supply

It will be recalled that the largest advancers of the early Chinese tin miners were the general merchants and the traders. This source of credit declined in importance from about 1900 onwards.

The exhaustion of rich tin bearing ground had the effect of forcing the Chinese miners to adopt new methods of operation and a greater use of mechanical power. These invariably cost more than the older methods of mining. More capital than ever before were required in the operations of the mines; capital amounts that exceeded the funds of the small miner and the limited credit that were available from the merchants.

Further, there was a greater and more varied demand for the use of the loanable funds in the hands of the merchants. With the economic development of the country, new lines of investment, especially in the rubber industry, were opened.

The increasingly risky nature and capital intensiveness of the tin industry, together with a wider and more varied avenues of investment for the merchants, resulted in a decrease in the supply of credit and loans to the miners form this class. Many preferred the comparative security of catering to the needs of the growing population than to do business with the tin miners.

Opium farmers and the owners of gambling houses which ranked second only to the merchants in importance as advancers to the Chinese tin miners completely disappeared from the scene. The reason was political. The closing years of the nineteenth century saw a gradual abolishment of these revenue farms. In 1901, opium duty farms in all the protected Malay states in the west coast of the country were abolished. By 1912, the gambling houses, the last of the productive revenue farms were also abolished. These changes in the government's policy which in part reflected changes in fiscal policies deprived these Chinese capitalists of tremendous profits. It had the effect of causing these as a class to withdraw from being the advancers to the Chinese tin miners.

Finally, the grocerers and provisioners also declined in importance as the advancers. This was largely due to the fact that the tie which existed between the tin miner and the provisioners was gradually undermined and progressively weakened. With the expansion and the development of communications and transportation and as the number of provisioners increased, the tin miners' tie to an individual or particular provision shop was no longer a necessity. Like the merchants, many of the grocerers shifted their attention to the rising class of wage earners. Those that remained as advancers to the tin miners decreased in numbers and became specialist firms in the supply of mine and plantation accessories.

Hence, the old sources of credit decreased in importance and gradually disappeared from the mining scene.

It was no longer the ordinary merchant or grocerer who provided credit to Chinese miners. As tin mining became more specialised and sophisticated, as well as capital intensive, the sources of credit supply shifted to the hands of those large firms that were inextricably connected with the industry. These specialist firms which depended on a large measure on the tin industry for their own existence. These include the Smelting Agencies, the Tin Ore dealers, the specialist mine and plantation suppliers etc.

These new sources of credit created by a change of times and circumstances will form the main topic for discussion in a later chapter.

Changes in the Organizational Structures of the Mine

The evolution from purely manual means of operation to increasingly mechanized methods of ore extraction also caused the structure of the Chinese mine to undergo changes.

The earliest Chinese mining enterprises were family businesses. Sole proprietorships were the most common unit of mining enterprises, partnerships were also known, though they were less common. These two business units comprised the only Chinese mining organizations up to the early decades of the twentieth century,

With the evolution from labour intensive operations to mechanized methods of extraction, this picture has however altered. The most important development in this respect has been the rise of partnerships as an important form of mine finance.

Partnerships as noted above, were not unknown even in the earliest days of the tin industry. It is important to note however, that the very nature of partnerships has undergone changes.

Most of the earlier partnerships were largely limited to the family and the immediate relatives of the miner. This is no longer true today. This is not to deny that such partnerships do not exist today. But partnerships between miners of different lineage and descent became increasingly common with the twentieth century.

No information were available on the extent of partnerships in the Chinese tin mining industry for any period of time. But, it is generally recognised that their numbers are not small.

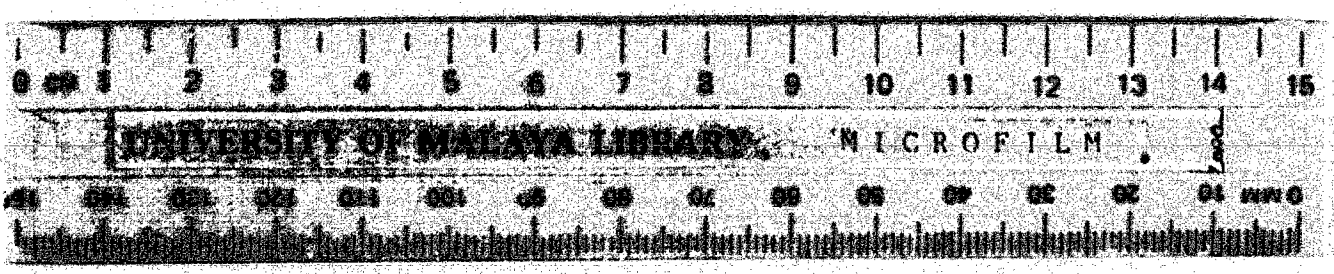
There was also an increase in the number of limited liability companies. These are largely private limited liability companies. Large limited liability companies of the public tyoe were unknown until very recently. These and other methods of mine finance shall be discussed in detail in Chapter IV.

It is not difficult to find the reasons for these changes in the organizational structure of the Chinese mines.

They developed principally because technological developments made the tin industry increasingly capital intensive. This made individual finance of a mine difficult and for the small miner, virtually impossible. The natural solution and the one which the Chinese turned to was the pooling of resources through the formation of partnerships and companies.

The general spread of education and the familiarisation

of Western units of business organizations and the knowledge of the advantages they offered was another.



CHAPTER III

THE CHINESE TIN INDUSTRY TODAY

The Main Methods of Operation

Four main methods of operation may be recognized in the Chinese mines today. These are

(a) Gravel Pumping

(b) Underground Mining

(c) Hydraulic Mining, also termed Hydraulicing

(d) Open-Cast Mining

A great deal has been written on this particular aspect of the tin industry. Hence, the description given below shall only be of a brief and cursory nature.

(a) Gravel Pumping

The mining of tin with the gravel pump involves several processes. Stanniferous soil is first broken down with the use of water monitors. The slurry produced is next drawn up a 'Palong' by means of a gravel pump. Tin concentrates having a higher specific gravity (specific gravity 7.5), is deposited at the floor of the palong.[1] While, the rest of the slurry pass along the palong to be deposited as waste and tailings at the end of the structure. This separation of the ore from the waste marks the completion of the extraction process. Tin concentrates on the palong are collected at regular periods of time by manual means.

(b) Underground Mining

This method of extraction is not dissimilar to that used in the mining of coal. The ore is won by teams of mine labourers who may enlist the use of mechanical aids. Underground mining is prominent

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[1] The 'Palong' is a long wooden Sluce used to recover tin from the tin-bearing soil.

in Malaya only on account of the single large underground mine at Sungei Lembing in Pahang. Amongst the Chinese, underground mining largely takes the form of scattered small scale shafting and cave-mining. This is common chiefly in the states of Perlis and Kedah.

(c) Hydraulic Mining (or Hydraulicing)

Essentially, the process involved in hydraulic mining is identical to that of the gravel pump method of ore extraction. In hydraulicing, both the water monitors and the palongs are retained as the standard equipment. The difference arises in that the water monitors operate under a natural head pressure. Further, the slurry is also largely, if not, entirely raised by the use of hydraulic elevators, hence dispensing with the use of gravel pumps.

(d) Open Casting

Open casting traces its descent from the early open-pit mines where the ore was dug up by coolies. Today, both manual and mechnaical means are employed in the extraction of the ore. One distinctive feature of open casting is that no use of water is made in the entire process. In contrast, gravel pumping and hydraulicing requires the extensive use of water. In open-casting, the mineral may also be raised by belt-conveyors and truck haulage systems. These are however used only in the larger mines as the equipment are costly (such equipment are used in the Sungei Besi open cast mines and the large alluvial mine in Klian Intan, Perak).

In addition to the four main methods described in the previous paragraphs, Dulang washing or Panning may also be used by the owners of gravel pump mines (panning in the tailings for residual ore) and by small time dulang washers. The latter form, though less important than it was in the 1930's, is still common in Malaya.

The Relative Importance of Different Mining Methods

By far, the most important method of operation in terms of production is gravel pumping. This may be seen from Table III which shows tin output by different methods of production and by European and Asian interests for the period 1951 to 1962. It should be noted that throughout the period covered by the Table III, more than $\frac{3}{4}$ of the total ore production for each year by the Asian mines, came from the gravel pump mines. 'Asiatic'

TABLE III

TIN PRODUCTION - BY PRODUCERS AND METHODS (PICULS OF TIN CONCENTRATES)

Year	Producer	Dredge	Gravel Pumping	Hydrauli-cing	Open-Casting	Under-Ground Mining	Others	Dulang Washing	Percentage	Total
1951	European	674,000	30,000	30,000	17,000	48,000	-	-	61%	769,000
	Asian	-	409,000	2,000	8,000	12,000	4,000	49,000	39%	484,000
1952	European	663,000	30,000	27,000	16,000	44,000	-	-	61%	780,000
	Asian	-	453,000	2,000	7,000	7,000	3,000	20,000	39%	492,000
1953	European	642,000	27,000	23,000	18,000	45,000	-	-	60%	755,000
	Asian	-	461,000	2,000	12,000	6,000	4,000	22,000	40%	507,000
1954	European	709,000	33,000	29,000	18,000	44,000	-	-	61%	833,000
	Asian	-	475,000	2,000	12,000	6,000	5,000	24,000	39%	524,000
1955	European	693,000	29,000	29,000	17,000	44,000	-	-	59%	812,000
	Asian	-	506,000	1,000	11,000	6,000	7,000	24,000	41%	555,000
1956	European	684,000	30,000	32,000	16,000	42,000	-	-	58%	804,000
	Asian	-	529,000	1,000	14,000	11,000	7,000	25,000	42%	587,000
1957	European	627,000	31,000	36,000	18,000	41,000	-	-	55%	753,000
	Asian	-	550,000	-	10,000	15,000	7,000	24,000	45%	606,000
1958	European	444,000	170,000	16,000	13,000	28,000	3,000	-	61%	521,000
	Asian	-	296,000	-	7,000	10,000	5,000	19,000	39%	337,000
1959	European	419,000	20,000	17,000	13,000	30,000	4,000	-	61%	503,000
	Asian	-	288,000	-	7,000	10,000	5,000	14,000	39%	324,000
1960	European	622,000	34,000	25,000	19,000	40,000	3,000	-	65%	743,000
	Asian	-	362,000	-	2,000	10,000	6,000	21,000	35%	401,000
1961	European	633,000	49,000	29,000	45,000	42,000	3,000	-	62%	801,000
	Asian	2,000	444,000	-	-	11,000	5,000	28,000	38%	490,000
1962	European	633,000	49,000	29,000	45,000	42,000	3,000	-	62%	801,000
	Asian	2,000	444,000	-	-	11,000	5,000	28,000	38%	490,000
	European	611,000	63,000	26,000	53,000	42,000	2,000	-	60%	797,000
	Asian	2,000	467,000	-	11,000	8,000	5,000	31,000	40%	520,000

Source:- Bulletin of Statistics 1963, 1956 - 1960, July 1956.

is used in the Bulletin of statistics publications to include all Asian miners. It is a well known fact, that over ninety percentage of these Asiatic miners are Chinese. Indigenous miners engage in small scale sporadic mining activities. Their output form an insignificant part of the total ore produced by the Asiatic miners, though in future the picture may change.

The figure on 'dredging' in Table III may be ignored, for this is a Western monopoly until very recently. It was not until 1962 that Asiatic miners (Chinese) acquired a share in tin production through the use of the dredge and it was not until mid-1965 that the first Asiatic dredge (Selangor Dredging) controlled by the Chinese was floated. The relative importance of Gravel Pumping and the extent of its popularity among the Chinese tin miners may also be seen from Table IV, which shows the distribution of different types of mines in operation in this country from the year 1929 to 1963. Hence, whereas there were 36 hydraulic mines in 1929, the figure has dropped to 5 in 1963. (Total figures - Asiatic and European mines included), while the number of gravel pump mines have shown a steady increase for most of the entire period under consideration.

Thus, it may be noted that among the Asiatic miners, gravel pumping is the most important method of mining. Ninety percent of the output from Asiatic mines are derived from gravel pump mines. Amongst the Chinese miners then, the tin industry is gravel pump one. In view of this observation, the later sections in this chapter will be devoted to a discussion of the capital requirements of gravel pump mines alone. However, much of the considerations noted are of general and wider application and hence are useful in the determination of capital requirements of other forms of mining too.

The predominence of gravel pumping in the Chinese tin industry is chiefly because it is the lowest cost form of open mining. Moreover, it is inherently more effective than other methods of tin ore extraction - as the dredge, in the extraction of a higher percentage of ground lying on an uneven and hard bed rock. It is also well suited in the re-working of previously dredged areas and in the extraction of the ore from low tin content fields and small sized tin fields. Finally, gravel pumping involves the use of a comparatively very much smaller amount of capital investment than dredging. Its main defect lies in that it is a comparatively expensive method of operation. This may be seen in that double the power is needed to provide about 2/3 of the tin concentrate as compared to the dredge.

TABLE IV

TIN MINES - BY METHODS, 1929 - 1963

Year	Dredging	Gravel Pumping	Hydrau-licing	Open-Casting	Under Ground Mining	Other	Total
1929	105	428	36	18	735	-	1,322
1930	69	316	35	22	793	-	1,235
1931	56	280	30	23	804	-	1,193
1932	28	231	38	35	736	-	1,068
1933	23	268	36	30	637	-	994
1934	56	367	36	13	440	-	912
1935	70	394	30	7	344	-	845
1936	90	527	26	8	286	-	937
1937	93	635	34	10	257	-	1,029
1938	55	372	32	17	291	-	767
1939	96	538	33	20	230	-	917
1940	104	733	34	22	160	-	1,053
1941	103	668	31	17	143	-	962
1946	18	102	23	1	6	66	216
1947	56	523	24	10	27	48	488
1948	67	464	22	8	313	39	633
1949	79	518	19	5	18	50	686
1950	80	561	19	4	24	45	733
1951	83	584	12	5	17	39	740
1952	80	552	12	5	11	46	706
1953	76	482	10	3	11	47	629
1954	79	567	11	5	9	48	719
1955	76	634	14	4	10	43	781
1956	78	633	13	5	26	29	784
1957	76	597	10	4	25	26	738
1958	34	333	9	1	19	21	417
1959	45	392	9	-	20	11	483
1960	69	470	11	3	20	18	591
1961	72	572	10	5	21	16	696
1962	66	582	10	7	22	17	704
1963	66	593	5	5	22	18	709

Source: Bulletin of Statistics 1956, 1956-60, 1961, 1962, 1963.

Capital Requirements of Gravel Pump Mines

The capital requirements in gravel pump mines vary with the intended scale of operation. The use of several instead of the usual two water monitors combination would, to give an example, invariably raise the initial capital of a mine.

Chiefly on account of this reason, it will be difficult to determine the capital requirements of Chinese gravel pump mines. In the following paragraphs, an attempt is made to provide a rough picture with the use of a 'standard sized' Chinese gravel pump mine as a model.[2]

At the present time, the capital involved in the establishment of a standard gravel pump mine to treat about twenty thousand to thirty five thousand cubic yards per month is in the region of $100,000 to $150,000. This figure excludes expenses on prospecting and other pre-mining payments such as survey fees.

It must be emphasised that this figure is only an approximation. The capital involvment in gravel pump mines will vary with place and with time.

The initial outlay of $100,000 - $150,000 is expended in manner similar to the actual expenditure on a mine given below (see Table V).

TABLE V

CAPITAL REQUIREMENTS AND USE IN GRAVEL PUMP MINE
(8" GRAVEL PUMP, TWO WATER MONITORS, AND A 170' PALONG)

		Average Costs
(1)	Purchase of 8" gravel pump plants (prime movers)	$25,000
(2)	Purchase of 2 water monitors (and prime mover)	$24,000
(3)	Installation and Purchase of Power Generator (diesel)	$ 3,000
(4)	Construction expenditure on the palong	$18,000
(5)	Expenditure on pipings	$ 8,000
(6)	Erection of mining kongsi (accomodation for 40 to 50 workers)	$12,000
(7)	Development of communications	$ 5,000
(8)	Miscellaneous expenditures as construction of tin ore dressing shed	$ 6,000
	Total	$101,000

[2] 'Standard Size' in Chinese mining circles refer to 8" Gravel Pump Mines.

Cost and Expenditure in Gravel Pump Mines

Operating Cost: Operating cost should be viewed with caution. Not only do they vary with the type of plant invested (diesel or electric) but also with a great deal of other factors. For example, in cases where the rehabilitation of land is necessary, a considerable amount of labour will be needed for the construction of drainage networks. Operational costs in such cases will be invariably higher.

Today, the operation costs of an 8" gravel pump mine to treat 25,000 to 35,000 cubic per month, is calculated to be in the region of $0.50 to $1.00 per cubic yard. To put it in a different form, the cost of operating the mine will approach $120,000 to $240,000 per year.

The findings of a study in the costs of gravel pump mines give the operation costs as follows:

(a) Power and fuel costs vary between fifteen cents to forty cents per cubic yard. The average fuel and power costs of gravel pump mines is thirty-three cents per cubic yard.

(b) Gravel pump mines with a combination of electric pumps and diesel pumps have a combined power and fuel cost of about thirty-six cents per cubic yard. This is to be contrasted with an average of thirty cents per cubic yard for diesel power operations.

(c) Labour costs range from twenty cents to twenty-five cents per cubic yard.

The actual operating cost of an 8" gravel pump mine is given in Table VI.

TABLE VI

COSTS OF OPERATIONS IN AN 8" GRAVEL PUMP MINE DRIVEN BY A DIESEL ENGINE

Grade of ground worked	-	0.30 kati per cubic yard
Depth of ground worked	-	20' to 50'
Hours of work per day	-	16 hours
Throughout	-	20,000 cubic yards

		Per month
(1)	Cost of diesel oil - 7,500 gallons @ 62ø per gallon	$ 4,640
(2)	Cylinder oil	$ 540
(3)	Salaries wages and food expenses for 30 workers	$ 5,200
(4)	Repair of oil engine (maintainence)	$ 800
(5)	Maintainence of gravel pump	$ 800
(6)	Maintainence cost of monitors	$ 300
(7)	Siting of pipe-lines	$ 400
(8)	Transportation expenses	$ 300
(9)	Expenditure on timbers	$ 250
(10)	Resiting of engines at six months interval	$ 500
(11)	Miscellaneous expenditures - E.F.P. payments, workmen compensations and insurance	$ 500
	Total	$14,230

The Nature of Costs in a Chinese Tin Mines

From Table V and Table VI, it can be readily seen that the Chinese tin industry today is a relatively heavily capitalized one.

Less readily appreciated is the fact that a large proportion of the capital invested is in the form of Fixed cost or Sunk cost. A $100,000 to $150,000 must be invested merely to provide mining plant and equipment. This investment may be regarded as Fixed cost.

In comparison to the largeness of fixed cost in the Chinese gravel pump mines, the variable costs are small, though it is larger than those of the tin-dredge.

It is this largeness in the fixed costs that makes the gravel pump mines and the tin industry unadaptable to changes in the scale of its operations with fluctuations in the price of the metal. It is this factor that cause many mines to operate despite losses so long as the variable costs of its working are covered.

Factors influenced the Size of the Initial Capital Outlay in Gravel Pumping

The factors that influence the size of the initial capital outlay of a Chinese gravel pump mine may be grouped under two categories. Namely, the Subjective factors and the Objective factors.

The subjective factors are those factors which the miner have some if not complete control over. The miner for example may for his own reasons decide on the use of larger plants to work an average grade field.

Objective factors refer to those groups of factors which the miner has no control over. Greater emphasis will be placed on these factors as it is these that largely dictate the size of the initial outlay involved.

The Objective Factors

(1) The depth of the tin bearings. Based on the depth of which tin concentrates are located, mine have been classified into two categories. The shallow and the deep mines. Tin bearings located at average depths of 30' or more distinguishes the deep from the shallow mines.

It is evident that smaller capital investment in plant and machinery is necessary to start a mine in shallow tin grounds.

Less initial outlay is need principally because of the ease with which tin concentrates may be extracted. Less elaborate mine equipment and smaller horse powered plants are required.

With the deep mines, difficulty of extraction necessitates the use of additional equipment, thus, resulting in a larger capital investment.

(2) Physiographic and Edaphic Factors. The relevance of these factors in the determination of the size of initial capital outlay here again lies with the ease or the difficulty of extraction of the ore from the ground.

The nature of the soil conditions is an important factor. Loamy and sandy soil makes gravel pumping easier. Little more than the average standard gravel pumping equipment may be used. Initial capital investment in such a case may be low as $80,000.

An important physiographic factor is the nature of the ore deposits. This in chief will determine the employment of costly earth moving machinery.

The bulk of the country's tin consist of the so-called "Secondary Tin Deposits". While a large part of these are found in the alluvial flats in the country, hence making mining easier. It is also to be found in alluvial deposits on the slopes of hills and mountains and also in granitic areas. In such areas, the use of machinery and earth moving equipment will be necessary. This will add to the capital involved in the operation of the gravel pump mines.

Various types of earth moving equipment have been introduced in gravel pump mines. Basically, the reason for their employment is to increase the output from gravel pump mines when the nature of the tin ore deposits make gravel pumping alone inefficient. The motive behind their use is to increase the solid content of the slurry produced by the monitors.

Physiographic situations in which the use of heavy machinery and earth moving equipment may be forced upon the miner are as follows:-

(a) Where tin deposits are located close to limestone and granitic outcrops. Here, the use of shovels to bench the rock faces become a necessity.

(b) The presence of large quantities of scattered pieces of quartz and granite boulders in the tin field. Such obstacles seriously impair the performance of water monitors. This is because the water treats only the rock surface and cannot be focussed adquately on the stanniferous soil. The use of Drag lines for the removal of these boulders are hence required.

(3) The availability of a large source of water supply. It is apparent that in contrast to the other methods of mining as open-casting, gravel pumping mining is a wet mining technique. Enormous quantities of water is a pre-requisite for operations to be economical. The importance of water lies in that it is both the agent in the disintegration and the transportation processes. The lack of adequate water supplies would mean that pipe lines to the nearest water sources would have to be constructed, while, reservoirs would have to be built. These expenditures mean that a larger capital outlay would be required than would be the case if such expenditures were unnecessary.

While certain stanniferous soil may be quite easily broken down by monitors, a considerable amount of water is required to wash the tin bearing soil to the pump sump. In areas where water is not available in sufficient quantities, the solution to the problem is again the use of earth moving machines. Bulldozers are used to move the stanniferous soil to the proximity of pumps whereby they may directly washed to the pump intake and hence providing a very high density feed to the pumps. This process economizes the use of water but a larger amount of capital would have to be invested in the form of purchases of earth moving equipment.

(4) Legal considerations and obligations. The operation of all mines in this country are subject to the regulation of a board "the Rulers in Chief Council". This council governs the behaviour of mines and incorporates representatives from the Mines Department, the Jabatan Kerja Raja, the Drainage and Irrigation Department, and the State Foresty office.

This body lay down pre-conditions such as the deviation of stream etc., in the interest of the public which the miners must satisfy before operations may commence. Such pre-conditions expressed by the council would clearly affect the size of the initial capital outlay of a gravel pump mine.

The Subjective Factors

For economic and private reasons miners may also be influenced to invest a greater or a smaller amount of capital in gravel pump mine.

One subjective factor that may influence a miner to decide on a larger investment is 'The value of the tin ore content' in the field to be worked. Miners may favour heavier plants and auxilliary equipment to treat good grade mining land. It must be stressed that such a decision is entirely in the hands of the miners

A second consideration is the size of the land to be mined. A small land area may influence the miner to rent the necessary plant than to install one of his own, he may use a smaller gravel pump. Hence, capital expenditures will be lower.

Lastly, the lease of life of a mine may also influence a miner todecide on a larger or smaller initial outlay. Here, the miner has a choice between a larger plant and a shorter life for the mine (given the size of the mining lease) and a lighter plant and a longer lease of life for the mine, with returns stretched out over a longer period of time.

CHAPTER IV

CHINESE FINANCIAL ARRANGEMENT AND CREDIT SOURCES

The previous chapters have traced the early credit sources of the Chinese miners and the developments in the Chinese tin industry. It was seen that technical developments in the tin industry and a change of time and circumstances have brought about a breakdown in the early system of loan advancement. Chapter III has shown that today,— Capital funds of a substantial size are required in the establishment and operation of a mine. At this stage, a question may be raised; "How do the Chinese tin miners finance and obtain the large sums of money and capital needed for the operation of their mines?"

It is hoped that an answer would be provided in this chapter. The purpose of this chapter, thus, will take up the account on credit sources which have been left incomplete and to bring this account up to date.

Chinese Financial Arrangements

The chief forms of Chinese financial arrangements and business organizations are not dissimilar to those to be found in Western societies.

(1) Sole proprietorships. This form of individual mine finance is less common today. The reason is that it is becoming more difficult than ever before to finance the entire operations of a mine with the limited funds of one miner, as the costs of operation and capital requirements of Chinese mines have increased.

It is believed that amongst the Chinese tin miners in Malaya today, sole proprietorships cover some ten to twenty percent of the total mines in this country.

Mines financed through the sole proprietorship form of business organization today, are largely owned and manged by the 'Old-timers' of the trade. Such third or fourth generation miners are the largest Chinese miners in the country and form the leaders in the Chinese tin industry. With rich mining land in short supply, and heavier capital expenditures, it is difficult for the smaller tin miners to operate mines on a sole proprietorship.

(2) The Chinese Mining "Kongsi" The Chinese "Kongsi" is the equivalent of the Western partnership. The kongsi, as indicated before, is one of the most important form of mine finance in Malaya today.

Members of a kongsi contribute capital in various forms. Contributions in the form of mining leases or titles mining plant and equipment are not uncommon. More rarely, contributions in the form of services are also made. Members of the kongsi begin business with the drawing up of a 'Hup Thong' loosely translated as 'agreement' in which the share capital of the partners, their duties, the distribution of profits, are all stated. The conclusion of the Hup Thong gives the kongsi a legal existence.

While the kongsi is a popular form of financial arrangement, among Chinese tin miners, it is also a risky form of mine finance for its members. This arises mainly from the legal character of partnerships - the most important of which is that all partners are "Joint and severally liable". Nowhere are the implications of this feature of a partnership greater than in the tin industry - where, the liquidation of the personal properties of partners through the default of others are common.

This defect of the partnership is increasely recognised by Chinese tin miners. Today, thus, there is a tendency towards the conversion of unlimited liability partnerships into private limited companies and limited partnerships.

The Chinese mining kongsi has normally a short life. The Hup Thong having a life usually until such time as when the tin deposits in the land are depleted. Hence, it may be regarded as a short term financial arrangement.

(3) Limited Liability Private Companies. In recent years, the Limited Liability Private Companies as a means of raising sufficient capital funds by the Chinese tin miners have come into importance. The reasons for its increasing popularity amongst Chinese miners lie in the merits this business unit offers. These advantages are well known. They include limited liability and a reduction in the amount payable in taxes.

(4) Limited Liability Public Companies. These are until very recent times not used by the Chinese tin

Miners as a means of raising capital for their mines. (In sharp contrast to European mining enterprises which are almost always public companies.) This is because firstly, the capital requirements of Chinese methods of ore extraction are not extremely large. Seldom do they exceed $300,000. Use of public companies are avoided as funds may be raised through other means as the 'Kongsi'. Secondly, the Chinese tin miners have always preferred the concentration of control over the management and operations of these mines in the hands of one or two persons.

(5) The Pok Chow. This form of finance is peculiar to the Chinese mining community in Malaya. The Pok Chow is in many respects similar to the "profit-sharing" system.

A miner lacking sufficient capital for the finance of the entire operations of a mine often resorts to the use of the Pok Chow arrangement as a practical solution.

Essentially, the Pok Chow is an arrangement between the miner and the 'Kepala' (representing the coolies) for the workers to contract their wages. Quite clearly, such an arrangement would lessen the financial burden on the miner, since he no longer meets the labour costs of the mine. Labour costs, it will be remebered, are substantial in the labour intensive Chinese method of operation.

In brief, the Pok Chow form of mine finance operates as follows. The miner supplies the essential mining plants and equipment and also lodging. Lacking sufficient capital funds, he pays no wages to the labourers. To operate the mine, the miner makes an arrangement to the kepala, for the workers to contribute their services without any payment of wages. Frequently, the labourers have to provide their own sustenance, though sometimes food may be advanced by the miner and the costs deducted from the Gross sales of the ore produced from the mine.

The miner receives his profits (if any) from the sale of the ore produced from the mine after deducting a predetermined portion per picul of ore to be paid to the workers as their share of their earnings.

Alternatively, the miner, (depending on the agreement made with the 'kepala') may buy the tin ore from the 'kepala'. The proceeds from the sale of the ore by the kepala go as earnings to be distributed among the labourers, while the miner makes his profits from the sale o

ore at a higher market price he buys the ore from the kepala and the price he sells it in the market.

The miner pays the kepala normally a quarter of the tin ore price per picul of the metal sold. These are distributed among the others according to the number of "Kungs"[1] worked and the degree of skill involved in their jobs as their earnings.

It should be noticed that the miner takes about 75% of the proceeds from the total sale of all the ore produced. It will be a mistake to interpret this as entirely profits for it must be remembered that he has other expenditures such as those on fuel and maintainence of machinery.

It is clear that wages of the mine labourers vary with the tin ore price, the assayed value of the ore produced as well as with output of the mineral produced per month. It may be noted that a greater output of ore may be obtained in mines where the Pok Chow is in use. This is largely the result of an added incentive to produce more, as the workers' earnings will vary with the quantity of the ore extracted.

Hence, it may be seen that the Pok Chow is an ingenious way of keeping a mine in operation when the variable costs of mining operations cannot be met with by the miner himself. Today, it is chiefly in this context that the Pok Chow arises in Chinese mines. It serves only as a means of tiding over a temporary period of financial difficulties which a miner may face. From its very nature, it can be seen that it is a short term arrangement. It is seldom used when the industry is properous or where the tin ore content of the land to be mined is high.

The reasons are that on the one hand/(a) few miners will be willing to share his profits with others if it can be helped. (b) The miner loses control over the management and operation of the mine. (c) The miner runs the risk of ruinage of his land as the Pok Chow encouraged extraction of the ore from the richest tin areas in the field. On other hand, the workers prefer security of employment and a steady source of income of fluctuating and uncertain earnings as may well be the case under the Pok Chow.

One observation may be noted in this account of the financial arrangements of the Chinese miners. This is that they are rarely capable of raising really large amounts of capital funds. This seems to be confirmed by the fact that

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[1] One 'Kung' equals eight hours of work.

ore at a higher market price he buys the ore from the kepala and the price he sells it in the market.

The miner pays the kepala normally a quarter of the tin ore price per picul of the metal sold. These are distributed among the others according to the number of "Kungs"[1] worked and the degree of skill involved in their jobs as their earnings.

It should be noticed that the miner takes about 75% of the proceeds from the total sale of all the ore produced. It will be a mistake to interpret this as entirely profits for it must be remembered that he has other expenditures such as those on fuel and maintainence of machinery.

It is clear that wages of the mine labourers vary with the tin ore price, the assayed value of the ore produced as well as with output of the mineral produced per month. It may be noted that a greater output of ore may be obtained in mines where the Pok Chow is in use. This is largely the result of an added incentive to produce more, as the workers' earnings will vary with the quantity of the ore extracted.

Hence, it may be seen that the Pok Chow is an ingenious way of keeping a mine in operation when the variable costs of mining operations cannot be met with by the miner himself. Today, it is chiefly in this context that the Pok Chow arises in Chinese mines. It serves only as a means of tiding over a temporary period of financial difficulties which a miner may face. From its very nature, it can be seen that it is a short term arrangement. It is seldom used when the industry is properous or where the tin ore content of the land to be mined is high.

The reasons are that on the one hand (a) few miners will be willing to share his profits with others if it can be helped. (b) The miner loses control over the management and operation of the mine. (c) The miner runs the risk of ruinage of his land as the Pok Chow encouraged extraction of the ore from the richest tin areas in the field. On other hand, the workers prefer security of employment and a steady source of income of fluctuating and uncertain earnings as may well be the case under the Pok Chow.

One observation may be noted in this account of the financial arrangements of the Chinese miners. This is that they are rarely capable of raising really large amounts of capital funds. This seems to be confirmed by the fact that

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[1] One 'Kung' equals eight hours of work.

with few exceptions, the Chinese tin industry today is still composed of a relatively large number of independent concerns many of which are comparatively small.

Credit Sources of Chinese Miners

Chapter II have traced the disappearance of the early system of loan supply and advancement. In their places new sources of credit supply have developed. These include:-

(1) The Smelting Agencies

(2) The Diesel and Industrial Fuel Distributors

(3) The Timber Merchants

(4) Local Engineering Works and Foundry Shops

(5) The Import Agencies , and

(6) The Tin Ore Dealers.

The Smelting Agencies

At the present period there are three smelting agencies through which the entire output of ore mined in this country are processed. These are the Straits Trading Company, the Eastern Smelting Company and the Oriental Smelting Company.

Of these three it is known that both the older smelting companies, the Eastern Smelting and the Straits Trading Companies engage in the provision of loans to the Chinese tin miners.

These loans are however, as a rule not encouraged by the Smelters. They are available only to the larger tin miners who have gained the trust of the smelters and are his regular clients.

Loans advanced by the smelters usually range from $10,000 to $20,000. Security backing must be given for such loans. These may be given in the form of mine assets such as mining leases and plant. Larger sums are sometimes provided. But, large loans are given only under exceptional circumstances where the smelter have had a long history of dealings with the miner when he is a reputable person.

Loans provided by the smelters are usually of one year duration though the maximum period for a loan advanced is two years.

Interests are charged on the loans provided by the

smelters. This interst rate is normally 8% per annum on the value of the loan given.

Loans made by the smelters are repaid by monthly instalments at monthly intervals. This is done when the miner sends his ore to be processed at the smelters. The smelters (depending on the arrangement made by the two parties) deducts a sum which is frequently about $20 - $30 per picul of ore processed as the monthly repayments (calculated with interst) owed by the debtor-miner.

It is important to note that the sole aim in the provision of such loans by the smelters is not to derive profits from the interest levied on loans supplied, but to insure a regularity in the supply of ore from the miners which is essential for the economic operations of the smelting works. In other words, financial aid is provided chiefly with the aim of maintaining goodwill between the larger Chinese miners which supply a substantial portion of the ore processed by the smelters.

Further loans are not given unless the miner is able to show that he is in financial difficulties. In times of prosperity, the smelting agencies withdraw the supply of such loans to the local miners.

This source of loans is usually available to the larger miners. The smaller miners cannot afford the rate of interest charged and are not able to provide the securities demanded by the smelters. Thus, the small scale and marginal miners are deprived of the use of such loans and are forced to secure their loans elsewhere.

These loans by the smelting agencies have been a great boon and help to the larger miners when the whole industry is in difficult times.

The Distributors of Diesel and Industrial Fuel

The distributors of diesel and industrial fuel in this country form an important source of credit to the Chinese tin miners of this country. This arises mainly because of an economic tie between these fuel distributors as the suppliers and the tin miners as the consumers of industrial fuel.

An average gravel pump mine consumes about 8,000 - 10,000 gallons of diesel fuel per month. Thus the gravel pump mines form an important part of the market in Malaya for industrial fuel.

Distributors supply a loan to the value of the fuel consumed by the miner per month in the form of dieseline. This is given in advance of payment. No interest are paid largely

because of the keen inter-distributor competition for the supply of fuel to the miners. Such interest free loans in the form of fuel are of a short term nature. The maximum period allowed by the distributor for a loan on fuel is 60 days. But the established miners are able to obtain much longer term loans form these distributors,

The whole transaction is conducted on the basis of mutual trust. No down payments are made by the miner.

In addition favourable discounts are also offered by these distributors. Discounts of 3% on dieseline and 15% on lubrication oil are given to the average miner.

The Timber Merchants and Dealers

Large quantities of wood and timber are needed in the construction of the mining kongsi and the palong. In particular the consumption of "Jungle Poles" in the construction of the palong is large. The estimated expenditure on timbers in the establishment of a gravel pump mine is $8,000.

A loan approximately equal to this value may be obtained from the saw millers and the timber merchants. This loan is given in the form of supplies of wood and timber on credit. They are given interest free and without any form of security backing. No down payments are required.

Such credit facilities provided by the timber merchants are also of a short term nature with repayment due within thirty to sixty days.

The number of merchants offering such credit facilities to the Chinese tin miners is not known. But it is generally agreed by the tin miners interviewed that a good number of the local timber companies engage in such transactions with the tin miners.

The Local Engineering Works and Foundry Shops

With the exception of the costly earth moving equipment and the prime movers which have to be imported, a larger part of the gravel pumping equipment such as the gravel pump itself and the water monitors are locally manufactured by Chinese owned engineering works. These local firms specialize in the production of gravel pumps and other mining machinery.

It was seen that a large part of the initial capital outlay of Chinese gravel pump mines are spent in fixed investments in the purchase of machinery and plant. Of this amount about $10,000 worth of machinery and equipment may be locally provided by the engineering works and foundry shops.

Machinery valued to this amount are provided in advance of payment to the tin miners by many of these specialist firms. No down payments are necessary and the transaction may be regarded as an interest free loan from the engineering works.

The whole transaction is again performed on the basis of mutual trust in the business integrity of the miner.

The period of the loan is frequently indefinite and variable. To the newcomers to the industry such loans are given to a maximum period of two months. But with the older tin miners the loans stretch over a indefinite time period.

It is certain that not all the engineering works and foundry shops in this country engage in the provision of such loans to the tin miner. Such credit are offered chiefly by the larger of these firms particularly those specialising in the manufacture of mine machinery.

In the tin mining state of Selangor alone, it is certain that at least thirty such local engineering firms engage in loan advancement of such a nature to the tin miners.

Import Agencies and the Agency Houses

The importers of mining equipment and machinery consist of large European managed firms. These large importers of mining equipment supply the two most important pieces of machinery - the two Prime movers to the Chinese miners. These two pieces of machinery cost the miner about $40,000 when new.

These prime movers are provided by the import agencies on a hire purchase basis. In other words as differentiated from all the other sources of credit discussed, the importers of machinery require a down payment before the machinery is delivered. This down payment is approximately 25% of the value of the machinery bought. This payment may be regarded as some form of security on the machinery advanced on credit by the import firms. The balance of the sum outstanding is repayable usually in 12 to 18 monthly instalments with a maximum of 24 monthly payments.

An interest rate of 10 to 12 percent is also levied.

Hence it may be noted that the importers of mines machinery while controlling the supply of the most vital pieces of machinery of the tin miners offer credit terms much less favourable than the other sources of credit discussed earlier.

The Specialist Mines and Plantation Suppliers

There are the large hard-ware cum grocery shops. They are the direct descendants of the early provisioner-advancers discussed in Chapter I.

Such firms as implied by their names cater only to the needs of the tin miners and the planters. The articles they supply range from food items to odd pieces of cables and pipes.

These mine suppliers chiefly supply the miners with food and provisions. The average consumption of rice in a mine of 40 workers is 1½ tons per month. The food bill averages $1,500 per month or about $30/- per head per month.

Such needs are supplied by the Mine supplier on credit. This takes the form of a loan to a sum agreed by the miner and the specialiest firms. This arrangement enables the miner to draw out goods on account for the period of the loan, No interest is charged on theloan provided. Such credit extended by these specialist suppliers are of a short term nature, the loans usually given for a period of two months.

The Tin Ore Dealers

In 1963 there were 78 licensed tin ore dealers in this country.[2] The majority of the Chinese ore dealers are actively engaged in the provision of loans to the tin miners. These loans are especially directed towards the small scale miners and the marginal operators.

Loans advanced by the Chinese tin ore dealers today are usually not larger than $10,000. Often the sum loaned to the miner is below $5,000.

These loans assume varied forms. They may be in the form of goods or food provisions or diesel fuel. More frequently they are in the form of cash.

Almost all of these loans are unsecured. The transaction is based on the basis of trust in the miners honesty. However the dealer states a condition that the debtor miner must abide with. This is that the debtor miner must deliver the entire ore output from his mine to the dealer.

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[2] Bulletin of Statistics Relating to the Mining Industry of Malaysia, 1963. Page 34.

Interest rates of varying amounts are also charged. Frequently they may be as high as 20% and may be concealed in the form of various payments which the miner is forced to agree to before the loan is given.

This high rate of interest on loans made by the tin ore dealers is possible mainly because the small miner have no one else to turn to for cash or monetary loans.

In recent years however, the rate of interest on loans provided by the ore dealers have been lowered. This is due to the keen competition between the ore dealers for the ore produced by the tin miner. This has led the ore dealers to lower their interests on loans in the hope of gaining the supply of ore from the mine.

Loans by the tin ore dealers are gradually declining in importance[3]. This is largely the result of several factors, the most important of which include the increasingly commoness of default and dishonesty among the small time tin miners; and that today, there are less attractive returns in the form of interest payments for the loan advanced by the ore dealers as a result of the rising number of marginal mines and the insecurity of operations as a consequence of ceaseless leasing and sub-leasing of mining titles.

Several observations may be made in the sources of credit supply of the Chinese tin miners in Malaya today.

Loans in the form of cash and monetary payments are less common. Generally the supply of cash loans are limited to the smelters and the tin ore dealers. These cash loans are of limited and often small amounts. In the case of the smelting agencies the loans are available only to the larger and established miners for, as a general rule they do not encourage loans to the small-time miners. In the case of the ore dealers loans are of small amounts and are directed mainly at the small scale gravel pump miners. In recent years, even these limited capital funds opened to the smaller miners have been on the decline.

Loans to the Chinese miners today thus are largely in the form of kind. These include the loans on timber, fuel, machinery etc., by the respective specialist firms.

It should be realized that such loans are given only because the tin miners' well-being are important to the economic

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[3]See Mr. Yip Yat Hoong - 'The Marketing of Tin Ore in Kampar' - Malayan Economic Review, October, 1959.

life of such firms. In this connection it may be noticed that the tie between the source of credit supply and the miner though it has shifted and changed with time have not been broken entirely.

Certain basic features of the system of loan advancement of the early miners have been retained. The most unique feature of which is that loans both in cash and kind are based on the confidence in the miner's business integrity as no security backing are demanded (except in the case of European firms). Arising from this feature the main defect of the early system of loan supply have not been eliminated. This is that new-comers to the industry and the disrupted miners will experience difficulties in securing credit facilities that are available to the established tin miners. It is thought that largely because of this that many a potential miner have been discouraged from entering the Tin industry.

It would appear that the disappearance of the most important class of mine advancers of financiers, the merchants and the opium farmers have not been replaced by a new class of mine advancers of any importance. It is believed that it is this lack of sufficient credit and finance through the provision of monetary sums of a large enough nature that have caused the high rate of Mortality amongst the smaller Chinese mining concerns. It has also hindered the expansion in the scale of operations of many mines.

Two reasons may be given for this lack of an adequate supply of monetary and cash loans.

The supply of mining land have gradually decreased. In the words of Mr. H. Dalton Brown," "The greater part of Malaya's tin ore reserves lie around the areas which have been previously mined"[4]. The implications of this stark fact are great. Today among the Chinese there is a general belief that the tin industry is approaching its end. Whether this is true on not is still conjectural as many factors such as the rate of demand as well as the rate of prospecting and exploration of new tin resources have to be taken into account. However, this belief has had the misfortunate effect of causing a shift of loanable funds to other lines of investment.

Further more, there is also the tendency of a channeling of funds and private investment to an increasingly important seotor of the Malaysian economy namely the Consumer goods and

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[4]The Straits Times, May 28th, 1964.

industrial sector. This rise in the investment opportunities in the consumer goods sector have contributed to the neglect of private cash loans to the primary production sector. In Malaya hence, private cash loans for the Chinese tin miners are increasingly scarce.

Bank Credit

Throughout the period of economic history, Banks have played leading roles in the development of industries.

This has not been so in so far as the Chinese tin industry in this country is concerned. At no time have the commercial banks played an active role in the development of the local Chinese tin industry. However the same cannot be said of the European tin mining enterprises.

Until the achievement of political independence in 1957, the largest banks in Malaya were foreign owned and managed. These were the branch banks of the large banking corporations in the United Kingdom. These banks mainly "the big four" the Chartered Banking Corporation, Mercantile Bank, Eastern Banking and the Hong Kong and Shanghai Banking Corporation had the control of the majority of the money deposits in this country. Hence their credit power exceeded any of the few locally owned banks in the pre-Independence era.

These four largest banks have not provided any form of direct finance to the Chinese tin miners. It should be again emphasized that this is not to imply that their credit facilities were not opened to the European miners. Indeed without their finance the European tin industry would not have developed as fast a rate as it had. But these same credit facilities that the banks have provided to the Western mining enterprises were not extended to the Chinese tin miners.

One reason is historical. It must be realized that the sole aim of their establishment in this part of the world was to meet the needs and the demand of the foreign tin mining enterprises and the planters for stable financial institutions and banking facilities in an area where local monetary institutions were few as well as insecure. Hence until the recent past these banks were in Malaya only to serve the needs of the foreign enterpreneurs and not the local businessmen including the Chinese tin miner. As a result these banks were mostly if not entirely interested in short term lending to the foreign enterprises in the export industries in tin and rubber. Much as the Chinese tin miners were an important part of the tin industry of this country they were neglected.[5]

In one line, these banks were not here to do business with the local Chinese tin miners.

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[5] See Edward Nevin. Capital Funds in Underdeveloped Countries

Secondly, partly on account of their historical origins, the foreign banks adopted conservative and traditionally rigid banking practices. Rigid rules of credit worthiness were demanded. Rules of credit worthiness which even the majority of the largest Chinese tin miners could not hope to satisfy. In other words, loan advancement to the Chinese tin miners who were unable to satisfy the rigid credit rules demanded by these bankers were considered unprofitable and unsound banking propositions.

Little wonder then, that the local Chinese tin miners were forced to the other sources of credit described in an earlier section. Hence there is some substance in the compliant by the Chinese tin miners that they have been discriminated against.

Now, it might be thought that with the achievement of political independence in Malaya, with the rise in the number of local banks and with the establishment of a central bank this situation of concentration of loans to foreign enterprises and a general neglect of the credit needs of the Chinese miners may be corrected.

This is what it would appear at first glance. First of all the number of commercial banks in this country have increased rapidly over the last four decades. At the end of 1964, there were 43 banks in Malaysia with 378 banking offices all over the country. Of these twenty-two are local banks while twenty-one are foreign banks.[6]

Secondly, it would be reasonable to assume that with the establishment of a central bank of Malaya the attitude of the foreign banks toward the local borrowers may be changed.

To a certain extent this has been done. Mainly through moral suasion by the central bank loans to local business-men have greatly expanded.

The Chinese tin miners have however benefited little from this development of an extensive banking system. From Table VII it may be seen that the mining and quarrying industries received in 1964 only about 2% of all the loans and advances made by commercial banks. It should also be noted that this 2% is shared with the quarrying industry. Further, it is also known that a large proportion of these loans were given mainly to the Iron mining industry. The Chinese tin miners thus, received a minor share of bank credit given to the mining quarrying industry.

Loans by the commercial banks to the Chinese tin miners have to be secured. Mining assets are not considered good security. This means that loans to the tin miners must be secured with non-mining assets such as property holdings. This has in effect placed bank credit beyond the reach of the small scale miners.

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[6] Central Bank of Malaysia Report 1964. Page 33.

Interest of between 9.6% and 10.8% per annum is charged. (This interest rate varies with the monetary policy adopted by the Central Bank of Malaya and in general, with the Bank of England rate.) Interest on loans to the Chinese tin miners are however not any higher than those paid by the other debtors.

The size of Bank loans vary chiefly with the value of the security offered. Usually, the commercial banks advance loans up to 50% of the value of the security offered.

It can be seen that the Chinese miner can draw on the credit facilities of commercial banks so long as he stakes his personal properties and non-mining assets as security for bank loans. Principally because of this and the fact that banks charge the commercial bank rate of interest on loans deprives the small miner from the use of bank credit.

Thus bank credit even today plays a passive role in the finance of Chinese tin mining operations. Why?

The demand for loans from the miners have not been lacking that they have not been satisfied largely lie with fact that Chinese miners are unable to provide sound securities demanded by the organised modern banking institutions.

More important, commercial banks have not been actively encouraged to provide loans to the Chinese miners. This is a result of a shift in the government's policy from heavy dependence on primary export industries to consumer goods industries. The defects of heavy dependence on tin and rubber have been recognised and there is hence much greater emphasis by the government in industrialisation and the diversification of the economy. To this end, commercial banks through direct and indirect persuasion from the government and the central bank have channeled the larger portion of their loanable funds to the creation and the finance of pioneer industries.

TABLE VII

CLASSIFICATION OF LOANS AND ADVANCES OF COMMERCIAL BANKS 1964

Purpose	31st Dec.1963		30th June '64		31st Dec. '64	
	$	% of Total	$	% of Total	$	% of Total
Agriculture	114.2	5.9	115.0	5.5	126.4	5.9
Mining & Quarrying	42.2	2.2	38.4	1.8	34.3	1.6
Manufacturing	186.8	9.6	266.7	12.8	282.8	13.1
Construction	110.2	5.7	125.2	6.0	190.4	6.5
Commerce	1,002.4	51.5	983.1	47.2	999.2	46.5
Professionals & Private Individuals	306.4	15.7	346.7	16.7	344.1	16.0
Others	182.2	9.4	207.2	10.0	244.0	10.4
Total	1,944.2	100.0	2,082.3	100.0	2,151.2	100.0

Source: Central Bank of Malaya Report 1964.

CHAPTER V

CONCLUSION

The Chinese tin industry in Malaya developed as the result of the rise of an external demand in the Western industrialised economics for tin as an industrial metal.

This external demand for tin has in the nineteenth century, generated investments in tin mining by the emmigrant Chinese in this part of the world. Until the early decade of the present century, these early Chinese miners accounted for the largest share in the mineral produced in Malaya. Their contributions to the country as a whole cannot be over emphasized.

But, while the demand for the metal has come from abroad, the finance needed in the development and exploitation of the tin resources in this country by the Chinese has come from the Chinese community itself. The development of the Chinese tin industry has been thus largely 'autonomous' - in the sense that operations were self-financed by the Chinese themselves.

The source of their finance have been drawn from within the Chinese community themselves. It was seen, that to exploit the tin resources of this country, these miners have drawn on chiefly the funds of the wealthier classes of the community and from the firms that are directly and indirectly involved with the mining of tin. These constitute, to borrow a term the 'unorganised money market', for the miners in this country. It is from this unorganised money market that the Chinese tin miners sought their finance and their credit. The price they paid was, as noted, high. Nevertheless, without these merchants, ore dealers and provisioners, the Chinese tin industry would never have got onto a start.

To a certain extent, while the old system of credit supply and loan advancement have broken down, the situation has not greatly altered today.

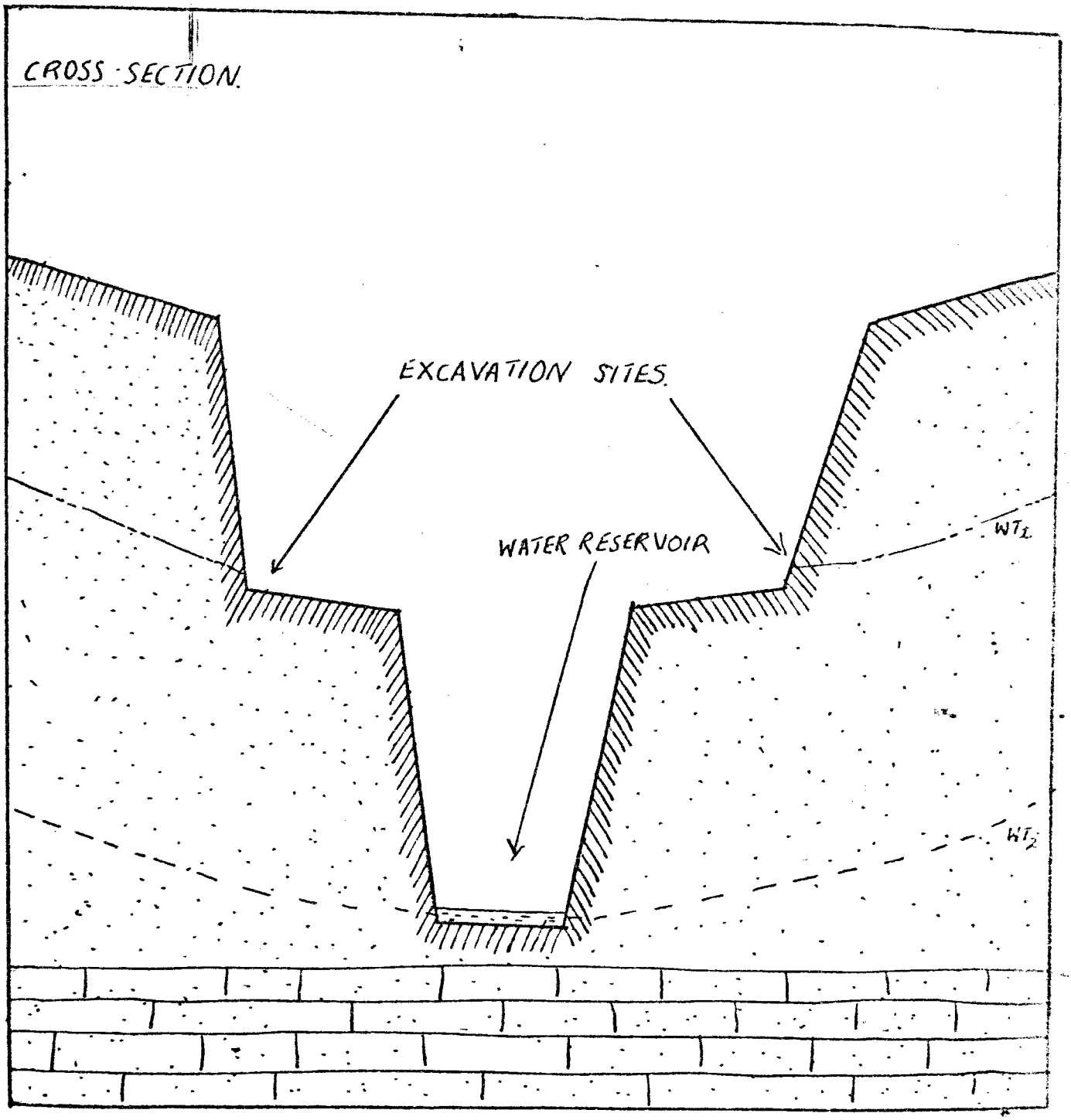
Despite a parallel growth of Banking and Financial Houses - the ingredients of an organised money-market, with the growth of the Chinese tin mining industry, such facilities as offered by these modern Institutions of Finance are not within the reach of the majority of Chinese tin miners especially the marginal miners for reasons we have already noted.

Thus even today, the source of finance and credit is still drawn from a wide assortment of specialist firms dependent on the Chinese tin industry for their economic well being. In other words, the chief sources of finance and credit of the Chinese tin miners are still limited to those people and firms having an economic tie with the industry.

The loans provided by these firms with one or two exceptions notably the smelters and the ore dealers are in kind rather than in cash. They are also of limited size. Nevertheless it is only through the use of such non-monetary loans that the operation of marginal mines, that would have been otherwise abandoned, are possible. Therefore, the importance of these creditors and the part played by the unorganised money market in the tin industry should be realised. For, until such time that small scale Chinese tin miners are able to meet the stringent rules of security demanded by the large number of Banks in this country, these creditors and advancers will continue to be the chief sources of credit and finance to a large majority of the Chinese tin miners.

It is interesting to note that the Chinese tin miners who have played a significant role in the development of the industry and indirectly in the economic development of the country, (through export duties on the ore) have to date, no financial institution that is sympathetic to their increasing needs for cash.

DIAGRAM ILLUSTRATING THE TIEN-PING FOO MINING SHAFT



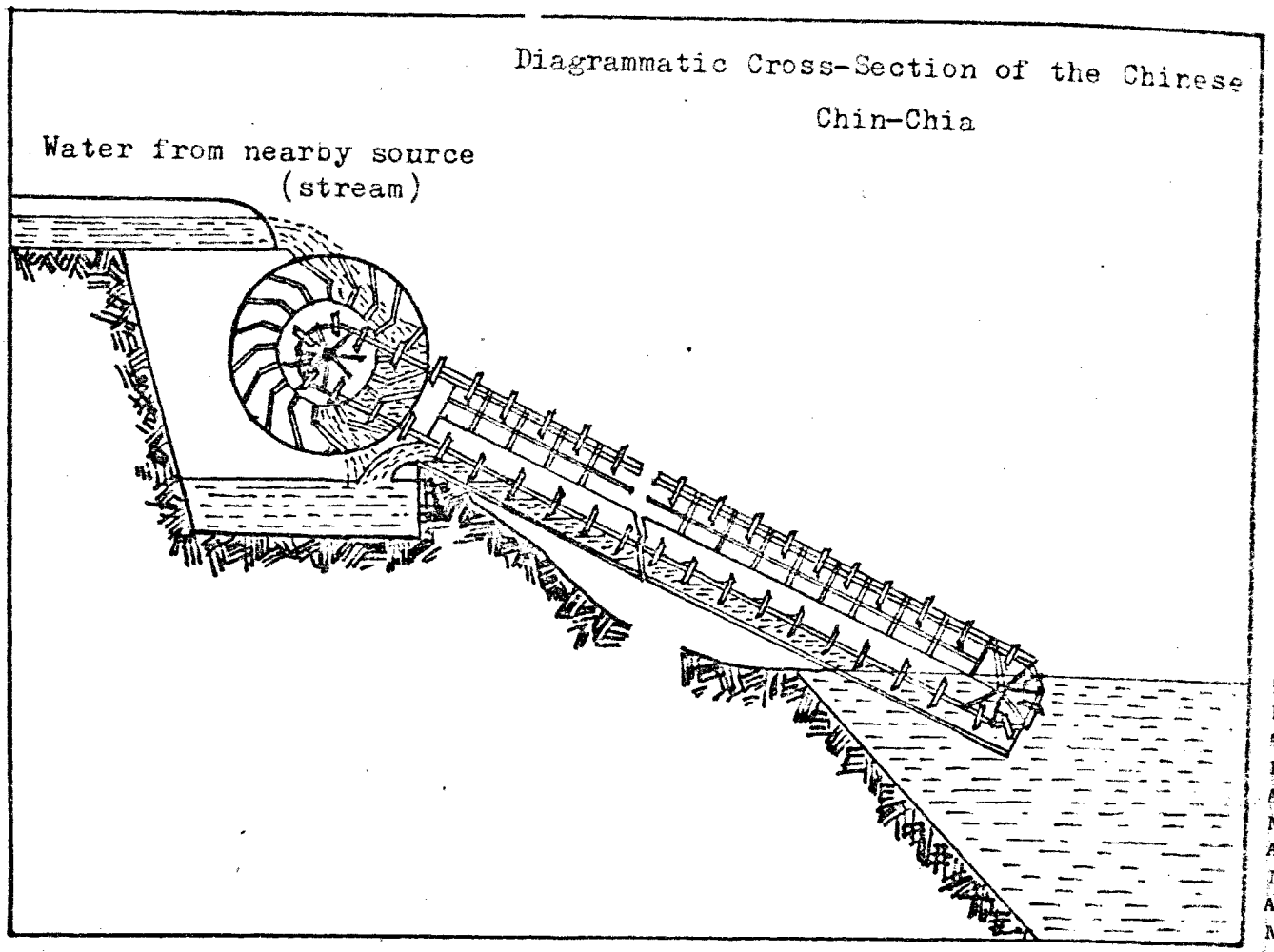
KEY

	IMPERVIOUS BED.
———	ORIGINAL WATER TABLE
- - - -	PRESENT WATER-TABLE.

The excavation of a deeper central section lowers the water table. This permits dry-mining in the adjoining compartments.

APPENDIX B

THE CHIN CHIA



The Chin Chia consist of a rotating wooden chain of 'scoops' driven round two woooden wheels of unequal diameter, the one at the top of the mining shaft being larger than that at the base of the shaft. The lower end of the Chin-Chia was placed at the bottom of the mine (See diagram above). The pump was driven by water.

The Chin Chia was reputed to be able to pump 1,500 to 3,000 gallons of water per hour. Its effective operation was however limited by the regularity of water supply to furnish the motive power.

APPENDIX C

Lampanning or Ground Sluicing

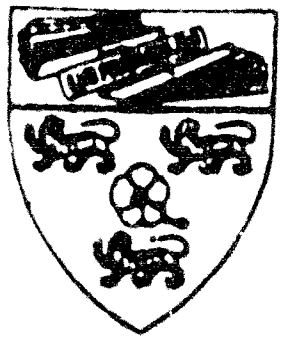
This is the most popular method of ore extraction amongst the indigenous miners.

Stanniferous soil is extracted with the means of hoes and dumped into a ditch through which water flows in from a nearby water source. Stanniferous material is next broken up with hoes to free the tin concentrate from the earth. The Slurry produced is then driven down the ditch with wooden spades. Tin concentrates are collected from the floor of the ditch. (Tin retention ditches are built at regular intervals.)

The chief defects of this method are:

It is a wasteful method as often the disintergration process was incomplete.

Further, its large use of water also limited it use in areas with close proximity to streams.



TAMAT