# The Economics of Tin Control

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by

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Abstract of Ph.D. Thesis.

The Economics of Tin Control.

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The economic problem of the tin industry is essentially the problem of price fluctuations, which lead to the instability of producers' income and employment. In the past, high prices did not meet with effective short-run reaction of the consumers, who were unorganised; but they caused, after a time-lag, a large increase in output. The consequent tendency for price to fall was precipitated during the general depression by a sharp decline in demand. Price then remained low for a long time, owing to the short-run price-inelasticities of both supply and demand.

Producers were highly organised and had a propensity to combine. Low prices brought about a producers' restriction scheme, made possible by the governments who had strong interests in the tin industry. The restriction scheme succeeded in raising price, but not in stabilising it. It created, in addition, a number of economic, social and moral problems.

The present study covers the period from 1914-18 to the present day. The problem is stated in Chapter I. The next two chapters discuss consumption and the demand function. Production is described in Chapter IV; and the financial control of the industry and Governments' interests are analysed in

1 Backwardation throughout 30's

2. Triangular trade — mostly in U.K. — [illegible] [illegible]

3. [illegible]

4 p 30 (Art)

5. Rural wages — change in comp. position

6. Politics — ~~A.O. Control~~ L.T.C. in [illegible]

7. How large a change required to secure technical optimum

8. Havers — Technical advisor to I.T.C

9. p 241 — long term demand trend of new prod. price

10. Bolivia: no. of miners

11 427 mostly

12. [illegible] share

Chapter V. Chapter VI makes an analytical study of costs. The next part of the work (Chs.VII to X) is devoted to the examination of the actions of the Producers and the States. In the last chapter, the prospect of tin control is discussed in the light of past experience, the I.T.O. Charter, the Wheat Agreement, Buffer Stock and other proposals.

In the course of the study, the works of Rowe, Knorr, Eastham, Schut and other writers on the subject are critically examined.

# The Economics of Tin Control

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## Abbreviations

| | |
|---|---|
| ABMS | = American Bureau of Metal Statistics. |
| AER | = American Economic Review. |
| AOMC | = Anglo-Oriental Mining Corporation. |
| CTS | = Consolidated Tin Smelters, Ltd. |
| EJ | = Economic Journal. |
| FAO | = United Nations Food and Agriculture Organisation. |
| FIC | = French Indo-China. |
| FMS | = Federated Malay States. |
| ILO | = International Labour Office. |
| ITC | = International Tin Committee. |
| ITO | = International Trade Organisation. |
| ITRDC | = International Tin Research and Development Council |
| ITSG | = International Tin Study Group. |
| JPE | = Journal of Political Economy. |
| LCES | = London and Cambridge Economic Service. |
| LTC | = London Tin Corporation. |
| NEI | = Netherlands East Indies. |
| QJE | = Quarterly Journal of Economics. |
| RES | = Review of Economic Studies. |
| S.S. | = Straits Settlements. |
| TPA | = Tin Producers' Association. |
| UMHK | = Union Minière du Haut Katanga. |
| UMS | = Unfederated Malay States. |

## Weights

Ton = long ton of 2240 lbs. = 1.016 metric ton (unless otherwise specified)

Picul : Malayan picul = $133^1/3$ lb.
The picul used in Indonesia is slightly more, and that used in Siam slightly less than the Malayan picul.

## Exchange Rates (1921-1940)

Malaya: (S.S)$ = 2s.4d. from 1923, previously slightly less.
Siam : Baht = 1s.10d. throughout the period.
N.E.I.: Gulden = about 1s. 8d. up to 1930.
= 2s. to 3s. thereafter.
Bolivia: Boliviano = 17d. to 18d. up to 1931.
= 11d. to 14d. from 1931 to 1935.
(official rate) = 18d. from 1936
(de facto rate) = declined from 1s. in 1935 to 3d. in 1937 and about 1½d. in 1940.
U.S.A.: $ = about 4s.6d. (1922-25)
= about 4s.0d. (1925-31)
= 4s. to 6s. (after 1931)

# CHAPTER I

# THE PRICE OF TIN.

## (A) Introduction.

1. The problems of primary products are political, social and economic. During the last few centuries, Western Powers, partly on account of the industrial revolution, and partly on account of the commercial and political rivalry among themselves, often came into conflict with each other over the sources of raw materials. This constitutes essentially international political problems. The question of food supply, both in the spheres of production and distribution, forms another set of problems predominently social. Economic problems of primary products in general arise from the instability in their price and production, and hence from the instability in producers' income and employment.

While recognising the fact that there can be no clear-cut division of any problem into the three categories referred to, the present thesis is concerned with the economic side of the subject.

2. Tin is a raw material of industry. Its economic problems must be viewed against the general background of the industrial activities of the world, especially of the main industrial countries. An instability in the general business activity makes itself felt on raw materials such as tin, and in turn, a depression in the income and expenditure of raw material producers contributes to the depression of the wider world.

Consequently, any study of the economic problems of tin will have to be based on the crucial assumption of how far mankind will succeed in the control of the trade cycle. Throughout this thesis, and especially with regard to the discussion of future policy, it will be assumed that human efforts will succeed moderately in damping down economic fluctuations: in other words, it is assumed that economic fluctuations in the future, while not entirely eliminated, will have a smaller degree of intensity than during the period between the wars, in spite of the growing complexity of our economic system. The trend of thought and action among Governments, business men and economists, especially in leading countries, and the provisions of the I.T.O. Havana charter on Employment and Economic Activities, indicate that this assumption will be a realistic one.

3. The period under study is, in the main, that between 1920 and 1940. Reference will, however, be made to the situation and trend during and after the Second World War. The long-term problems of tin are best illustrated by the period between the wars, but even within this period, a distinction must be made between a period of relatively free market and one of controlled production, with the years 1930/31 as the dividing date. During the first period, the tin industry presented a set of problems. The control established and imposed throughout the second period was intended to provide a solution to these problems. We shall consider how far it succeeded in doing so,

and whether there have not been any new problems and difficulties arising out of such control.

(B) THE PRICE OF TIN.

I The Course of Price.

4. The problem can be approached by following the course of tin price.

The lowest price of tin ever recorded in London since the beginning of the 19th century is £52½ per ton in 1878. The highest record between the recent two wars belongs to the year 1920, when the price reached £419½ per long ton. This record was surpassed in March 1947, when the officially controlled price in London was fixed at £437.

Between 1921 and 1939, the lowest level of price was £100 per ton in June 1931, and the highest £321 in October 1926. The second peak occurred in March 1937 when the price jumped suddenly and sharply to £311.

The following table shows the range of price in £'s in London, sub-divided into the "free" period 1921-1930, and the "controlled" period 1931-1939.

Table I.1.

Long-Period Range of Tin Price in London.

(£ per long ton) (Standard cash)

| Period | Highest | Lowest | Range | Average | Range as % of Average | Ratio of Lowest to Highest. |
|---|---|---|---|---|---|---|
| 1921-1930 | 321.1 | 104.6 | 216.5 | 219.0 | 98.8 | 1 : 3.07 |
| 1931-1939 | 311.2 | 100.3 | 210.9 | 196.4 | 107.4 | 1 : 3.10 |
| 1921-1939 | 321.1 | 100.3 | 220.8 | 208.3 | 106.0 | 1 : 3.20 |

It can be seen from this table that :

(a) The average price of tin over the period is in the neighbourhood of £200 a ton.

(b) The trend of the price is on the whole in a downward direction, for in spite of the producers' measures to support price during the thirties, and the increased demand due to preparations for war in the later part, the average price is somewhat below that of the twenties. (See Note 1). This can be explained by the fact that the increase in demand for tin was more than offset by the reduction in costs owing to the improvement in the technique and by the opening up and development of new sources of supply.

(c) The degree of fluctuation in the price of tin (as expressed by the last 2 columns) is considerable.

5. The course of tin price can be best seen in Figure I.1, which is based on the daily mean price of standard tin quoted on the London Metal Exchange. (See Note 2).

The comparison between cash price and "futures" (3 months) price can also be seen from the same chart. When cash price is lower than "futures" price, the difference is called

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Note 1 This is a fair comparison, because the periods compared are two complete business cycles.

Note 2 The price quoted in New York is in $ per lb. of Straits tin, and that quoted in Singapore is in S.S.$ per picul of Straits. Quotations in the 3 markets are in general more or less in line with each other, except in such few abnormal periods as at the beginning of the European War, late in 1939.

a "contango; when this difference is a negative one, it is called a "backwardation". Contangoes and backwardations generally reflect the expectation of the market as to the course of price in the short-run future. A contango shows an expected rise and a backwardation the opposite. In the chart, contangoes are indicated by the letter C and backwardations by the letter B. The magnitude of the contango or backwardation is shown by the lettering along the price line in this fashion:

| | |
|---|---|
| Sc or Sb .. .. .. .. | $<$ £1 per ton. |
| c or b .. .. .. .. | £1 - £3 per ton. |
| C or B .. .. .. .. | £3 - £6 per ton. |
| CC or BB .. .. .. .. | £6 - £10 per ton. |
| CC or BB .. .. .. .. | $>$ £10 per ton. |

During the post-war slump, contango persisted with short interruptions, right up to the beginning of 1924; and in the great depression, it persisted from the beginning of 1929 to mid-1933, i.e. very nearly 4½ years. Out of the 10 years in the 1920's there were approximately 3¾ years backwardation; on the other hand, backwardation prevailed in the 1930's from the middle of 1933 right up to the end of 1940, with the exception of a short period of contango in the 1938 slump.

6. Attention is drawn to the fact that when the price is at a very high or very low level, it may, and usually does, remain at that high or low level for a long time, with occasional violent shootings-up or crashings-down. This is illustrated by the chart on 3 distinct occasions:

(a) a high level from 1926 to 1927

(b) a low level from 1930 to 1932

(c) a high level from 1936 to 1937.

It is interesting to note that the expectation of the market is as often fulfilled as not. The contango shown in 1924/25, which indicated an expected rising trend was followed by an actual rise in 1926. In the beginning of 1927, when backwardation reached a magnitude above £10, the market was again right, for price fell steadily afterwards, but, on the other hand, in 1929, after a large fall in price, the market showed an expectation for a rise by a very large contango; that expectation was not, however, fulfilled. Again, late in 1936, there was a backwardation indicating an expected fall; but a surprise increase in demand spurted the price up and the market apparently changed its mind by showing a contango at a price level as high as £240. This was fulfilled, for the price shot up to a peak of £311 within a few days.

7. The subject of market expectation will be discussed more fully when we come to discuss the elasticities of supply and demand. It is briefly mentioned here, in order to show that on the whole, the average long-term price, as expected by the market, was lower in the 1930's than in the 1920's.

Between 1921 and 1925 (contango with brief periods of backwardation) the market apparently considered that a price level of £240 - £250 was not unduly high. In 1929, with a big contango, the price of £200 was considered too low. Not so in 1936, and the beginning of 1938, when a backwardation remained at the £200 level.

When we speak of a price being too high or too low in this context, we mean that it is too high or too low in relation to the expected future (3 months) supply and demand conditions, taking into account the trend of production and consumption. It has been said (see Note 3) that "as the long-term trend of tin consumption is steadily progressive, the natural tendency of tin prices should be upwards". This reasoning obviously neglects the supply side.

II <u>The problems of low price.</u>

8. A further point relating to the price of tin during the period between the two wars is that, with the exception of about 5 years in the 1920's, price was supported by some measure or another, and sometimes by two or three measures simultaneously (see Figure I.1). Between March 1921 and April 1924, there was the Bandoeng Pool agreement. Preceded by a voluntary restriction scheme in 1930, the Inter-governmental Tin Control Scheme, which began in March 1931, ran throughout the rest of the period and was from time to time supplemented by a buffer-stock scheme. The interesting point to note at this stage is that these various measures by the producing interests generally began when the

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<u>Note 3.</u> by 'Tin', the official organ of the Anglo-Oriental Mining Corporation and later of the Tin Producers Association.

price of tin fell to a level of £180 per ton, and threatened to fall, or actually fell, further. The Chart clearly illustrates this point. See the beginning of the Bandoeng Pool, of the Voluntary Restriction of 1930, and again the beginning of the second International Buffer Stock Scheme in the middle of 1938. This is not to say that producers viewed £180 as a definite red line below which they must act. Indeed preliminary work in the negotiation for an international agreement takes a long time; several months in many cases, but on the strength of this evidence that international action was taken at the £180 price level, it seems to be safe to say that, in the past, a price of £180, or a little above, was regarded by the producers as a "depressed" level, below which they tried, at least, to prevent it from falling.

The depressed level of price occurred during the period on three occasions:

(a) a period of about 18 months in 1921/22,

(b) a period of about 42 months from the last part of 1929 to May 1933.

(c) a short period of 5 months in 1938.

The last period was too short to have any really serious effect on the producers, and was stopped by the Armament Demand, late in 1938.

During the period 1921/22, price fell sharply from a peak of about £420 in 1920 to a low level of £150 in 1921, and further to £140 in 1922, but the depression was essentially a unique and temporary phenomenon, because, apart from a decline in tin consumption due to the post war slump, the depression was due to the sudden release of stocks which had been accumulated in the Far East during the war, owing to the shortage in shipping, which by 1921 was entirely eased. In spite of the narrow scope of the Bandoeng Pool, the period of depression was relatively short; and in the second half of 1922, tin price was restored well above the £180 level.

9. The depression of 1929/1933 has different characteristics and deserves a more detailed consideration.

The price of tin fell steadily from £215 in July 1929 to below £120 per ton in mid-1930, from which date until the middle of 1931, it fluctuated between £120 and £100. The first Inter-governmental restriction scheme, re-inforced by the International Pool in 1931, succeeded in raising the price slightly to the £130-£140 level towards the end of the year; and after a short relapse to £102 in the beginning of 1932, the price was successfully lifted to a level well above £200 from mid-1933. It is a debatable point how far below £100 the price would have fallen in the absence of the above-mentioned measures undertaken by the producing interests, but there is no doubt that it would have gone definitely below £100. This is confirmed by the fact that during the month of April 1932, when the average price of tin in London was as low as £109, the average contango was only £2.

The following table shows the data relating to the output and intake of tin compared with price during the period 1928-33.

Table I.2

Output, Intake, Price and Stocks of Tin 1928-1933.

| Year | 1 Mine Production ('000 long tons) metal content. | 2 Smelters' Production | 3 Price. ann.aver. £ per ton standard cash. | 4 Deliveries. ('000 long tons) | 5 Consumption | 6 Visible Stocks. Average of ends of months. ('000 long tons.) |
|---|---|---|---|---|---|---|
| 1928 | 177.9 | 181.5 | 227.2 | 127.9 | 165.2 | 19.6 |
| 1929 | 192.6 | 192.0 | 203.9 | 141.1 | 178.0 | 27.2 |
| 1930 | 176.0 | 176.8 | 142.0 | 127.8 | 161.3 | 42.2 |
| 1931 | 148.9 | 153.8 | 118.5 | 109.2 | 135.4 | 55.4 |
| 1932 | 99.2 | 105.7 | 135.9 | 74.1 | 99.5 | 58.4 |
| 1933 | 91.0 | 99.8 | 194.6 | 98.8 | 127.2 | 44.4 |

Sources: 1,3,5: I.T.R.D.C. (International Tin Research & Development Council)

2: Metallgesellschaft.

4,6: W.H.Gartsen.

In the table, the supply side is represented by the figures of mine production and smelters' production. The figures for smelters' output in column 2 indicate the flow of new tin in metal form. In order to give the total supply of tin at any point of time, this flow of new tin has to be added to the figures for stocks. Visible stocks in column 6 are those registered by the market and do not include consumers' stocks and other stocks which are "invisible".

Mine production figures represent the supply of tin one degree more removed from the market, as the tin concentrates thus produced have to be smelted and refined before being sold to the consumers. They do, however, show the reaction of the mining producers to the price of tin; since the price received by the miners from the smelters for ore is based upon the price of tin metal in the market. It must be borne in mind that since 1930 and 1931, mine production has been restricted, "voluntarily" or compulsorily, in a large part of the producing world. Subject to the restriction in the supply of ore, the output of the smelting industry is not otherwise artificially limited.

On the demand side, the figures for deliveries and consumption are given here. Delivery figures represent the quantities bought and sold and are taken from the market returns which cover the reporting warehouses only. Deliveries which are made directly from smelters to their consumers do not appear in the market returns and can only be estimated with a certain degree of arbitrariness. Similarly, consumption figures are estimates, although their plausibility is supported by other data such as the output of tin plate and other products using tin. The actual quantity of tin which is smelted cannot be obtained exactly. The discrepancy between the deliveries and consumption figures represents approximate changes in consumers' stocks.

It is obvious that, as the difference between smelters' production and deliveries is widened, the price of tin will tend to fall; and as this gap becomes smaller or negative, the price will tend to rise.

(a) Output.

10. How did the tin miners react to the movement of prices? We have seen in Table I.2 that, in 1929, in spite of the fall in price from an average of £227 in 1928 to £204, the world mine production increased from 177,800 tons to 192,300 tons. In fact, most countries producing tin increased their output. A glance at the statistics of production during the 1920's will show that 1929 was in fact the last year of an upward trend in tin production, beginning in 1921/22. In other words, the period 1921-1929 was a period of development in the tin industry,and a fall of £20 to a level still above £200 was not sufficient to halt the progress in production. Moreover, producers' reaction to a fall in price cannot normally be sudden, even though the entire cost may not be covered by receipts in the short run, so long as the price is expected to recover later. It was not until the end of 1929, and in 1930, when price fell below the £180 level, that mine production figures began to decline. In some cases, output declined as the result of a voluntary restriction scheme, but in others, such as in Cornwall and in Australia, mines were

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closed as the price fell below the £200 level. However, on the whole the decline in production was not as considerable nor as rapid as was generally expected at the time. Indeed, some producing countries even increased their production in 1930 above the 1929 figures, (See Note 4) and among the principal countries which applied the voluntary restriction scheme, prescribed by the Tin Producers' Association, the decrease was small in many cases. Table I.3 illustrates this point.

Table I.3

Price and Output of Tin. 1929 and 1930.

| | 1929 | 1930 | Change % of 1929 |
|---|---|---|---|
| Average Price (£ per ton) | 203.9 | 142.0 | -30.3% |
| Output ('000 long tons) | | | |
| Australia... ... ... | 2.24 | 1.45 | -35.3% |
| U.K. .. ... ... ... | 3.27 | 2.49 | -23.8% |
| *Nigeria ... ... ... | 10.73 | 8.57 | -20.1% |
| *Bolivia ... ... ... | 46.34 | 38.15 | -17.7% |
| *Malaya ... ... ... | 69.37 | 63.97 | - 7.8% |
| *N.E.I. ... ... ... | 35.92 | 34.90 | - 2.9% |
| China . ... ... ... | 6.78 | 6.86 | + 1.2% |
| Siam .. ... ... ... | 9.94 | 11.06 | +11.2% |
| Burma.. ... ... ... | 2.40 | 2.75 | +14.6% |
| World . ... ... ... | 192.60 | 176.00 | - 8.6% |

Source : I.T.R.D.C.
Note : * = Countries in which voluntary restriction was applied in 1930.

The table covers all the countries which in 1929 produced 2,000 tons of tin or more. The only country not given here which has subsequently become an important producer is the Belgian Congo.

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Note 4 This does not preclude the possibility of an even greater increase, had the price not fallen.

11. In 1931, in spite of the compulsory restriction scheme operating in the main producing countries, price fell still further, and did not actually recover above the £180 level until 1933. Owing to the application of the quota system in various countries, it is not possible to assess the reaction of the miners which would have taken place had they not been subject to State regulations limiting output. Of all the countries which appear in Table I.3, those which are marked with an asterisk were under such regulations from March, 1931, plus Siam which joined the scheme on a privileged basis from September. The cases of China, Burma, U.K. and Australia, which remained 'free', and that of Siam during the first 8 months can, however, be considered. Table I.4 shows that, with the exception of Siam and Australia, mine production was reduced in all countries, the most outstanding case being U.K.

Table I.4.

Price and Output : "Free Areas"
1930 - 1931

| | 1930 | 1931 | Change % of 1930 |
|---|---|---|---|
| Average Price (£ per ton) | 142.0 | 118.5 | -16.5% |
| Output ('000 tons) | | | |
| U.K. ... ... ... ... | 2.49 | 0.60 | -75.9% |
| Burma ... ... ... ... | 2.75 | 2.01 | -26.9% |
| China ... ... ... ... | 6.86 | 5.95 | -13.2% |
| Siam ... ... ... ... | 11.06 | 12.93* | +16.8% |
| Australia ... ... ... | 1.45 | 1.75 | +20.7% |

Source : I.T.R.D.C.
Note : * = annual rate of first 8 "free" months.

Indeed, in 1931, amongst all the tin producers of the world, Siam and Australia were the only two countries which actually increased their output in the face of the lowest level of price. (See Note 5). From the trend of production, it may be said of Malaya, and probably of Nigeria and the N.E.I. also, that but for the artificial restriction, their output might have been maintained, or even increased. The explanation lies in the flexibility of the wages and cost structure in these countries. This, we shall discuss in a subsequent chapter, but whether this conjecture is right or wrong, the fact remains that even China and Burma, who produced tin more or less under the same cost conditions as Malaya, N.E.I. and Siam, had actually reduced their output in 1931, without artificial interference.

12. The above analysis, to sum up, shows that during the period 1929-1931:

(a) When the price level fell to £200, few mines were closed down; on the contrary, the trend of production remained upwards. This, even without a fall in consumption, had a depressing effect on the next period.

(b) Even when price fell to a level of £140, several producing countries still increased their output. Of those which reduced theirs, the most important ones only did so through a voluntary restriction scheme.

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Note 5 The case of Australia, however, may be explained by the fact that her output in 1930 had fallen so low that it became the record minimum.

(c) With a price level of £120 or below, countries which increased their output became rare exceptions.

(d) It took more than three years of falling and low prices to reverse the upward trend of production. This decline in output was rather small up to 1931, and it would appear that a substantial reduction could not have been achieved without a compulsory restriction scheme enforced by Governments, or by a complete collapse in price.

(e) Table I.2 shows that it was not until 1933, when mine production was reduced to less than half of that for the year 1929, that the price of tin rose above the £180 level.

(b) Intake.

13 On the demand side, Table I.2 shows that the absorption of tin was about halved between 1929 and 1932, but the fall in deliveries was more serious in 1932 than in previous years, although the large fall in price occurred earlier on, the price level in 1932 being, in fact, slightly higher than in 1931. On the other hand, the 41% fall in price between 1929 and 1931 was not sufficient to cause any increase in demand, since, as we shall see later, the business factor is in this case far more important than price considerations. In the face of business slump, tin consumers could not be tempted to buy more tin even at a much lower price. This further aggravated the problem of tin price.

14. An element of considerable importance determining

the price of tin on the demand side has always been the role of the U.S.A.,which is the largest consuming country. Although full analysis must await a subsequent chapter, it may be pointed out here that the U.S. consumers' stocks of tin (i.e."invisible") have a tremendous influence on the course of prices. A comparison between deliveries and consumption figures (which in the case of the U.S.A. are fairly reliable, though by no means perfect), shows the movements in consumers stocks during the period 1929 - 1935.

Table I.5.

Approximate Movements in Consumers' Stocks in the U.S.A. 1929 - 1935.

long tons of tin

| | 1<br>Deliveries | 2<br>Consumption | 3 = 1 - 2<br>Movements (+ or -) in Consumers' Stocks. | |
|---|---|---|---|---|
| Stockpiling | | | | |
| 1929 | 89,116 | 87,000 | + 2,100 ) | |
| 1930 | 79,225 | 71,600 | + 6,600 ) | + 16,400 |
| 1931 | 63,450 | 55,800 | + 7,700 ) | |
| Destocking | | | | |
| 1932 | 36,320 | 40,600 | - 4,300 ) | |
| 1933 | 57,815 | 61,400 | - 3,600 ) | - 18,000 |
| 1934 | 46,215 | 53,300 | - 7,100 ) | |
| 1935 | 59,110 | 62,292 | - 3,000 ) | |

Sources : 1. Statistics of Commodity Exchange, Inc.
2. American Bureau of Metal Statistics (estimates)

Table I.5 suggests that, had it not been for the stocking-up of tin in consumers' hands from 1929 to 1931, price during this period would have sunk even lower than it actually did. Notwithstanding a great fall in production in 1932, price was still low, mainly because the deliveries to the U.S.A. were halved, compared with 1931. From then on, the consuming interests reversed their policy regarding stocks, and allowed them to run down in the face of rising and high prices. Not only was this stocks policy used as a weapon against higher prices fostered by a producers' agreement, it also afforded the consumers a handsome profit; and in this way they acted in the capacity of speculators.

(c) <u>Conclusions regarding the Great Depression</u>.

15. The foregoing analysis points to these facts regarding the problem of price slump:

(a) The decline between 1929 and 1931 was mainly due to the increase in supply, caused partly by the spectacularly high price in 1926/7 and partly by the improvement in production technique, and subsequently due to the stubborn resistance of producers in order to survive. In this first period, the demand factor played a relatively minor role.

(b) In 1932, when the restriction scheme succeeded effectively in limiting world output to about half of that in 1929, price was slightly raised, and the rise would have been greater but for the decline in demand, which already began to be felt in 1931, but which was most serious in 1932. Demand factors, which are related to business activity, were of major importance in 1931/1932.

(c) The first two years of the inter-governmental restriction operation and the Tin Pool did not succeed in raising price, because of the low level of industrial demand, and the stock-liquidating policy of the consumers.

(d) The depression in the tin industry was protracted and aggravated because, on the one hand producers were slow in cutting down their output, and, on the other, consumers were impressed by the business prospects rather than low prices.

The following could also be added:

(e) As seen in the chart of Fig.I,1,the slump in price in 1938 threatened to repeat the story of 1929, but it was interrupted by a Buffer Stock Scheme, a sharp cut in production quota, and, more important still, by the rearmament demand on the eve of World War II. It may be fallacious to conclude from this that in the absence of these factors a depression of the 1929/33 type would have followed; but it remains true to say that however well the international quota system may succeed in raising prise in prosperous times, it could not prevent the price falling below the £180 level.

III The Problems of High Price.

16. As low prices hurt the producer, so high prices are distasteful to the consumer, but unlike the case of low prices where it was possible, at least ex-post, to point to the £180 level as the approximate crucial level, it is difficult, if not impossible, to say, even approximately, what the crucial price is at various points of time in the upward direction. For one thing, the reaction of consumers to the price of materials such

as tin, which make up a small percentage of the cost of the produced goods, is relatively unimportant in the short run. Substitutes, even where possible, cannot be used suddenly because of the difficulty in adjusting production plants on the one hand, and the conservative character of popular taste for consumption goods on the other.

This is not to say that consumers in the past suffered, entirely in silence, the price of tin to rise to any conceivable level. On the contrary, as in the case of producers when price is low, complaints are often heard from consumers, especially criticising the International Tin Committee for its policy of organised scarcification of tin and high prices, but there has been no successful attempt at forming a monopsony to counteract the producers' organisation, in spite of the fact that 55%-60% of the annual world consumption is concentrated in the U.S.A. and U.K., and in spite of the fact that the tin-plate industry alone is responsible for roughly 35% of total consumption.

The U.S. Government and Congress showed active concern over the matter of tin, partly owing to the strategic considerations, partly on account of the general sense of resentment against a cartel exploitation in a commodity of which the U.S.A. is the largest consuming country while having practically no tin mines within its territory; and, perhaps, occasionally because the price was too high and tin was scarce. Mr.Cordell Hull, in a statement to the Tin Sub-Commission of the World Monetary and Economic Conference in London, July 1933, expressed the concern of the American Government at the formation of the American Tin Pool; but confined himself to saying that "(The plan) should be such as to permit of and provide for, the prompt and orderly expansion of supply to meet improvement in demand". In 1934, when the average price reached £230, the House of Representatives directed its Committee on Foreign Affairs to investigate "the extent to which the U.S. is dependent upon foreign nations for its supply of tin and .... whether acquisition by the U.S. of foreign tin resources .... would improve the present <u>costly</u> and dangerously dependent position of the U.S. with respect to this matter ....". Again, when in 1938 a buffer stock agreement was about to be concluded with the object of stabilising prices within the £200 - £230 limits, protests were voiced by the American Government, as well as by the private consuming interests.

17. From the point of view of the producers as a whole, and of the Government of the producing areas as well, a high price is not an unmixed blessing, and this is true both in the short-run and in the long-run. Firstly, substitutes will be resorted to by consumers in the long-run, even when the cost of tin forms a very small element in the total cost of the products. Secondly, a high price will keep high-cost mines in production as well as call forth new mines into production;

and even under restriction agreements, countries which are not members of the schemes can step up production without limit. Thirdly, a policy of high price brought about by the excessive restriction of output can only result in a widespread unemployment of men and machinery in the industry, thus creating a problem which, from the point of view of the State, would counteract the benefit of higher prices.

18. The persistence of a backwardation in the market, indicates that during most of the period between the middle of 1933 and 1937, the price of tin was considered by the market as being too high, especially between 1935 and 1937. The annual average price during this period varied between £205 and £242.

Another period in which the price of tin can be said to be definitely high is between 1924 and 1927, when the annual average price varied between £240 and £290. During this period, moreover, as can be clearly seen in the Chart of Fig. I.1, price fluctuations were very large and frequent, ranging from the lowest of £200 to the peak of £320. The shortage of tin during this period was due, on the demand side, to a large and sudden increase in consumption. On the supply side, it was due to the halt in development in various fields in the East during the war, and to the fact that there was a considerable time lag between the increase in investments and the increase in output. When finally the price reached the highest levels in 1926/27, it called forth a large investment, and world production in 1929 was 70% above that of 1921. Although consumption still rose steadily until 1929, and only declined a little in 1930 and 1931, the price of tin started falling in 1927 and reached a low level of £104 in 1930. Quite apart from the crash in demand which at any rate was not serious until 1932, the tragedy of tin in the Great Depression was caused by over-investment, which, in turn, was the result of high, 'fantastic' prices during 1926.

IV The Problem of Price Fluctuations.

19. This brings us to another evil in the tin industry related to price - i.e. price fluctuations. Price fluctuations are undesirable both for the consumers and producers. We have seen that excessively high prices lead to over-investment and over-production, and, even if demand does not decrease, can and did bring about a slump in the tin industry. Excessively low prices, on the other hand, especially when they are persistent and protracted, not only ruin a large number of producers after a long period of struggle for survival, but generate a serious scarcity of tin as consumption suddenly increases. This is particularly true of a mined raw material such as tin, where the maintenance of lode mines is costly during a close-down period or where, in the case of alluvial mining, machines such as dredges are expensive and require time for construction and rehabilitation. Several lode mines, e.g. in Cornwall, were closed down, and in some cases were allowed to be flooded during the Great Depression of the 1930's and their re-opening could not be justified unless and until prices rose to a very high level. The Eastern alluvial fields cannot produce their

own dredges which have to be constructed in Europe, Australia or America and then transported to the field.

Fluctuations of price also upset the working of both producers and consumers in the sense of increasing the element of uncertainty in their plans. For the producer, this is an extra cost added to the "normal" risk of a mining industry in general. For the consumer, fluctuations may result in big losses, or big windfalls (although a small amount of tin is used in each unit of the final products), because tin is an expensive raw material. From the point of view of the community, price fluctuations are undesirable for at least two reasons: State revenues, e.g. royalties, export duties, etc. fluctuate with them, and in all the main producing areas tin is one of the most important sources of Government revenue, direct and indirect. The other evil of price fluctuations for the Government of producing areas is that of unemployment. Recurrent unemployment of men and materials in times of dwindling Government revenues was a grave problem for mining countries which, in the case of tin, may be classified as primitive areas. The problem is all the more serious where the factors of production thus thrown out of employment are specific.

Let us now examine the severity of the fluctuations in tin price during our period. Figure I.1 clearly indicates two kinds of fluctuations: long-term or cyclical fluctuations and short-term fluctuations.

(a) Long-term Fluctuations.

20. Long-term fluctuations only need brief consideration here, since they are associated with the general business cycle, and could not be discussed without reference to the general economic and social framework. It is sufficient to point out that the magnitude of the ranges between peaks and troughs in the case of tin is considerable, and is exceeded by few other commodities, of which rubber is an extreme case.

Table I.6 gives the ratios of the lowest and highest prices of tin during the period.

Table I.6.

Long-term Fluctuations of Tin Prices.
(London Standard Cash)

| Direction | Period from to | Length of time (months) | Ratio between Lowest & Highest |
|---|---|---|---|
| 1 Upward | Feb.1922-Oct.1926 | 56 | 1 : 2.3 |
| 2 Downward | Oct.1926-June 1931 | 56 | 1 : 3.2 |
| 3 Upward | June 1931-Mar.1937 | 69 | 1 : 3.1 |
| 4 Downward (interrupted) | Mar.1937-May 1938 | 14 | 1 : 2.0 |

For the purpose of comparison, table I.7 is given below and comprises the principal food and raw materials as well as the "wholesale price index for all commodities".(See Note 6) Calculation is made from the monthly average price in New York and the result is slightly different from Table I.6.

Note 6. Source: U.S.Bureau of Labor Statistics.

Table I.7.

Comparative long-term fluctuations of food and raw material prices (1921-1938)

Ratio between Lowest and Highest.

"All commodities" 1 : 1.8

| | | | |
|---|---|---|---|
| Tin | 1 : 3.6 | Raw Wool | 1 : 4.5 |
| Copper | 1 : 4.5 | Cotton | 1 : 5.9 |
| Lead | 1 : 3.8 | Meat | 1 : 2.8 |
| Zinc | 1 : 3.1 | Butter | 1 : 3.1 |
| Rubber | 1 :38.4 | Wheat | 1 : 3.4 |

Tin occupies about the middle position among the primary products, being between the foodstuff on the one hand and raw materials such as rubber on the other. Attention must be drawn, however, to the fact that tin is an expensive metal reckoned per unit of weight. In the above table, the range of tin prices expressed in absolute terms, is in fact among the greatest of the list.

(b) Short-term Fluctuations.

21. We shall also confine ourselves to stating the intensity of short-term fluctuations of tin price, and comparing it with other materials,leaving discussion aside for a later stage. The following Table I.8 is calculated from the daily mean prices quoted in the London Metal Market. Prices of consecutive "market" days are compared; and the frequencies are observed for price differences of (a) between £3 and £5 per ton, (b) between £5 and £10 per ton, and (c) above £10 per

ton. Movements in either direction are taken into account, but movements less than £3 in magnitude are neglected. The result indicates the frequencies and magnitude of fluctuations within the range. Annual fluctuation ranges, both in absolute and relative terms, are given in Table I.9 which should be read in conjunction with Table I.8 in order to give the full idea of short-term fluctuations:

Table I.8

Frequencies and Magnitude of Short-term Fluctuations of Tin Price 1921-1938.

| | Frequencies of Movement between consecutive "market" days. | | |
|---|---|---|---|
| | £3 - £5 | £5 - £10 | >£10 |
| I Relatively stable : 7 years<br>1922, 1928, 1929, 1931, 1932, 1934, 1938 | | | |
| exemplified by 1934 (most stable) | 55times | 1 time | Nil |
| and 1929 (least stable) | 36 times | 7 times | Nil |
| II Moderately Fluctuating : 8 years<br>1921, 1923, 1925, 1926, 1927, 1930, 1933, 1936. | | | |
| exemplified by 1926 | 30 times | 15 times | Nil |
| and 1936 | 26 times | 10 times | Once |
| III Violently Fluctuating : 3 years<br>1924, 1935, 1937. | | | |
| 1935 | 29 times | 16 times | 3 a |
| 1924 | 51 times | 27 times | 5 b |
| and 1937 | 55 times | 36 times | 15 c |

a biggest difference : £14
b biggest difference : £20
c biggest difference : £24

Table I.9

Range of Annual Fluctuations of Tin Price
1921-1938.

| Year | (£ per long ton - London Cash Standard) Highest | Lowest | Average | Range | Range as % of Average. |
|---|---|---|---|---|---|
| 1921 | 210.5 | 148.0 | 165.4 | 62.5 | 38 |
| 22 | 187.9 | 139.0 | 159.5 | 48.9 | 31 |
| 23 | 240.0 | 176.0 | 202.2 | 64.0 | 31 |
| 24 | 298.3 | 200.8 | 248.9 | 97.5 | 39 |
| 1925 | 290.0 | 229.0 | 261.1 | 61.0 | 23 |
| 26 | 321.1 | 261.4 | 291.2 | 59.7 | 21 |
| 27 | 319.6 | 257.3 | 289.1 | 62.3 | 22 |
| 28 | 266.0 | 205.8 | 227.2 | 60.2 | 26 |
| 29 | 229.8 | 174.0 | 203.9 | 55.8 | 27 |
| 1930 | 180.6 | 104.6 | 142.0 | 76.0 | 54 |
| 31 | 141.9 | 100.3 | 118.5 | 41.6 | 35 |
| 32 | 157.8 | 102.4 | 135.9 | 55.4 | 41 |
| 33 | 230.1 | 141.1 | 194.6 | 89.0 | 46 |
| 34 | 244.0 | 222.2 | 230.4 | 21.8 | 9 |
| 1935 | 245.5 | 208.2 | 225.7 | 37.3 | 17 |
| 36 | 244.6 | 175.2 | 204.6 | 69.4 | 34 |
| 37 | 311.2 | 180.9 | 242.3 | 130.3 | 54 |
| 38 | 217.2 | 153.3 | 189.6 | 63.9 | 34 |
| | Average | | 203.4 | 64.2 | 32 |

It may be remarked here that the claim of the International Tin Committee for success in stabilising price was justified by the 1934 record, although the stabilised level was as high as £230 per ton. However, the claim lost its weight in 1937, when both the frequencies and the range of fluctuations were by far the greatest of the whole period, exceeding even the notorious "free" year of 1924.

Finally, we compare the short-term price fluctuations of various primary commodities in Table I.10. The figures compared are the average annual ranges of prices expressed as percentages of the average prices. This, admittedly, can only be a rough comparison, since the frequencies of movements are neglected.

Table I.10.

Comparative short-term Fluctuations in the Prices of Primary Products. 1921 - 1938.

Average Ranges as % of average Prices.

| | | | |
|---|---|---|---|
| Tin | 32% | Raw Wool | 20% |
| Copper | 33% | Cotton | 31% |
| Lead | 44% | Meat | 22% |
| Zinc | 32% | Butter | 23% |
| Rubber | 47% | Wheat | 30% |

## (C) PRELIMINARY STATEMENT OF THE PROBLEM.

22. In the above analysis, we have taken the price course as the starting point for the present enquiry. Even at this stage, several points arise which can be summed up as follows :

(a) The price of tin fluctuates considerably both in the short- and long-run. A slump tends to be protracted and, at its end, to generate a boom of fantastic magnitude, which, in its turn, causes the next slump to be more serious. The concept of equilibrium price, whether or not attainable in economic theory, is rarely reached or even approached in the case of tin during the period under consideration.

(b) The fluctuations appear to be caused in the short-run by the inelasticities of both supply and demand in relation to price; and in the long-run, by general trade activities. Superimposed on this problem, which applies to most primary commodities, there appear to be some other factors belonging particularly to the tin industry which brought the price of tin down to a ruinous level, even before the general trade depression and caused serious problems, even while demand was actually expanding.

(c) In the past, inter-governmental agreements on production restriction, supplemented by occasional buffer pools, have not succeeded in curing the inherent difficulties, even viewed from the angle of price alone. Whether they have, or have not, created new difficulties which are apt to influence the present and future situation, will have to be examined. From the point of view of price, stability was achieved to some extent at a very high level, but the schemes were unable to prevent wild fluctuations at times, nor did they succeed in preventing price from receding below a crucial level.

(d) It is generally recognised that the organisation and behaviour of producers acting singly or collectively are very important factors in the industry, and consequently deserve detailed analysis; but the actions and reactions on the part of the consumers, which so far have escaped the notice of most students of the tin industry, are also very important. One brief point has been made in paragraph 14 above, regarding the stock-holding policy of U.S.consumers. More detailed analysis of the subject is needed.

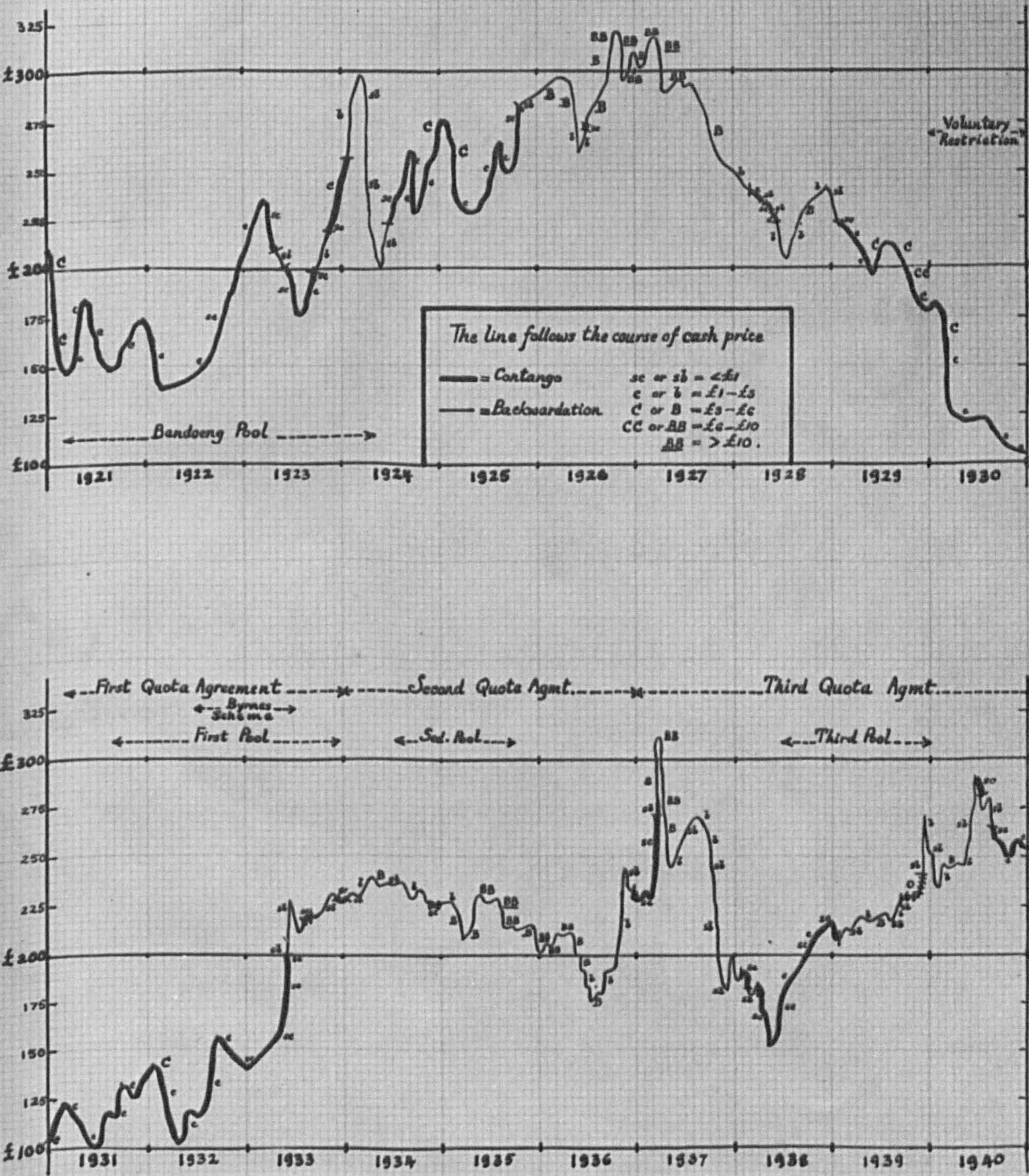
(e) Since international schemes of tin have been in the past a matter of agreement between governments and are likely to be more so in the future, the interests, direct and indirect, of the States in mining and consuming countries, have to be taken into account.

FIGURE I.1.

(end of Chapter I)

# The Price of Tin 1921-1940.

*London – Standard – £ per long ton.*



## CHAPTER II

## CONSUMPTION.

### (A) THE COMMODITY TIN.

1. Like many other commodities, tin, as bought and sold in the market and consumed in manufacture, is not a homogeneous commodity. Generally speaking, the tin metal which is tenderable on contracts in the important markets of the world is above 99% in purity, and is delivered in slabs or ingots of between 28 lbs. and 120 lbs. in weight. Tin thus tenderable is divided, according to its degree of purity, into two big classes within which there are various brands, sometimes designated by the countries where they are smelted and refined. The two classes are:

Class A : degree of purity of 99.75% or above.

Class B : degree of purity less than 99.75%.

Naturally Class A commands a higher price than Class B.

Typical analyses of some well-known brands are given as follows:

Table II.1.

Typical Analyses of Tin.

| | Tin | Antimony. | Arsenic | Lead | Bismuth. | Copper. | Iron | Silver. | Sulphur. | Nickel, Cobalt. |
|---|---|---|---|---|---|---|---|---|---|---|
| Class A | | | | | | | | | | |
| Straits : Eastern Smelting Co. | 99.907 | .003 | .035 | .024 | .009 | .003 | .008 | - | .008 | .003 |
| Straits : Straits Trading Co. | 99.895 | .004 | .031 | .029 | .007 | .025 | .009 | - | - | trace |
| Banka | 99.983 | .0101 | trace | .0001 | - | - | .0064 | - | - | - |
| English : Chempur | 99.9919 | .003 | - | .0027 | .0006 | .0005 | .0013 | - | trace | - |
| Class B | | | | | | | | | | |
| English : Cornish L & F. | 99.180 | .139 | .080 | .440 | .020 | .118 | .008 | - | - | .015 |
| Chinese : Wing Hong No.1. | 99.343 | .031 | .040 | .434 | .007 | .052 | .010 | trace | .011 | .072 (cobalt) |

Source : I.T.R.D.C.

2. Even within Class A, "Straits" tin, both of the Eastern Smelting Company (Penang), and of the Straits Trading Company (Singapore) are the favourite among the consumers, and usually command a premium over the "English Standard", or other brands. Before the war, consumers in the United States used "Straits" for the most important line of consumption, i.e. for making tinplate, as well as for tin foil; English-smelted tin was usually reserved for use in solder, etc. Tinplate manufacturers in Great Britain use "English Standard refined tin", and those in Germany "Banka" and German "Berzelius :Rose Brand".

The preference for "Straits" may be due partly to trade prejudice; but the main reason is a rational one. The effects of impurities are considerable from the point of view of the consumers. For instance, very small quantities of lead and copper soften the metal, whereas the hardness increases when slightly greater quantities of these impurities are added. In fact, hardness, appearance, fluidity and other qualities of tin are affected favourably or unfavourably according to the use for which it is intended, by variations of such impurities as arsenic, iron, antimony, etc. More important still from the economic point of view is the loss to the consumers resulting from drossing which is considerably increased by antimony, copper, bismuth, arsenic, sulphur, zinc and especially iron.

"Straits" tin is not preferred, however, merely because it is purer than other brands. Table II.1 shows that "Straits" tin is only 99.89 or 99.91% pure, which is lower than Banka, Chempur, American Vulcan (99.98%), U.M.H.K.(99.96%), and a few other brands. During 1920/21, the American Smelting and Refining Corporation attempted to put a certain quantity of very pure electrolytic tin onto the markets both sides of the Atlantic, but it was found not to be readily saleable. Endeavours were made by the Dutch Government to popularise "Banka" brand in the U.S.A., pointing out that any difficulties experienced in working with Banka tin were due merely to unfamiliarity with its characteristics, and in particular with its greater fluidity, necessitating somewhat lower melting temperatures. In the words of an American manufacturer, however, "Banka tin did not have a solid casting, and there were slight blow holes in the casting, which, when put into the molten metal, exploded and caused a splashing of the metal and a very great hazard to the workman".....“But, according to the same authority, that difficulty has been overcome." (See Note 1). Although Banka tin and other refined brands are held high in the scale of preferences of the consumers, it is probably true to say, even today, that "Straits" tin still

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Note 1. Evidence of W.A.Irvin, President of U.S.Steel Corporation, N.Y., to the Tin Investigation Sub-Committee of the U.S. House of Representatives Committee on Foreign Affairs on H.Res.404, 73rd Congress,2nd Session and H.Res.71,74th Congress, 1st Session. (1934-35), p.1013 in Tin Investigation (U.S. Government Printing Office, Washington, 1935).

reigns supreme. "Banka" tin, on the other hand, commands a premium over "Straits" on account of its greater purity; but in view of its more limited uses, its output was said to be deliberately restricted in normal years.

## (B) PROPERTIES AND USES OF TIN.

### I Normal Industrial Uses.

3. Tin is used in normal times because of the following properties: (a) resistance to corrosion, (b) low melting point, (c) anti-friction, (d) softness and ductility, (e) toughness when alloyed, (f) appearance, (g) special effects when in chemical compounds. Some of these properties are not clearly separated from each other.

#### (a) Corrosion Resistance.

4. Small quantities of tin added to other metals and alloys remarkably increase their resistance to corrosion. Most acids contained in food, such as vinegar, lime juice, etc. do not affect tin; others are decomposed by it. This property explains why tin is used to coat steel sheets in the manufacture of tinplate, whose main use is in food packing and canning industry. The physical qualities desired in the tinplate are imparted to the steel sheets by the thin skin or filament of tin, which actually forms an alloy with the steel. Beyond a certain required thickness, tin does not actually add to the physical qualities or to the value from the consumer's standpoint The minimum thickness varies with the use forwhich tinplate is intended.

(b) Low-melting point and joining property.

5. Tin fuses at about 232° Centigrade. (See Note 2). This property of tin, together with its ability to join separate pieces of metal or several metals to one another makes it an essential metal in solders. Generally, solders are tin-lead alloys of various combinations according to the purposes. The proportion varies between 30% tin (in Plumbers' Solders) and 95% (in special electrical solders). Eutectic solders, or, as commonly called, Tinman's solders, contain 63% tin, and are used for the making of tin cans. Lead alone does not adhere readily to such metals as iron and copper, and for this purpose, tin is necessary. Moreover, the greater the proportion of lead in a solder, the longer it will take to solidify. The low melting point of the tin-lead alloys enables them to be used to join other metals without risk of melting the latter. Apart from cans, solders are used in the manufacture of engines, radiators, telephone and radio apparatus, generators and for general plumbing purposes etc.

(c) Anti-friction

6. Tin's anti-friction property makes it an essential component in bearing metal, i.e. the metal which bears the friction in machinery. Tin has a capacity of holding a film

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Note 2. Compare with aluminium 660°, copper 1,083°, iron 1,535° nickel 1,452°, lead 327°, zinc 419.4°. Cadmium, tin's closest rival as solder, melts at 321°.

of lubricant on its surface, and at the same time, resisting corrosion by the lubricant. A tin-based bearing-metal helps to avoid "seizure" (see Note 3) during a failure of the lubrication of short duration, because the low melting point of tin allows the bearing metal to fuse rather than to cause "siezure". Its softness and plasticity enables the bearing metal to adhere firmly to the backing or support, and minimise the adverse effect caused by inequalities in the loading.

Bearing metal may be either tin-based or lead-based. A tin-based bearing, commonly called Babbitt is a tin-copper-antimony alloy, copper and antimony serving to give the strength necessary for supporting the load and resisting wear and tear. Normally, Babbitt contains about 89% tin, although in some cases the proportion may be lower. Tin-based bearings are tougher and more costly than lead-based ones, and are consequently used for heavier duty. For lighter tasks, lead-based alloys may be as low as 10% or even lower: the main element being lead which is soft.

(d) Softness and Ductility.

7. The relative softness and ductility of tin, together with its non-toxicity and anti-corrosion properties, enable it to be used in the form of foil for wrapping food, chocolate, cigarettes, etc.; and in the form of collapsible tubes for

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Note 3. A part of a machine "siezes" when it becomes stuck, owing to excessive heat or pressure through a failure of the lubricant.

containing toilet preparations, tooth-paste, ointments, etc.

Although tin is less malleable than gold and silver or copper, it is more so than platinum, lead and zinc. It can be flattened to a thickness of 1/5000 in.; in practice, however, the thickness of tin foil is about 0.0065 in.; 1 lb. of tin makes about 7000 sq. in of foil.

Tin foil is, in general, pure tin leaf containing from 1% to 3% antimony with other impurities not exceeding 0.3%. It was formerly used for the silvering of mirrors. Today, the Chinese are still consuming annually a large quantity of tin foil in the form of ritual papers, as money burned for the dead. Electrical apparatus, e.g. condensers, also contains tin foil.

Collapsible tubes contain up to 4% copper, or up to 3% antimony.

(e) <u>Toughness in Bronze.</u>

8. A copper-tin alloy is commonly known as bronze. Both metals taken separately are soft, but as an alloy, bronze is harder than either element. Ancient bronze contained 88% copper and 12% tin. Much of modern bronze is 88% copper, 10% tin and 2% zinc.

Bronzes with high tin content can be cold-worked and wrought; low-tin bronzes are suitable for the production of castings of all kinds.

The following are some of the uses of tin-copper alloys:

Bell Metal : 20% tin + 80% copper.

Gun Metal : 10% tin + 88% copper + 2% zinc.

'Phosphor' bronze : 10% tin + 89% copper + 1% phosphorus (used for pump plungers, valves and the bushes of bearings)

British copper coins : 4% tin + 95% copper + 1% zinc.

Gun metal alloys are used for castings of high strength and resistance to corrosion. Bronze containing up to 33% tin is used chiefly in the production of certain types of telescopes. A cast bronze, composed of a solid solution of tin dissolved in copper, is said to be the ideal bearing structure as well as an excellent material for gearing.

(f) <u>Appearance</u>.

9. An ingot of pure tin is silvery-white, exhibiting considerable lustre, and is not subject to tarnishing on exposure to normal air. This quality is responsible for the widespread use of tin in various forms of consumers' goods, especially for decorative purposes. Britannia metal, used for spoons, forks, teapots, etc., is a tin-antimony alloy. Pewter was originally a tin-lead alloy; but the latter metal is no longer used, owing to the risk of its contaminating food; nowadays pewter consists nearly entirely of tin, a small amount of antimony and copper; the latter being added to it in order to strengthen the metal. A large number of small metallic articles, such as lighting fixtures, buckles, buttons, etc., are tinned so as to improve their appearance.

(g) Special effects in chemical compounds.

10. In the form of chemical compounds, tin is used for various purposes in manufacture, some of which are mentioned here:

Tin oxide : an opacifying agent in the manufacture of white glazes and enamels, presenting a white surface covering on the off-colour ware.

Tin chloride : a mordant for dyeing and bleaching textile goods, and in treating natural and artificial silk to make it rustle and to increase its weight.

Tin oleate : useful as lubricating oils.

Other tin chemical compounds have pharmaceutical uses.

(h) Other uses.

11. Of the other common uses not yet mentioned, the following can be added:

Terneplate : which is a steel sheet, coated with an alloy of tin and lead (1 : 3), instead of pure tin as in the case of tinplate. Terneplate is used largely for roofing, for gasoline tanks on automobiles, in the construction of metal furniture and cabinets, and some is substituted for tinplate in non-food containers.

Printing metal : which is an alloy of lead (50% - 88%) + antimony (10% - 33%) and tin (2% - 20%). The function of lead is to constitute the body of the type, tin to confer fluidity and toughness; antimony to confer hardness and the expansiveness necessary to obtain sharp-faced types.

Galvanized iron-sheet : about 0.5% of tin, (the rest being zinc) is used for this purpose in order to give the surface of the sheets an extra-brightness.

Electric Copper-wire: Tin is used to coat electric copper wire, where the latter is to be insulated with rubber compound, in order to prevent its contamination by the sulphur of the insulation - electrical properties of copper being affected by sulphur.

II General Characteristic.

12. The general characteristic of the uses of tin is that in almost every line of consumption, the cost of tin forms a very small fraction of the total cost or price of the final, or semi-final products. The possible exception is tinfoil, which is more or less pure tin, but even in this case, the proportion in cost between tin and the final product including the food wrapped may be very small. The following table is an illustration of this fact: the price of tin being taken at £470 per ton as in mid-1947, which date is also used for the prices of the final products. The proportion of tin entering into each case is according to the pre-war normal practice. It is to be noticed that where the proportion of tin cost is high, the products in which tin is incorporated, namely solder, and bronze are only semi-finished goods.

Table II.2

Value of Tin as Percentage of the Value of the Products in which it is Incorporated.

| I<br>Uses | II<br>Cost of Tin. | III<br>Finished or Semi-finished goods and their prices. | IV<br>II as % of III |
|---|---|---|---|
| Hot-dipped tinplate. | 0.156d.per can | Canned food : 10d. - 2s.6d. | $1\frac{1}{2}$% - 0.5% |
| Solder(Plumbers') (2 lead :1 tin) | 1s.1d.per lb. | Solder 1s.6d.per lb. | 72% |
| Bronze(10% tin) | £46 :13 :4d.per ton. | £152 per ton. | 31% |
| Motor car | 13s.6d.per car | £350 to £3,000 per car. | <0.2% |
| Collapsible tubes (size 5in.x 1in. diameter). | $1\frac{1}{2}$d.per tube. | Tooth paste : 1s.6d. | 7% |

III Tin as a Strategic Material.

13. In modern warfare, nearly everything can be called strategic raw-material ; but tin is one of the materials which have direct uses in warfare. Moreover, U.S.A., the chief consuming country depends entirely upon imports for her tin supply. A report on Tin Investigation by a sub-committee of the U.S.House of Representatives Committee on Foreign Affairs in 1934-1935, listed, as the specific uses for the metal, 36 items for the Army and 20 others for the Navy, ranging from machine guns to forks and spoons, from tanks to buckets, from bomb fuzes to bomb cases, and added :

"it will be recognised at once that while there are comprised in the above list certain specific uses for the metal peculiar to the War and Navy Departments, its actual use in national defence during time of war will include all of the major uses set forth under the industrial applications of this material. For examples, tinplate, as represented by tin cans and other containers, is a primary necessity for the feeding and supply of troops, while bearing metals, solders and practically all other industrial applications are either directly included in military and naval equipment or are incident to the manufacture thereof. For these reasons it is evident that in all of its major fields of usefulness, tin should be classed as one of the most important commodities in the scheme of national defense...." (See Note 2.)

In practice, in 1940, the U.S.Army and Navy Munitions Board included tin among the 14 commodities listed as "strategic materials", defined as vital for defence and obtainable generally from beyond the territorial boundaries of the United States - as distinct from "critical materials", 15 in number, which were held to present less intractable supply problems. These definitions were replaced in March, 1944, by an announcement by the U.S.Army & Navy Munitions Board: "Strategic and critical materials are those materials required for essential uses in a war emergency, the procurement of which in adequate quantities, quality and time, is sufficiently uncertain for any reason to require prior provision for the supply thereof."

Tin was thus one of the first seven minerals and metals designated by the U.S.Metals Reserve Company for stockpiling and ranked second in relative cost of deliveries to the M.R.C., amounting to over $211,500,000.

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<u>Note 4.</u> U.S.Tin Investigation: op.cit.p.13.

At the end of the war, the M.R.C.held 53,500 long tons of pig virgin tin on 30th September,1945. This stockpile became 55,600 long tons on 1st June,1946.

In July 1946, U.S.Congress passed the Strategic and Critical Materials Stockpiling Act which received the Presidential assent at the end of the month, allowing the Secretaries of War and of the Navy through the Procurement Division of the Treasury to "make purchases of strategic and critical materials ....and to provide for their storage, security and maintenance for stockpiling purposes....which purchases shall be made, so far as is practicable from supplies of materials in excess of the current industrial demand...." The money appropriated for the first year ending 30th June 1947 for the purchase of all strategic materials stockpiled, amounted to $100 million.

At the end of 1947, the reserve stocks of the U.S. Navy and U.S.Treasury, not available for industrial allocation were 12,140 tons of pig tin.

14. What has been said above concerning the strategic significance of tin for the United States of America can be applied to all major consuming countries. The main difference in emphasis is due to (a) the greater importance of the U.S.A. as a consuming country, and (b) the non-availability of tin in the U.S.itself. From this last point of view, U.K. and U.S.S.R. to some extent, are in a slightly different position, but none of the major consuming countries is self-sufficient, as far as tin ore is concerned.

## (C) QUANTITATIVE ANALYSIS OF THE INTER-WAR CONSUMPTION BY USES.

### I World Consumption.

15. The relative importance of the various uses of tin is indicated in Table II.3, which gives the estimated actual (See Note 5) world consumption of tin. The figures are no more than estimates, since exact figures are not available. For the purpose of comparison, the margins of error in the absolute figures should cancel out, and the figures appear to be consistent with the production of tinplate, solders, babbitt, etc. Moreover, the trend of consumption as shown in this table for the world as a whole for particular uses is confirmed by Table II.6 for the United States, which is more complete, with a smaller margin of error. Nevertheless, within these limits of reliability, the data used here, and the results of the analysis thereof, are to be treated as tentative, subject to the circumstantial confirmation of the investigation in subsequent paragraphs.

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Note 5 as distinct from (1) deliveries which are the quantities sold and (2) apparent consumption which is calculated from production + net import ± change in stocks. These two items normally appear in trade statistics.

Table II.3

World Tin Consumption by Uses (1927-1936)

(Estimated by the I.T.R.D.C.)

('000 long tons of virgin tin)

| | Tin-plate | Solder | Babbitt | Bronze | Foil | Collapsible Tubes | Chemicals. | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1927 | 40.3 | 32.0 | 20.0 | 12.0 | 10.0 | 7.0 | 8.5 | 24.2 | 154.4 |
| 1928 | 44.2 | 32.0 | 21.0 | 13.0 | 12.0 | 8.0 | 10.8 | 26.0 | 167.0 |
| 1929 | 47.5 | 34.0 | 23.0 | 14.0 | 12.0 | 9.5 | 11.0 | 29.0 | 180.0 |
| 1930 | 45.1 | 31.0 | 19.0 | 11.0 | 8.7 | 9.9 | 9.0 | 26.3 | 160.0 |
| 1931 | 41.9 | 23.0 | 13.0 | 9.7 | 7.5 | 9.0 | 7.3 | 21.6 | 133.0 |
| 1932 | 35.6 | 17.0 | 11.0 | 8.1 | 6.2 | 8.4 | 5.2 | 19.5 | 111.0 |
| 1933 | 50.0 | 21.0 | 12.0 | 9.2 | 6.3 | 9.8 | 5.9 | 21.8 | 136.0 |
| 1934 | 47.0 | 22.0 | 12.0 | 8.6 | 5.8 | 9.6 | 5.0 | 21.0 | 131.0 |
| 1935 | 52.0 | 30.0 | 14.0 | 9.9 | 5.9 | 10.5 | 5.5 | 23.2 | 151.0 |
| 1936 | 61.0 | 31.0 | 15.0 | 11.0 | 5.5 | 11.6 | 5.2 | 22.7 | 163.0 |

source : I.T.R.D.C.Yearbook : 1937 :Tinplate 69,000 tons
Total 176,000 "
1938 :Tinplate 46,000 tons
Total 145,000. "

16. The following points emerge from the figures and may be considered valid for the period from 1927 up to the beginning of the war :

(a) The trend in total world consumption of tin, allowing for cyclical fluctuations, is roughly stationary, with a slight decline. The 1937 peak compares slightly unfavourably with the 1929 peak (17,600 tons compared with 18,000 tons). The same is true of 1938, compared with 1930; 1936 with 1928 etc.

(b) The cyclical fluctuation of consumption as measured by the ratio between the 1929 peak and the 1932 trough is 1.5 : 1.0. This range of fluctuation, however, is smaller than that of deliveries, which is roughly 2 : 1. This latter consideration is more relevant with respect to the market and price.

(c) During the period, tinplate, solder and babbitt retained the first three places in order of importance. Bronze, fourth place until the depression, lost its place in 1932 to collapsible tubes, which at the beginning of the period were the least important single users of tin in the classification. Foil and chemicals also suffered a severe decline.

The position can be summed up as follows: Allowing for cyclical fluctuations, the following forms of consumption showed an upward trend:

Tinplate : 1936-1928 = +16,800 tons or +38% of 1928;

Collapsible Tubes : 1936-1928 = + 3,600 tons or +45% of 1928;

and the following forms of consumption showed a downward trend:

Foil : -6,500 tons or -54% of 1928
Chemicals : -5,600 tons or -52% of 1928
Babbitt : -6,000 tons or -28% of 1928
Bronze : -2,000 tons or -15% of 1928.
Solder : -1,000 tons or -3% of 1928.

(d) Among the various users of tin, some are more subject to cyclical fluctuations than others. A rough indication of the cyclical sensitivity of each use is obtained by taking the 1929 peak and the 1932 trough, the latter figures being adjusted to allow for the trend of consumption which is assumed to be at a constant rate over the period 1928 - 1936. Abstracting for the moment from the price-elasticity of demand, we obtain the following results:

Table II.4

Cyclical Sensitivity of Consumption in Various Uses.

(data based on Table II.3)

| Uses | Consumption '000 tons 1929 I | 1932 (adjusted) II | Range I - II | Ratio II : I | Order of Sensitivity |
|---|---|---|---|---|---|
| Tinplate | 47.5 | 29.3 | 18.2 | 1 : 1.6 | (3) |
| Solder | 34.0 | 17.4 | 16.6 | 1 : 2.0 | (1) |
| Babbitt | 23.0 | 13.25 | 9.75 | 1 : 1.7 | (2) |
| Coll.Tubes | 9.5 | 7.0 | 2.5 | 1 : 1.3 | (7) |
| Bronze | 14.0 | 8.85 | 5.15 | 1 : 1.58 | (4) |
| Foil | 12.0 | 8.6 | 3.4 | 1 : 1.4 | (6) |
| Chemicals | 11.0 | 7.3 | 2.7 | 1 : 1.51 | (5) |

17. The characteristics of world tin consumption in various uses during the period 1927 to 1936 can now be restated and summarised in Table II.5:

Table II.5

Characteristics of World Consumption
by Uses.

| | Importance % of total | | Trend : Average Annual Change ('000 tons) | Cyclical Fluctuations. | |
|---|---|---|---|---|---|
| | 1927 | 1936 | | Range. Absolute quantities ('000 tons). | Ratio trough :peak. |
| Tinplate | 26% | 37% | +2.10 | 18 | 1 : 1.6 |
| Solder | 21% | 19% | -0.10 | 17 | 1 : 2.0 |
| Babbitt | 13% | 9% | -0.75 | 10 | 1 : 1.7 |
| Coll.Tubes | 4.5% | 7% | +0.45 | 2.5 | 1 : 1.3 |
| Bronze | 8% | 7% | -0.25 | 5 | 1 : 1.58 |
| Foil | 6.5% | 3% | -0.80 | 3.4 | 1 : 1.4 |
| Chemicals | 5.5% | 3% | -0.70 | 2.7 | 1 : 1.5 |

The summarised characteristics of the uses of tin in the Table are supported by inductive and deductive reasoning based on the technological considerations in each line. During the 1930's, the use of canned food became more popularised, reinforced in 1933 by the introduction of tin cans for automobile oil, (See Note 6) and in 1935 by the introduction of beer canning. The trend of tinplate production was accordingly an upward one. Since tin is used in cans for its non-toxicity,

Note 6 Petroleum Companies began to retail their automobile oils in tin cans to protect consumers against fraudulent substitution of lower grades of oil. See Minerals Yearbook : (U.S. Bureau of Mines) 1935, p.512.

anti-corrosion and appearance, substitutes were not readily available, and since canned goods belong to the semi-luxury category, the consumption is moderately unstable in relation to the trade cycle.

In solder and babbitt, tin has few comparatively good substitutes. Unless the price of tin is exceedingly high, or shortage serious, the most which will be done is to vary the proportion of tin in the alloy. In both cases, the limits within which the variation can be technically achieved are narrow. It is, nevertheless, this unfavourable variation in the technical coefficient of tin which is responsible for the downward trend of tin consumption in these particular cases. Moreover both solder and babbitt are used in the construction industry or in the production of machinery and capital or durable consumers' goods; their consumption accordingly is highly sensitive to the business cycle. The same applies to bronze to a somewhat smaller degree.

The contrast in the trends of tin consumption between foil and collapsible tubes is outstanding, and is due to the fact that tin foil has ready substitutes and belongs to the 'fancy goods' category, whereas the use of collapsible tubes was increasingly popular, as well as protected from substitutes by the non-toxicity of tin. Both foil and tubes being used in consumption goods, the fluctuation in consumption according to the business activity is, therefore, not very large.

The use of tin in chemicals suffered both a downward trend and a moderate degree of fluctuation, being vulnerable to substitutes and at the same time employed as producers' goods.

II. U.S.A.Consumption.

18. Statistics of tin consumption, sub-divided into various forms of use are available only for the U.S.A.covering the period before the war. In the U.K. a start was only made in 1942 by the Ministry of Supply to break up the figures into various uses.

In the U.S.A., there are two sources of information as to the figures of consumption, the American Bureau of Metal Statistics, and the U.S.Bureau of Mines. The A.B.M.S.'s data cover most of the period between the wars, but the figures refer only to the consumption of virgin tin. As far as tinplate, foil and collapsible tubes are concerned, this would not make any substantial difference, since secondary tin consumed in these forms is negligible. But the exclusion of secondary tin would distort the picture for terneplate, solder, babbitt, bronze, and especially chemicals. Before the war, the following percentages of virgin tin have to be added for secondary tin: 200-300% for terneplate; 70-80% for solder; 25-50% for babbitt; 70-95% for bronze; 60-80% for tin oxide and 200%to 800% for other tin chemicals. Moreover, in the A.B.M.S. reports, bronze and brass, collapsible tubes and foil are presented under one heading, which is not sufficient for our purpose.

The Bureau of Mines figures include secondary tin consumption and the division of uses meets with the requirement of our analysis. However, before 1935, reports were made only at intervals of several years :for 1925, 1927, 1928 and 1930. From 1935 onwards, figures are available for every year.

In Table II.6, the figures represent the consumption of both secondary and primary tin. Those for 1928 and 1935-1938 are from the Bureau of Mines. Figures for 1929 and 1932 are based on the figures of the A.B.M.S., and include a large element of estimates:

Table II.6

Consumption of Tin in the U.S.A.by Uses.

(long tons of primary and secondary tin)

| | Tin & Terne-plate | Solder | Babbitt | Coll. Tubes | Bronze and Brass | Foil | Chemi-cals | Total |
|---|---|---|---|---|---|---|---|---|
| 1928 | 27,913 | 18,394 | 10,339 | 2,864 | 5,436 | 5,068 | 5,331 | 86,475 |
| 1929 | 30,100 | 24,800 | 12,600 | | 15,000 | | ? | 95,000 |
| 1932 | 17,000 | 10,000 | 4,000 | | 9,500 | | ? | 48,500 |
| 1935 | 28,354 | 16,644 | 5,152 | 3,548 | 4,630 | 1,629 | 4,520 | 71,173 |
| 1936 | 35,062 | 18,750 | 6,679 | 3,556 | 6,190 | 1,688 | 2,885 | 83,050 |
| 1937 | 40,618 | 19,858 | 6,773 | 3,571 | 6,496 | 1,460 | 2,706 | 90,130 |
| 1938 | 24,552 | 12,798 | 4,157 | 3,427 | 3,932 | 879 | 2,067 | 58,275 |

The pattern of consumption in the U.S.A. appears to be as follows:

(a) order of importance : tin and terneplate (c.40%), solder, babbitt, bronze and brass, collapsible tubes, chemicals and foil.

(b) trend : upward : tinplate, collapsible tubes (stationary in the late 1930's), bronze and brass (stimulated in the late 1930's by war preparations)

trend : downward : decline more than 50% : foil, chemicals, babbitt; decline less than 50% : solder.

(c) Cyclical sensitiveness cannot be assessed from the statistics; the following order appears to be a reasonable approximation :

babbitt, solder, tinplate, bronze, chemicals, foil, collapsible tubes.

## (D) MAJOR CONSUMING INDUSTRIES.

19. Among the industries consuming tin are: tinplate and food canning, automobile, machinery, railway, building, electricity, aeroplane, refrigerator, radio, cigarette, cosmetic, silk, pewter etc. Statistics of tin consumption are lacking in most individual industries, except for tinplate in several countries. Figures in Table II.7 for tin used in the automobile industry are estimates made by the I.T.R.D.C.

For the world as a whole, the tinplate and automobile industries consumed respectively about 26%-40% and 6%-10% of total consumption, making a total of 37%-50% for the two. For the United States, the figures are : tinplate 33%-53%; automobile 11%-20%; making together 52%-68% of the total consumption of tin by the U.S.A.

## Table II.7

## Tin Consumption in Tinplate and Automobile Industries

(mostly estimated)

| | WORLD(1) | | | | | U.S.A. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total consum-ption (long tons) | Tinplate (long tons) | Tinplate % | Automobile (long tons | Automobile % | Total(2) consum-ption (long tons) | Tinplate (3) (long tons) | Tinplate (3) % | Automobile (1) (long tons) | Automobile (1) % | |
| 1923 | 125,500 | | | 15,000 | 12.0 | 67,900 | 24,700 | 36.4 | 13,000 | 19.2 | 1923 |
| 1924 | 133,000 | | | 15,000 | 11.3 | 64,300 | 22,500 | 35.0 | 13,000 | 20.2 | 1924 |
| 1925 | 150,900 | | | 17,000 | 11.3 | 75,900 | 26,000 | 34.2 | 15,000 | 19.8 | 1925 |
| 1926 | 138,300 | | | 18,000 | 13.0 | 75,500 | 27,100 | 35.9 | 16,000 | 21.2 | 1926 |
| 1927 | 154,000 | 40,300 | 26.0 | 16,000 | 10.4 | 72,600 | 24,200 | 33.3 | 13,500 | 18.6 | 1927 |
| 1928 | 167,000 | 44,200 | 26.5 | 18,000 | 10.8 | 79,600 | 26,600 | 33.4 | 15,200 | 19.1 | 1928 |
| 1929 | 180,000 | 47,500 | 26.4 | 19,500 | 10.8 | 87,000 | 28,600 | 32.9 | 16,700 | 19.2 | 1929 |
| 1930 | 160,000 | 45,100 | 28.2 | 15,000 | 9.4 | 71,600 | 26,800 | 37.4 | 12,000 | 16.8 | 1930 |
| 1931 | 133,000 | 41,900 | 30.8 | 10,000 | 7.5 | 55,800 | 23,300 | 41.8 | 8,000 | 14.7 | 1931 |
| 1932 | 111,000 | 35,600 | 32.0 | 6,500 | 5.8 | 40,600 | 16,100 | 39.7 | 5,000 | 12.3 | 1932 |
| 1933 | 136,000 | 50,000 | 36.7 | 9,000 | 6.6 | 61,060 | 28,910 | 47.3 | 7,000 | 11.5 | 1933 |
| 1934 | 131,000 | 47,000 | 35.9 | 11,000 | 8.4 | 53,280 | 25,100 | 46.9 | 8,000 | 15.0 | 1934 |
| 1935 | 151,000 | 52,000 | 34.4 | 12,000 | 7.9 | 61,900 | 28,900 | 46.8 | 9,000 | 14.5 | 1935 |
| 1936 | 163,000 | 61,000 | 37.4 | 14,000 | 8.6 | 74,000 | 35,400 | 47.9 | 11,000 | 14.9 | 1936 |
| 1937 | 176,000 | 69,000 | 39.2 | 16,000 | 9.1 | 78,200 | 41,000 | 52.5 | 12,000 | 15.4 | 1937 |
| 1938 | 145,000 | 46,000 | 31.3 | 12,000 | 8.3 | 50,600 | 24,300 | 48.0 | 8,000 | 15,8 | 1938 |

Sources : (1) ITRDC (International Tin Research & Development Council)
(2) Up to 1926 :ITRDC apparent consumption. From 1927 : ABMS: virgin tin
(3) ABMS(American Bureau of Metal Statistics)

It has been shown in Section (C) that tin consumption by the tinplate industry during the period under consideration showed a steady increasing trend, and a moderate cyclical-sensitivity. The consumption of tin by the automobile industry, on the other hand, is shown by Table II.7 to be declining both absolutely and relatively, and was more fluctuating in accordance with industrial activity.

I Tin-plate Industry. (See Note 7)

20. Tinplate is a steel sheet coated with a thin layer of tin on both faces. The steel used is 'mild', of low carbon content. The proportion by weight of tin in tinplate of the grade which was commonly used before the war varied between 1½% and 1¾% - i.e. a ton of tinplate contained approximately 30 lb. of tin. Reckoned in terms of value in the late 1930's, when tinplate price was just over $100.00 per ton, the value of the tin incorporated in a ton of tinplate was about $1.50, or about 1½% of the tinplate value.

The trade in tinplate is, in common with other commodities, full of jargon and ways of reckoning, and symbols peculiar to the trade. The following is a much simplified description of the commodity.

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Note 7. The technological description of tinplate manufacture in this section is a very simplified version of that set out in various technical books and periodicals. W.E.Hoare and E.S.Hedges' Tin Plate (Edward Arnold - London, 1945) has been very heavily drawn upon.

Tinplate is sold in basis boxes. (See Note 8). The basis box is a unit of area of 31,360 sq.in.of tinplate. The weight of a basis box varies between 50 lbs. and 256 lbs. according to the thickness of the plate; but the standard weight, used as the unit of commerce, against which contracts are made and market prices quoted, is 108 lbs. basis in the U.K. (107 lbs. base U.S.A.). This is represented by the basic index IC, called "common substance".

The thickness of IC tinplate is about 0.0120 in. The thickness of tin in tinplate varied before the war between 0.00008 in. and 0.0004 in., according to the class to which the tinplate belonged. However, the tin content of tinplate, or "tin yield", is usually expressed as so many pounds of tin per basis box. (See Note 9). It is generally accepted that one pound per basis box is equivalent to 0.0000606 in. thickness of tin on each face of tinplate.

As will be seen in the next paragraph, tin coating in tinplate can be done either by the older method of hot-dipping, or by the newer method of electroplating. In the hot-dip process, it is not easy to keep the coating thickness consistently below 1 lb. per basis box, whereas electro-deposition can make the coatings thinner or thicker according to the service required of the material.

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Note 8. "Basis Box" is the term used in U.K; in the U.S. it is "base box".

Note 9. This applies to the U.S.and U.K.; on the European continent, it is expressed as grammes of tin per sq.metre of tinplate.

In hot-dipped tinplate, the thickness of the tin coating is indicated by the use of terms such as "coke", "charcoal" , etc. The term "charcoal tinplate" is applied to material carrying a heavier tin coating than the more widely-used "coke" grades. The average tin yield of each grade, per basis box, is as follows:

| | |
|---|---|
| Standard Coke | 1 - $1\frac{1}{2}$ lb. |
| Best coke | $1\frac{1}{2}$ - $1\frac{3}{4}$ lb. |
| Kanners Special | $1\frac{3}{4}$ lb. |
| Common Charcoal | 2 lb. |
| Ordinary Charcoal | $2\frac{1}{2}$ - $2\frac{3}{4}$ lb. |
| Best Charcoal | $>3$ lb. |
| Special Charcoal ) | very heavy coating |
| Premier Charcoal ) | (about 7 lb.) |

Electro-tinplate is not necessarily thinly coated, but during the second World War, when the shortage of tin dictated an economy in the use of tin, it was found that 8 oz. tin coatings could be consistently produced by the electrolytic process, which was not possible by the hot-dipping method. An 8 oz. electro-tinplate, however, cannot be expected to behave as a generally satisfactory substitute for $1\frac{1}{4}$ lb. hot-dipped tinplate. Unless the productive technique improves in the future, electro-tinned or hot-tinned coatings are approximately equal in protective effect on the steel, provided they are of the same thickness. In other words, the amount of rusting after outdoor exposure, has been found to depend upon the thickness of tin rather than on the method of tinning. The important point lies in the fact that it is now possible, by the electrolytic process, to reduce the minimum tin-yield by half, making the cost of tin embodied in tinplate $0.75 instead of $1.50 as before.

21. The manufacture of tinplate can be divided into two stages: the preparation of the steel base, and the tinning or coating of the plate.

The steel can be prepared either by the hot-pack process or by the newer method of continuous cold-reduction process. In the hot-pack process, comparatively small ingots of steel are used, and the end-products are separate steel sheets; whilst in the cold-reduction process, heavy slabs are rolled down to finished tinplate gauge in the form of a continuous coiled wide strip. The cold-reduction process was introduced in 1928; it was soon found capable of producing, with little labour, sheet steel of superior physical properties to that laboriously produced by the older method, particularly with respect to uniformity of gauge and ability to stand deep drawing. Direct labour costs have been reduced sharply, but the outlay required for the new equipment has been very great. From 0.2% in 1929, the proportion of tinplate sheet produced by the cold-reduction process had risen to 58% in 1938 and in 1943 to 99.5% of the total. In 1943, the last of the hot-rolling mills in the U.S.A. ceased operation and the plant was dismantled.

The coating operation can be done by hot-dipping or by electrolysis. In the hot-dipping method, the sheets are conducted by means of rollers, through a layer of flux into the tin contained in a large vessel called the tin pot, out through a thick layer of grease (palm oil), and then cleaned. The steel plate to be tinned must be in sheets, not in coiled strip, as continuous hot-tinning of strip has not been found practicable, except on relatively narrow widths. The steel-base produced by cold-reduction process has therefore to be cut up in sheets for dipping.

Not so with the electrolysis process, which is adaptable to coating wide strip in continuous length. The principle is the same as that in ordinary galvanising. The choice of the bath is influenced by plant considerations such as installation costs, power demands, and heating requirements; by questions relative to the types of basis material available, whether strip or sheet, hot-rolled or cold-rolled, etc. Electrotinplate, as deposited, has a smooth matt surface, which is generally less attractive than the bright appearance of hot-dipped tinplate; but the appearance can be improved by imparting a satin-finish by scratch-brushing with nickel-silver wire brush burnishers, or a lustrous finish can be obtained by momentarily melting the electro-deposited tin coating.

22. Although development of the technique of electro-plating was started some years before the second World War, and

completed just before the war, the actual operation on a commercial scale was begun in 1942 in the U.S.A., partly because of the desire to economise tin. At the time of writing, the improvement in the process has not reached perfection, and experimental work is still in progress. It has been found that thinly coated material is quite unsuitable for making plain cans for most foodstuffs, as the rate of corrosion both outside and inside the can is too high. For a number of foodstuffs such as beans, peas, corn, meat and some marine foods, lacquered electrolytic plate carrying 8 oz. of tin is satisfactory; but it is not quite good enough for mildly corrosive fruits and vegetables, because it becomes corroded locally at discontinuities in the lacquer and eventually the cans perforate. A move has been made to increase the tin-coating thickness to ¾ lb. per basis box, and it is probable that, unless research becomes more successful, the thickness will be further increased - when tin becomes more plentiful - though still below the hot-dipped tin content. At the same time, when tin is again plentiful, 8 oz. or even thinner coatings will doubtless find their own markets, particularly as they afford a solderable steel, and one which can be stored for long periods in reasonably dry air without rusting. Considering that electrolysis has been more and more adopted by producers, as will be seen below, the amount of tin required by the tinplate industry as a whole is likely to suffer a reduction in the short run; but in the long run, with the more widespread use of solderable thinly tin-coated steel, the amount of tin required may be expanded.

It is impossible as yet to compare the costs of production of electrolytic tinplate with that of hot-dipped tinplate, as the former are said to be a closely guarded secret. The general impression is that the most economical point of production in electrolytic tinplate has not yet been reached, and is not likely to be until the availability of metallic tin permits wider expansion in uses.

Electrotinplate must not be regarded as a mere emergency substitute for hot-dipped plate. The process has become more and more popular with the producers because it is more suitable for coating wide coiled strip of continuous cold-reduction steel, and also because it permits the coating to be regulated to any desired thickness. Started in 1942, the process has been adopted so widely that by 1947, in the U.S.A., every maker of tinplate makes both electrolytic and hot-dipped plate. A large sum of money has been invested in electrolytic lines; and the Welsh tinplate mills have already decided to adopt the technique: a large electrolysis plant being in the course of erection in the works of Richard Thomas and Baldwin in South Wales (in the middle of 1947). The following table showw the progress of electrolytic process in the U.S.A.:

Table II.8

Growth of Electro-tinplating in the U.S.A.

| | Hot-dipped Tons('000) | % | Electrolytic Tons('000) | % |
|---|---|---|---|---|
| 1940 .. .. .. | 2,445 | 100 | - | - |
| 1941 .. .. .. | 3,133 | 100 | - | - |
| 1942 .. .. .. | 2,361 | 96.7 | 74 | 3.3 |
| 1943 .. .. .. | 1,634 | 83.7 | 294 | 16.3 |
| 1944 .. .. .. | 1,786 | 73.4 | 578 | 26.6 |
| 1945 .. .. .. | 1,745 | 66.4 | 769 | 33.6 |
| 1946 .. .. .. | 1,616 | 64.3 | 797 | 35.7 |
| 1947 .. .. .. | 1,869 | 53.5 | 1,444 | 46.5 |

Source: International Tin Study Group

23. Tinplate manufacture as understood today was founded in the early Middle Ages in Bohemia. The secret was guarded by Bohemia until the XVI$^{th}$ century, when the industry was started in Saxony with Dresden as its centre. In the XVII$^{th}$ century, France tried to consolidate the industry; but a definite measure of success was not obtained until 1714. As for England, in 1575 block tin was being exported from Cornwall into Germany for the manufacture of tinplate. Until 1730, most of the tinplate came to England from Germany via the Elbe and Hamburg. In 1750, there were four tinplate works in Great Britain. The number had risen to 11 in 1800, and a century later was about 90. In the U.S.A., tinplate was first

manufactured in the second half of the XIXth century, and it was not until 1890 that tinplate manufacture began to grow in the U.S.A. under the protective McKinley Tariff. Japanese production began as late as 1925, but by 1939, Japan became the fourth biggest producing country, after U.S.A., U.K. and Germany.

## Table II.9

### Production and (Gross) Exports of Tinplate (inc. Terneplate) from Principal Exporting Countries.

(thousands of long tons)

| | U.S.A. | | U.K. | | Germany. | | France | | Japan = | Italy ø | World |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pdn. | Exp. | Pdn. | Exp. | Pdn. | Exp. | Pdn. | Exp. | Pdn. | Exp. | Pdn. |
| 1900 | 303 | - | 500 | n.a. | 30 | - | n.a. | - | - | - | 900 |
| 1910 | 723 | 12 | 777 | 483 | 56 | - | 40 | - | - | - | 1,640 |
| 1920 | 1446 | 226 | 608 | 349 | 30 | - | 21 | - | - | | 2,160 |
| 1921 | 794 | 108 | 297 | 225 | 54 | - | 16 | - | - | | 1,200 |
| 1922 | 1288 | 77 | 673 | 445 | 72 | - | 39 | - | - | | 2,121 |
| 1923 | 1507 | 124 | 727 | 546 | 43 | - | 49 | - | - | | 2,384 |
| 1924 | 1419 | 161 | 850 | 551 | 85 | - | 69 | - | - | | 2,492 |
| 1925 | 1658 | 161 | 767 | 508 | 90 | 10 | 82 | 15 | 6 | negligible | 2,706 |
| 1926 | 1782 | 251 | 571 | 371 | 99 | 20 | 83 | 21 | 11 | | 2,656 |
| 1927 | 1688 | 254 | 750 | 467 | 126 | 29 | 80 | 28 | 14 | | 2,805 |
| 1928 | 1839 | 250 | 817 | 529 | 133 | 34 | 100 | 23 | 16 | | 3,054 |
| 1929 | 1968 | 259 | 880 | 575 | 142 | 30 | 105 | 30 | 18 | | 3,259 |
| 1930 | 1763 | 217 | 814 | 505 | 124 | 37 | 104 | 25 | 22 | | 3,000 |
| 1931 | 1459 | 84 | 717 | 397 | 147 | 66 | 103 | 34 | 27 | 2.8 | 2,694 |
| 1932 | 1032 | 40 | 746 | 459 | 139 | 80 | 97 | 30 | 33 | 8.0 | 2,287 |
| 1933 | 1769 | 95 | 767 | 447 | 204 | 126 | 132 | 38 | 35 | 23.9 | 3,147 |
| 1934 | 1603 | 185 | 748 | 378 | 225 | 132 | 148 | 63 | 61 | 30.0 | 3,062 |
| 1935 | 1916 | 135 | 708 | 336 | 242 | 125 | 109 | 35 | 93 | 30.6 | 3,373 |
| 1936 | 2335 | 239 | 814 | 358 | 236 | 120 | 120 | 14 | 136 | 9.8 | 3,953 |
| 1937 | 2779 | 359 | 958 | 444 | 263 | 135 | 121 | 8 | 180* | 21.7 | 4,625* |
| 1938 | 1696 | 162 | 610 | 324 | 243 | 118 | 129 | 24 | 180* | 19.5 | 3,233* |
| 1939 | 2617 | 311 | 870* | 331 | 270* | ? | 145* | ? | 180* | ? | 4,500* |
| 1946 | 2414 | 356 | 439 | 118 | | | 47 | | | | 3,056* |

For sources and notes: see next page.

Notes to Table II.9

Sources : I.T.R.D.C. and Tin Study Group.
* = estimated
※ = no export from Japan.
ϕ = Italy's production figures not published.
n.a. = not available.

Although the U.S.A. is the biggest producing country, she exports only 10-15% of her output, whereas the U.K., second highest producer since before the first World War, was the biggest exporter (before the second World War), her export being 40-60% of her output. Among the smaller producers, the following countries were relatively important exporters in 1938. Czechoslovakia 2,254 tons, Italy 19,503 tons, Norway about 2,000 tons. On the other hand, Japan and India which were relatively big producers had negligible gross exports, which were far smaller than imports.

24. Modern tinplate manufacture involves a heavy capital investment in the form of plant and machinery, apart from the technical knowledge which were thought at one time to be the monopolistic secret of Bohemia, Saxony and more recently Wales. Heavy capitalisation, to some extent, leads to the association among Welsh producers. In the U.S.A., the McKinley Tariff favoured a combination within the tinplate industry from the start. (See Note 10).

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Note 10. See, e.g., Byron W. Holt: The Tin Plate Trust (New England Free Trade League, 1899) pp.6-7.

Before 1912, U.K. was the largest producer as well as the largest exporter in the World. She still retained, at the outset of World War II, the latter title, but conceded the former to the U.S.A., who, however, depended mainly on the home market for the disposal of her output. A serious check to the U.K.'s export occurred in 1926, when the general strike caused a sharp reduction to the benefit mainly of the U.S.A. Under an agreement concluded in November 1927 among the tinplate manufacturers of S.Wales, accepted by the "non-associated" as well as the "associated" makers, a systematic effort was made during 1928 to "adjust the supply to the estimated requirements of the market". The agreement provided for the suspension of work for 3 weeks out of every 13.

In actual practice, the measures of restriction adopted led to a cessation of work for 6 weeks during the 6 months ending May 1928, one week in August and two weeks during the 3 months ending November 1928, while production in December of the same year was also reduced under a decision to apply the full measure of restriction over the 3 months ending February 1929. There were at the time about 440 tinplate works in S.Wales with a capacity of over 900,000 tons of tinplate yearly. The productive capacity was thus artificially restricted to the extent of 20% (cp. outputs of 1924 and 1928).

In 1928, the tinplate manufacturers of South Wales and the United States made an agreement sharing the combined exports of the two countries in the proportion of 70% for the U.K. and 30% for the U.S.A. This agreement was supported by most of the mills on both sides and the proportion was observed until the slump of 1931 when the agreement disintegrated.

Three years later, on 1st July 1934, an agreement was signed by the principal exporters of tinplate for the regulation of international trade in their products. This was a more formal and more comprehensive cartel arrangement than the previous one. The U.S.A., U.K., Germany and France were regular members of the cartel. Italy and Norway also joined on the basis of special accords. An unincorporated association called the "International Tin Plate Association" was established in London, to be effective for 3 years. Later it was extended until June 10th 1938, when a new agreement, operative, though not signed, was made to extend the accord to 30th June, 1941. A Control Committee consisting of representatives of all member firms was in charge of managing the Association, whose policies were co-ordinated with the International Steel Cartel, though it was more independent of the latter than other organisations among the producers of steel goods. The principles of the cartel were the fixing of minimum prices and the division of the market, which was originally Wales 55%, U.S.A. 22%, Germany 16%, Italy and France 7% each. This division of the market represented a small increase for the U.K., and a small decrease for each of the other countries compared with 1934. Until 1930, however, the Welsh manufacturers supplied 75% or more of this export market. In 1936, when Belgium joined the Cartel, she secured as a concession an annual permissible export of 24,000 tons, though her gross export in 1937 was 300 tons, and her best export figure was 4,400 tons in 1930.

A schedule of minimum prices was fixed though the price policy of the cartel was limited to a small extent by the outsiders, particularly Czechoslovakia.

25. The post-war position is indicated by Table II.10 in which the 1937 output is shown for comparison.

Table II.10.

Tinplate Production 1937, 1946 and 1947.

(long tons)

| | 1937 | 1946 | 1947 |
|---|---|---|---|
| U.S.A. .. .. | 2,421,614 | 2,413,550 | 3,313,221 |
| U.K. .. .. | 957,800 | 439,000 | 553,200 |
| Belgium . .. | negligible. | 5,953 | 12,570 |
| Norway .. .. | 19,487 | 7,976 | 3,959 |
| Spain .. .. | 8,948 | 11,344 | 12,378 |
| Canada .. .. | 19,000e | 131,779 | 135,219 |
| France .. .. | 121,000 | 47,254 | 57,000 |
| India .. .. | 55,312 | 26,864 | 39,856 |
| Italy .. .. | n.a. | 4,857 | 12,749 |
| Czechoslovakia | 10,350 | n.a. | |
| Germany.. .. | 263,011 | | |
| Japan .. .. | 180,000e | | |
| World .. .. | 4,268,000e | 3,089,000e | 4,140,000e |
| Tin used in Tinplate .. | 68,800 | 37,800 | 46,100 |

Sources: I.T.R.D.C. and Tin Study Group.

e = estimated
n.a. = not available

Notice the expansion of Canada, and the contraction of almost all other countries, with the exception of the U.S.A, which, in spite of the regulations limiting the use of tin products, has kept her output at the 2.5 million tons level. U.S.A.'s record output was in 1941, when the output reached 3,133,402 tons.

In the U.K., in November 1943, the tinplate manufacturers submitted to the Board of Trade a scheme to scrap about 30% of the industry's pre-war nominal capacity, and to compensate the owners of eliminated plants from a levy on the production of the surviving enterprises. Early in 1947, the Steel Federation informed the Government that it was the programme of the industry to manufacture in South Wales by the continuous strip -mill process, approximately 650,000 tons of tinplate, or 15 million basis boxes, which is 75% of the estimated total nominal capacity of the country. The structure of the industry was further integrated by the formation of the Steel Company of Wales which comprises several main companies, and the production process of the new plants was to be improved, including the erection of a continuous hot-strip mill and three cold-production plants.

The Government of the Argentine is determined to stimulate tinplate production for food canning, and the production targets for her five-year plan, published early in 1947, include 70,000 tons of tinplate. (present production :nil);

at the same time the Argentine has entered into an agreement with Bolivia providing for a purchase of part of the latter's tin ore on long-term contracts.

In the Allies' plan for Germany, published early in 1946, in accordance with the Potsdam Agreement, Germany was to be allowed to consume 8,000 tons of tin in 1949, compared with 12,368 tons in 1937. The German tinplate output on this basis would be kept down correspondingly.

II Automobile Industry.

26. The consumption of tin in automobiles is, after tinplate, the most important source of absorption. The growth in the tin consumption in the 20th century is very closely connected with the advent of motor cars.

The chief uses of tin in automobiles are in the form of babbitt for engine bearings, solder for radiators, and bronze for bearings and bushings. Tin is also used to plate pistons in automobiles for the purpose of reducing friction, and terneplate may be used for the body and petrol tanks. It was estimated that in 1927, 11½ lbs. of tin were used on the average in the production of a car. This quantity, however small, was on the decline even before the war. In 1930, it became 8.01 lbs.; in 1936, 5.1 lbs.; (see Note 11); and both during and after World War II, owing to the control in the use of tin, it became 3¼ lbs. (See Note 12)

Note 11. U.S.Bureau of Mines: Minerals Yearbook 1936, (N.Y.1937)
Note 12. Tin(Tin Producers' Association) July,1947, p.4.

Taking the 1930 and 1936 peace-time figures, and the corresponding prices of tin of the time, it will be found that the total value of tin used in an average motor-car amounted to less than ten shillings - a negligible proportion of the cost of an automobile.

27. World automobile production in the early 1920's averaged about 4½ million cars yearly. (See Note 13). The trend was an upward one, reaching a peak of 6.3 million in 1929. In the subsequent slump, production figures fell to a minimum of just under 2 million in 1932, thereafter they followed a revival trend, reaching the 1929 level just before the war. In view of the great diminution in the quantity of tin per car, the total tin consumption in automobile production has been reduced to about 60% of the late 1920's peak. (See Table II.7 above).

The main countries producing motor cars before the recent war were, in order of importance, U.S.A., U.K., Germany, France, Canada, U.S.S.R. and Italy. The U.S.A. alone was responsible for about 80% of world production in 1937; U.S.A. plus Canada accounted for 84%; U.K., 8%; Germany, 5%; France, 3.5%; U.S.S.R., 3% and Italy 1¼%.

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<u>Note 13</u> The source of the figures in this paragraph is the Automobile Manufacturers' Association, N.Y.

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<u>Note 13</u> The source of the figures in this paragraph is the Automobile Manufacturers' Association, N.Y.

## (E) SUBSTITUTION AND WAR-TIME ECONOMY

28. Opinions regarding the substitutability for tin vary from that which indicates that there is "no efficient substitute for the main uses" to the view that substitutes are available for every line of consumption. The truth is that, technically speaking, the latter view is correct; but whether substitution is economically possible is another question. The relevant considerations influencing the decision of industrial consumers of tin with regard to substitution are:

(a) How far is the substitute satisfactory from the technical viewpoint?

(b) Is the price of tin going to be kept high? for how long? or is it likely to be lowered in the future?

(c) Is the technically possible substitute more or less expensive than tin, allowance being made for comparative efficiency? and what is the likelihood in terms of future comparison?

(d) Does the use of the alternative material involve a change in technique, plant, machinery, and is it worth while to have a change-over, in view of (a), (b) and (c)?

(e) What will be the final consumers' reaction towards the alternative material?

Substitution, as experienced in wartime, sometimes entailed a very high cost in terms of industrial efficiency. The introduction of substitutes always causes delay and confusion at first. Probably for this reason, the U.S. House of Representatives Sub-Committee on Tin Investigation,(See Note 14) reported in 1935 that "The evidence before the Committee does not indicate that there has ever been undertaken any comprehensive and systematic attempt to develop substitutes to replace tin in the arts and industries. Apparently, efforts in this direction have been limited to scattered and uncoordinated research by investigators in certain special fields". However, it was reported a few years earlier (See Note 15) that "when the price of tin was high, intensive research for substitutes resulted. The field for making important substitutions seemed very promising, because at that time (1920's) tin was the highest-priced metal in the common-base-metal group. Since then, the fall in the price of tin and the growing tin stocks have diminished the intensity of the search for substitutes".

It is proposed, in the following paragraphs, to investigate the technical substitute possibility for tin, since the technical possibility may become one day an economic reality. Moreover, once substitution has taken place at a particular point of time, the same four considerations (a) to (d) above apply to the possibility of reverting to the use of tin. Hence, the war-time practice of tin economy may have a serious long-run

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<u>Note 14</u> op.cit.p.34.

<u>Note 15</u> by C.W.Merrill in Minerals Yearbook 1932/33. (Bureau of Mines) pp.291/2.

effect on the consumption of tin. An investigation into war-time practice follows in para.31.

## I Technical Substitutes.

29 The following table, suggesting what can be used technically as substitutes for tin, does not claim to be exhaustive. It is compiled from technological books and reports, notably those published by the Tin Research Institute. Other sources of information are Ruth C.Leslie's Report to the U.S.Department of Commerce (1942), U.S.Bureau of Mines, Minerals Industry, U.S.Research Laboratories of the National Canners' Association, Iron Age, Engineering and Mining Journal etc.

Table II.11.

Technical Substitutes for Tin.

| Form of Consumption. | Uses | Alternative Materials |
|---|---|---|
| Tinplate | Food Canning | Glass; ceramics; waxed paper; cartons; bags of chlorinated rubber; plastics; very thin nickel-tin coating; aluminium; cadmium; lacquer; bonderized plate; dehydration of food; freezing of food; phosphate blackplate. |
| | Cans for lubricating oil. | Rubberized paper bags; cartons. |
| | Cans for paints, oils, dry materials, etc. | Tinned body with terneplate bottoms and tops; black-steel containers with terneplate tops and bottoms. |
| Terneplate | | Less tin and more lead content; steel coated with antimony with lead deposited over the whole. |

| Form of Consumption | Uses | Alternative Materials |
|---|---|---|
| Solder | | Less tin content; cadmium; silver; antimony; tellurium; zinc-tin (20:80); zinc-aluminium-tin (8-15 : 5-12 : remainder); lap welding and die stamping of tin cans. |
| Babbitt | Babbitt bearings. | Ball-roller bearings; tin-less graphite bearing for vacuum cleaners and refrigerators; lead-base alloys. |
| | Babbitt metal (soft alloy of tin 85-90% + antimony + copper) | Thinner coating of tin supported by stiff bronze or steel backing; lead babbitt containing no tin. |
| Bronze | | Alloy of copper, silicon and iron; chromium, aluminium, added to copper; nickel. |
| Foil | | Aluminium; cellophane; zinc; lead; waxed paper. |
| Collapsible Tubes. | | Aluminium; lead without or with tin coating; plastics. |
| Tin oxide | | Antimony oxide (for enamels) zirconium oxide (for ceramic glazes) |

The length of the list of substitutes in the table for each line of use is no indication of what has been applied in practice; it rather suggests the relative importance of tin in each particular use, which causes attention and research to be concentrated upon it.

A rough picture of the degree of substitutability in each use is given by K.E.Knorr (See Note 16) as follows:

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Note 16 Tin Under Control (Food Research Institute - Stanford University 1944) p.43.

| Degree of Substitutability | Uses |
|---|---|
| Considerable | Babbitt and foil (See Note 17) |
| Slight | Solder, bronze and brass, collapsible tubes, type metal. |
| Very slight | Tinplate, tinning, terneplate. |

30 Among the closest substitutes in the above list, aluminium, cadmium and lead appear to be the most important.

From the technical point of view, whether aluminium has a harmful effect on food is still a controversial question, though aluminium utensils have become more and more popular. It is generally agreed that salts of aluminium are undesirable as constituents of baking powders or self-raising flour; but the effect on health of the metal used as cooking utensils is not conclusive in either direction. Such evidence as exists is insufficient to decide against the use of aluminium, although some individuals are susceptible to even small doses of the metal. (See Note 18)

From the economic point of view, the use of aluminium in cans is found to be more costly than tin-coated steelplate, in spite of the fact that aluminium (New York) price fell from a yearly average of 32.72 cents per lb. in

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Note 17 To this "chemicals" should be added.

Note 18 See, on the one hand, W.G.Monier-Williams: "Aluminium in Food" (Ministry of Health: Report No.78 - 1935): and on the other: Mark Clement: "Aluminium:A menace to Health" (Faber and Faber 1941)

1920 to 15 cents in 1946, while the corresponding figures for tin are 49.101 cents and 54.54 cents. It is reported in 1947 that aluminium cans were made in smaller sizes for ½ to 1 cent more per can than tinplate cans. Moreover, aluminium cans have failed to withstand the rough handling to which ordinary cans are subjected. Enamelled aluminium sheet is said to be suitable material as far as resistance to corrosion is concerned, but it is too soft to hold a tight seam. Soldering of aluminium cans also offers some technical difficulties owing to the rapid oxidation of aluminium, and the substitution of aluminium for tin plate would involve adaptation of canners' plant and additional labour charges as it would be necessary to replace several mechanical processes with semi-skilled hand operation.

On the other hand, aluminium foil has been used in substitution for tinfoil, and is invading the fields where lead is excluded because of its toxic properties. Except for a trifling tonnage for dental foils and similar uses, tinfoil is gradually being replaced; the process had commenced even before the war. Aluminium for collapsible tubes has become an increasingly important factor, though the substitution in this case has many drawbacks; for instance, when used to contain soap substances, the formation of hydrogen with soap in contact with aluminium causes perforations to occur in the tubes. In other instances, the extrusion equipment for tin cannot turn out the same size aluminium tubes, and until the equipment is obsolete or replaced, tin collapsible tubes can still hold their markets.

Cadmium can technically be a substitute for tin in tinplating and in solder. During the 1st World War, attempts were made to use cadmium as a white metal alloy constituent. In the 1930's and during the recent war, further experiments have been made, but the annual world production of cadmium rose from a negligible figure in the early 1920's to only about 1,900 tons in 1930, and just below 4,000 tons in 1938. The average price per lb. in the late 1930's was $1.00, which was about double that of tin. In 1946, it was $1.50 per lb. Among technical difficulties, the disadvantage of cadmium is that cadmium salts are poisonous, and the use of cadmium alloys in solder is thus regarded with suspicion by a large section of the industries and trades. Such a prejudice is increased also by the fact that cadmium solder, applied to cans, gives a slightly darker colour to the seam, compared with a straight tin-lead ~~sold~~ solder of high tin content.

Lead is far cheaper than tin, but its toxicity and other adverse qualities limit its importance as a substitute for tin to a few lines of consumption, such as in certain light or medium duty babbitts, and certain types of collapsible tubes.

## II War-time Practice

31. The actual practice of tin economy in the U.S.A. was governed during the last war and still is by the Conservation

Orders M-43 (tin conservation) and M-81 (containers) and subsequent orders amending the previous ones and adapting them to suit the changing circumstances. In all lines of consumption, economy was effected by a reduction of the tin content by the imposition of a maximum percentage of tin to be used, or by the limitation or the prohibition of the use of tin for specified purposes.

In tinplate, the emergence of electro-tinplate was an important factor in economy, but even in hot-dipped plate, the standard tin yield per base box was reduced from 1.5 lb.to 1.35 lb. in May 1941, and further to 1.25 lb. since February, 1942. The tin content of terne metal was also reduced to 15% by weight. The decline in the average quantity of tin per base box in the U.S.A. is shown by Table II.12, the figures of which should be compared to the 1½ lb. per base box standard before 1942:

Table II.12

Average Tinplate Coating in the U.S.A. during the War.

(lb. of tin per base box)

| | Hot-dip | Electro | Overall Average |
|---|---|---|---|
| 1942 | 1,372 | 0.643 | 1.347 |
| 1943 | 1,393 | 0.659 | 1.255 |
| 1944 | 1,417 | 0.638 | 1.204 |
| 1945 | 1.469 | 0.643 | 1.183 |

Source: (partly) calculated from data published by the U.S. Bureau of Mines.

A ban was put on the use of tin containers for products such as beer, dog food, dried beans, tobacco, etc. Wherever feasible, terneplate was used in the place of tinplate, and in some cases both tinplate and terneplate were replaced by tinless blackplate. In this way, the peacetime annual consumption of tinplate and terneplate of 67.5 million base boxes was reduced to little more than half of that figure.

In other uses, the most substantial reduction occurred in tin-foil, the manufacture of which was banned after March 1942, except for a small quantity designed for special purposes. In solder, the maximum permissible tin content was limited to 30% from May 1942. The average quantity of tin actually used in solder fell gradually to about 27% in 1944 and 1945, which was slightly less than in 1943 (pre-war Plumbers' solder contained 30% tin, and Tinman's solder 63% tin). It is also reported that a kind of solder widely used contains 20% tin + 1.25% silver + 1.5% antimony + 77.25% lead. In babbitt, the average tin content was 14% and 12% in 1944 and 1945 respectively (cp. 89% tin-based bearing prewar). The percentage of tin in bronze and brass was also substantially reduced. The use of tin collapsible tubes was banned by M-115 (1st April,1942) for foods, cosmetics and some toilet preparations. Pure tin tubes were permitted only for certain pharmaceutical preparations. Drastic reductions are also applied to the consumption of tin in oxide, type metals and other alloys. The use of tin was not allowed in musical instruments, automobile body solder, office staples, jewelry, kitchen equipment etc.

Of these war-time restrictions, the most important ones which are likely to have long-period effect on the future peace-time consumption are electro-tinplate, foil and probably oxide and babbitt, not only in the U.S.A., but in other countries as well.

The impact of restrictions can be seen in table II.13.

Table II.13.

Consumption of Tin by Uses in the U.S.A.
During and After the War.

('000 long tons of primary and secondary tin.

| | 1939 | | 1945 | | 1947 | |
|---|---|---|---|---|---|---|
| | | % | | % | | % |
| Tinplate | 36.6 | 44 | 26.1 | 31 | )31.8 | 37 |
| Terneplate | 1.5 | 2 | 0.7 | 1 | ) | |
| Solder | 17.3 | 21 | 14.3 | 17 | 19.7 | 23 |
| Babbitt | 5.4 | 7 | 7.8 | 9 | 6.8 | 8 |
| Bronze and Brass | 6.4 | 8 | 27.1 | 32 | 21.1 | 24 |
| Collapsible Tubes | 3.5 | 4 | 0.5 | ½ | *1.4 | 2 |
| Tinning | 2.3 | 3 | 2.6 | 3 | 2.8 | 3 |
| Foil | 2.0 | 2 | 0.2 | 1/3 | | |
| Chemicals | 1.5 | 2 | ¤0.6 | 2/3 | )others | |
| Type Metal | 1.1 | 1 | 1.3 | 1½ | ) 3.5 | 4 |
| Total (including other uses) | 82.4 | 100 | 83.6 | 100 | 87.2 | 100 |

Sources: Bureau of Mines : Minerals Yearbooks and the International Tin Study Group.

¤ = includes 'miscellaneous'.
* = includes foil.

Notice that, although the tin content in babbitt and bronze and brass was reduced, the total tin consumption in these uses has actually increased, since these two lines of consumption are essential for armament production.

In February 1947, the Conservation Order M-43 was revised and controls in some lines have been relaxed. The principal relaxations include the permission to use $\frac{1}{4}$ lb. electrotinplate for kitchen and cooking equipment, the increase in percentage of tin permitted for use in solder, the permission to use tin as tin-oxide for the production of earthenware plumbing fixtures etc.

32. In the United Kingdom, the restriction of the use of tin started in July 1940 in the form of "The Control of Tins and Cans (No.1) Order (1940) No.1308", prohibiting the use of tinplate, tinned sheet, terneplate and terne sheet as containers for animal foods, certain other foods, bath crystals and salts, cigarettes, cosmetics and toilet creams etc. Subsequent orders followed the same line, and the list of articles for which tin was not allowed to be used was from time to time extended or contracted. Tin allocations were officially controlled. The omission of medium tin content alloys from bearing metals, and their replacement by high lead and low tin was urged by the Non-Ferrous Metals Control. The British standard for soft solders was revised, bringing the tin content downward. Table 11.14 shows the result of these restrictions: the breaking-up of consumption into various uses was not started until 1942:

Table II.14

Consumption of Tin by Uses in the U.K.
During and After the War.

('000 long tons of virgin and scrap tin)

| | 1939 | | 1942 | | 1947 | |
|---|---|---|---|---|---|---|
| | (virgin only) | % | | % | | % |
| Tinplate | 12.8 | 47 | 5.6 | 17 | 8.9 | 26 |
| Solder | | | 7.9 | 25 | 5.6 | 16 |
| Bronze, gunmetal, white metal etc. | | | 14.2 | 44 | 13.6 | 39 |
| Foil and collapsible tubes | | | 1.6 | 5 | 3.4 | 10 |
| Tinned copper wire | | | 1.0 | 3 | 0.7 | 2 |
| Tin compounds and salt | | | 0.3 | 1 | 0.9 | 2 |
| Tinning | | | 1.0 | 3 | 1.0 | 3 |
| Total (including other uses) | 27.3 | 100 | 32.3 | 100 | 34.7 | 100 |

Source: Directorate of Non-Ferrous Metals : Ministry of Supply.

In the U.K. statistics, babbitt and bronze are combined under the same heading, so are foil and tubes. Strict comparison cannot be made with the U.S.A. data in Table II.13. The big increase in foil and collapsible tubes in the U.K., owing to the post-war relaxation of restriction, contrasts sharply with the corresponding figures for the U.S.A.(in 1945), where restriction still applied.

(F) CONSUMPTION BY COUNTRIES

33. Table II.15

"Apparent" Tin Consumption by Countries.

('000 long tons) (primary tin)

| | 1923+ | 1929 | | 1932 | | 1937 | | 1945 | | 1947 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | | % | | % | | % | | % |
| U.S.A. | 77.6 | 84.9 | 46 | 35.5 | 34 | 86.6 | 43 | 55.6 | 57 | e60.0 | 45 |
| U.K. | 16.9 | 24.2 | 13 | 18.5 | 18 | 26.0 | 13 | ø16.4 | 17 | ø27.4 | 21 |
| Germany | 6.5 | 17.1 | 9 | 9.6 | 9 | 12.4 | 6 | - | - | 0.3 | 0 |
| USSR | ? | 4.8 | 2 | 3.8 | 3 | ж25.1 | 13 | ж5.5 | 5.7 | ? | ? |
| Japan | ? | 4.8 | 2 | 4.4 | 4 | 8.2 | 4 | 3.1 | 4.8 | 1.8 | 1 |
| France | 9.2 | 11.7 | 7 | 8.5 | 8 | 9.2 | 5 | 3.2 | 4.9 | 9.9 | 7 |
| Canada | ? | 2.6 | 1 | 1.4 | 1.3 | 2.6 | 1.3 | 3.7 | 5.0 | 3.6 | 3 |
| India | ? | 2.7 | 1 | 2.4 | 2.3 | 2.6 | 1.3 | - | - | 5.2 | 4 |
| World e | 136.5 | 183.6 | 100 | 104.6 | 100 | 199.1 | 100 | 96.0 | 100 | 132.6 | 100 |

Sources: ITRDC and Tin Study Group; U.S.Bureau of Mines; U.K. Ministry of Supply.
\+ for 1923 source = Metallgesellschaft(in metric tons)

"Apparent" Consumption = calculated by subtracting exports from imports and/or production, with adjustments for changes in stocks, so far as available.

e = estimated; ж = import figures; ø = real consumption.

Table II.15 is self-explanatory. Only three points need to be made: Firstly, the spectacular rise of the U.S.S.R. and Japan as important consumers before the war, even allowing for a reasonable degree of inaccuracy of the statistics.

Secondly, the relative share of the U.S.A. declined during the 1932 depression, and although the absolute figures of consumption rose by more than 50% in subsequent peacetime years, the percentage of the U.S.A. remained lower than in 1929, mainly owing to the expansion elsewhere. All the other main consuming countries, on the other hand, increased their relative shares during the Depression, particularly the U.K., whose consumption appeared to be less sensitive to the trade cycle than elsewhere. Thirdly, the 1945-1947 figures are included merely to describe the situation at the end of the war. It has, clearly, no simple bearing upon the future course of consumption. The positions of Japan and the U.S.S.R. are likely to be changed, and possibly the latter will, within a few years, resume her pre-war upward trend.

# CHAPTER III

## DEMAND AND STOCKS.

### (A) THE DEMAND FOR TIN TO CONSUME.

1. In this chapter, various factors will be considered, which have direct and indirect influences upon the demand for tin. Demand is used here in the sense of effective demand, i.e. the quantity of tin metal which is bought (and sold) in a period of time, as distinct on the one hand from mere want or requirement, and on the other hand from the quantity actually consumed during the period of time, as employed in Chapter II. Although the quantity demanded depends to a large extent upon the rate of consumption, the two magnitudes are not identical, and at times the difference between them is large, and the change in consumers' stocks is sometimes positive, at other times negative. (See Note 1). From the point of view of the market and the determination of price, it is the amount bought and sold, rather than the quantity consumed, that is relevant, in the short run.

2. The relation between price and demand is usually expressed by a demand curve with the two axes representing price as an independent, and the quantity as a dependent, variable. All other factors affecting the demand curve are usually lumped together in the diagram, and the changes in them are expressed by the movements of the curve. Further attention is focussed upon the price-quantity relation by analysing the

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Note 1. See Ch.I paragraph 14.

influence of a price change upon the quantity demanded into two components, namely the substitution effect and the income effect. (See Note 2).

I. The Shape of the Demand Curve.

3. We take first the price-demand relationship. It is important to distinguish between short-run and long-run demand curves.

(a) Short-period.

The opinion is prevelent among students (See Note 3) of the subject that demand for tin is inelastic in relation to price. The principles formulated by Marshall and Pigou lend support to this view, since "the demand for anything is likely to be more inelastic:

(i) the less readily substitutes for that thing can be obtained;

(ii) the less important is the part played by the cost of that thing in the total cost of some other thing in the production of which it is employed;

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Note 2 J.R.Hicks: Value and Capital (Oxford University Press 1939) Ch.II, paragraphs 3 - 6.

Note 3. e.g. J.W.F.Rowe: Markets and Men (Cambridge University Press 1936) pp.152-4; J.K.Eastham: "Rationalisation in the Tin Industry" (RES.Vol.IV No.1, 1936) p.13; K.E.Knorr: Tin under Control (Stanford Food Research Institute 1945) p.44.

(iii) the less elastic is the supply of cooperant agents of production;

(iv) the less elastic is the demand for any further thing which it contributes to produce."

(See Note 4).

The case of tin, described in Ch.II, appears to conform to the first two conditions. Allowing for the demand to hold stocks, "whose elasticity is certainly not zero", Eastham went as far as to state that "it may not be far from the truth to regard the curve of demand to consume as being vertical between the limits of £100, the lowest price reached in this century, and, say £250". (See Note 5).

The third condition of the Marshall-Pigou formula must not be overlooked. Among the most important materials which are used jointly with tin are steel, lead, copper, all of which are under monopolistic or oligopolistic control. The tinplate industry was, before the war, organised as an international cartel. Labour employed in the tin consuming industries

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Note 4. A.C.Pigou: Economics of Welfare (4th Edn.) Part II, Ch.XIV, para.5; cp.Alfred Marshall: Principles of Economics (8th Edn.) Book V., Ch.VI para.2.

Note 5. loc.cit., p.13. Such a statement cannot be proved or disproved statistically. But Eastham went on to say that "when substitution occurs, it tends to be of the nature of a shift in the curve". This last pronouncement is clearly untenable. If substitution is caused by the high price of tin, other things being equal, then this is reflected in the shape of the demand curve, not its position. The relevant curve may, of course, be short-run or long-run curve.

in the United States and the United Kingdom, and elsewhere, possibly with the exception of Japan, was highly organised and was not likely to be subject to a "squeeze" by the high price of tin. As far as condition (iii) is concerned, therefore, the demand for tin tends to be elastic, even in the short run.

The fourth condition, i.e. the elasticity of demand for the final products - is more difficult to assess, since tin is used in a great variety of products. Whichever way the effect may be, this condition (iv) is unlikely to be important, since a change in the quantity of the final product demanded will only cause a much smaller change in the quantity of tin demanded.

Taken as a whole, the short-run reaction of demand to price, in the case of tin, is likely to be negligible. The first two conditions of substitution and income effects are predominant and more than offset the opposite effect of the third condition. Thus in the short run, the price of tin can be forced upwards without substantially diminishing the quantity demanded. On the other hand, a large decline of price will by itself fail to stimulate an increase in demand, at least within several months or years.

(b) Long-period.

4. If we consider the ultimate interest of the tin producers, then the relevant demand curve is the long-run, not the short-run curve. The experience of tin in the 1930's suggests that in the longer period of between 5 and 10 years,

the price-elasticity of demand for tin is considerable. If the short-period assumption of inelastic demand is applied to the long-term policy of a producers' association, the result will be injurious to the position of tin relative to its rivals.

Substitutability is a concept related to time. The longer the period, the greater the possibility of using substitutes. In the case of tinplate, the period taken to reduce the tin content satisfactorily or to use substitute materials is necessarily long, since substitution involves a change in the machinery and production process. So long as it pays the consumer to keep the old plant working, rather than to install new machinery which would use less tin, the old plant is not likely to be scrapped, despite the high price of tin maintained over a long period. However, even here, war-time experience in the U.S.A., though not representative of normal conditions, suggests that the changeover in technique and machinery is possible in a matter of months, not years. In the cases of other uses of tin, e.g. foil, babbitt, solder and chemicals, the period necessary for a changeover is much shorter, and the price elasticity of demand for these uses is correspondingly large.

5. The possibility of replacing tin by rival materials is only one side of the question of substitution. The other relevant consideration is the possibility of expanding tin consumption in a dynamic world of rising income and increased industrialisation. If the price of tin is maintained at a

high level, and as a consequence there is an absence of any substantial or permanent expansion of its demand into new fields, despite the research and propaganda intended to stimulate the use of tin and despite increased industrial activities, that is a clear indication of the magnitude of the cross-elasticity of demand for tin. This was so in the 1930's. To be sure, it is possible to argue that in the 1930's there occurred in fact new outlets for tin consumption such as the canning of beer which started in 1935, and the adoption in 1933 of petroleum tin containers, but close examination of these cases reveals that the gains were small and sometimes short-lived. The emergence of petroleum tin containers was due to the fact that petroleum companies were trying to protect their retail consumers against fraudulent substitution of lower grades of oil; but in 1934, this new outlet for tin was lost to copper, since copper-coated steel cans were introduced as substitutes. The relevant consideration in this case is the relative movement of prices of various competitive materials. The accompanying diagram shows that since 1921 the movement of its price leaves tin in a much weaker competitive position towards the end of the period, compared to other non-ferrous metals, especially aluminium and cadmium, the nearest rivals.

6. Against the favourable effect of the second Marshall-Pigou condition, namely the negligible value of tin incorporated

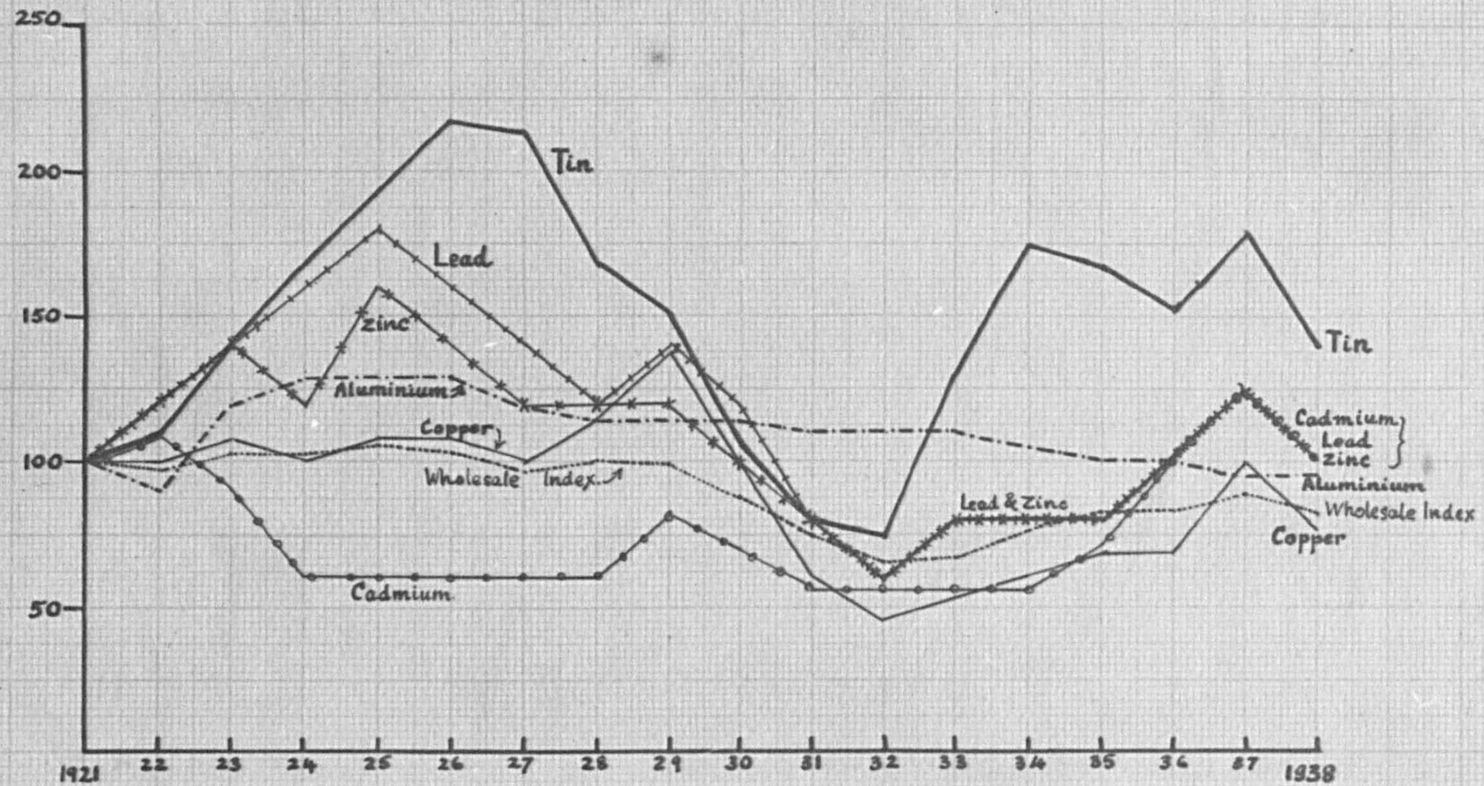


FIGURE III.1.
THE PRICE OF TIN
COMPARED WITH THOSE OF OTHER NON-FERROUS METALS AND THE WHOLESALE PRICE INDEX.
(1921 = 100.)

All prices are U.S. prices
Wholesale Price Index = U.S. Dept. of Labor's.

in the final product, there is the fact that tin is an expensive metal; it is the most expensive among the base metals. The movement in the price of tin, as is shown in Chapter I, is not of small magnitude. A change in the annual average price, say from £195 to £230 per ton (or 39 U.S.cents to 52 cents per lb.) between 1933 and 1934 (to take a moderate change) makes a difference of £3,500 to a firm which consumes 100 tons yearly. This change could not fail to affect the attitude of the big industrial consumer who does not buy tin in small quantities at frequent intervals, but acquires it in sufficient amount to cover his uses several months ahead. (See Note 6). No industrialist can afford to overlook such an important item in his cost accounting.

7. That the long-period demand for tin is elastic is supported by an examination of the facts in the 1930's, when tin price was maintained at a high level for several years. From 1929 onwards, the automobile industry adopted cadmium, instead of tin babbitt, and the use of tin per car has declined by about 70% since 1927. (See Note 7). The consumption of tin in foil and chemicals between 1927 and 1936 declined by more than 50%, and since the latter year, the loss has become much greater. Tin in bronze and solder likewise suffered, although to a smaller extent. (See Note 8). These

<u>Note 6</u> Statement of the President of the U.S.Steel Corporation, N.Y. to the Tin Investigation Committee, op.cit.p.1018.

<u>Note 7</u>. Ch.II, para.26.

<u>Note 8</u>. Ch.II, para.16 and Table II.3.

are by no means negligible lines of consumption, since combined together, they represent about 40% of the quantity annually consumed.

Even before the war, a prominent tin trading firm in London commented upon the competitive position of tin as follows:

"One of the principal uses of tinfoil is the wrapping of cheese. Much of this will be discontinued in the future, and be replaced by a rubberized transparent paper. This substitution, it is stated, will affect a considerable saving in cost. Other changes in industrial processes are resulting in reduced tin consumption.....Aluminium is now being more freely used in the manufacture of tubes in view of the high tin price. The tinplate industry still remains, of course, the backbone of tin consumption, but even here new processes are in operation by which the coating of metal has been reduced.....The total effect of these developments and substitutions is not serious; they are mentioned as evidence of a tendency." (See Note 9)

8. The conclusion drawn from the above consideration is that the demand for tin is inelastic in the short period, but elastic in the medium - or long-period, in the sense that if a high price is maintained for a few years, and is expected to be maintained in the future, tin will lose a large part of its markets to rival materials, and the potential consumption will be prevented from expanding. The short-run inelasticity explains the frequent divergences of market prices from the long-term average, and the momentary success of a monopolistic

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Note 9. "A Strauss & Co.Ltd., London, quoted in Minerals Yearbook (U.S.Bureau of Mines) 1939, p.682.

organisation in its policy of supporting price. The long-run elasticity, on the other hand, explains the decline in consumption trend, and creates conditions in which monopolistic control cannot be removed without a steep fall in price.

II Position of the Demand Curve.

(a) Business Activity.

9. We have shown, in Chapter II, paragraphs 16 and 18 and Table II.4, that the demand for tin is sensitive to business activity. The demand curve moves upwards and downwards in accordance with prosperity and depression. There is no perfect measure of the phenomena which we call the economic activity; but the national income figures and the indices of industrial activities can be used as approximations. More specifically for tin, the national income and industrial activities of the United States and the United Kingdom - main consuming countries - are relevant data. Within the general category of industrial activities, those in the tinplate industry, food canning, automobile, building, machinery and railway industries are the most important.

To illustrate the relation between business activity and the demand for tin, an attempt has been made to study the experience between the wars, by correlating tin deliveries or consumption with national income for the U.S.A. and U.K., and with the index of industrial activity for the world. The method employed is that of simple correlation analysis, which is a crude method. The result must therefore be regarded as approximative and tentative, not as an assertion of definite magnitudes.

Table III.1.

Illustration of the Influence of Business Activity on Demand for Tin.

| | U.S.A. | U.K. | World |
|---|---|---|---|
| Data Correlated | National Income[a] and Deliveries.[d] | National Income[b] and Apparent Consumption.[d] | Index of Industrial Activity[c] and Consumption[d] |
| Period | 1921 - 1938 | 1927 - 1938 | 1925 - 1938 |
| "Income" - Elasticity of Demand. | +0.925 | +0.507 | +0.827 |
| Correlation Coefficient | +0.737 | +0.343 | +0.769 |

Sources: a = S.Kuznets : National Income 1919-38 (NBER 1941)
b = A.L.Bowley : Studies in the National Income (NIESR 1942)
c = League of Nations: Bulletin of Statistics.
d = ITRDC.

The result is not satisfactory in the case of U.K., since the correlation coefficient is only 0.343, but the high coefficients for U.S.A. and the world are more reassuring. Taking the figures as they stand, the above table suggests that, with a change of 1% in the national income (or industrial activity index), the demand schedule will move in the same direction to the extent of a little less than 1% in the case of U.S.A. and the world. If the figure for U.K. is trustworthy, the corresponding movement for U.K. will be about ½%.

The movement of the demand curve in correspondence with the variations in the industrial activity, is an important cause of the cyclical fluctuations in the price of tin. (See Note 10). The intensity of the price fluctuations increases with the inelasticity of supply, which will be the subject of discussion in Ch.VI.

10. It has been shown in Ch.II that the cyclical sensitivity in tin demand for solder, babbitt, tinplate and bronze is larger than for chemicals, collapsible tubes and foil. In the latter uses, tin is more open to substitution and a fall in tin consumption has occurred in these since before the war. It is to be expected therefore, that as the consumption of tin has become more concentrated in the more cyclical-sensitive uses, the demand for tin as a whole will fluctuate more violently than before.

Not only is the position of the demand curve affected by business activity, but the shape of the curve is also influenced by it. The slope will tend to be less steep during the boom than during the slump, since high prices during the former period stimulate the research for, and the application of, substitutes.

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Note 10. Cp. Nicholas Kaldor: Speculation and Economic Stability (RES. Vol.VII, Oct.1939) paragraph 8, pp.10-11.

(b) <u>Other Influences.</u>

11. The position of the demand curve for tin is also determined by other factors such as the size of population, the real income per head of the population, the degree of mechanisation in productive process, the "taste" (e.g.increased popularity of tinned food), and technical progress. These various factors, with the possible exception of the last mentioned, will have positive effect upon the demand schedule. Technical progress, however, may work either way: research may open up new outlets for tin, but it may also result in further possibilities of more efficient and therefore more economical uses of tin.

III <u>A Multiple Correlation Analysis of Demand for Tin.</u>

12. The above approach to the demand analysis, using a diagram with two dimensions - price and quantity - has the merit of simplicity, but the limitations are obvious. Where the influence of price is small, compared to other factors, as in the case of tin, the ceteris paribus clause must be analysed, and as far as possible, quantitative relationships obtained between these factors and demand. The method which has become more widely used by econometricians is that of multiple correlation, which enables us to verify the relationships concerned, suggested by theoretical economics, as well as to determine the relative strength with which the various factors operate upon demand. (See Note 11, page 100)

13. Dr.M.J.Schut, a Dutch economist, has applied this method to tin, in his book "Tinrestrictie en Tinprijs" (See Note 12). He arrives at the following formula for world tin consumption:

1.1. $C' = +0.08A + 0.44B - 0.13P - 3.5T + 43$

C' represents the world tin consumption in thousands of long tons, and is made dependent upon four factors:

A, automobile production in ten thousand of cars.

B, tinplate production in ten thousand of tons.

P, price of tin in £ per ton.

T, time measured in years.

The regression coefficients + 0.08, + 0.44, - 0.13 and - 3.5 indicate the relative influences of all these four factors; their signs correspond to what they should be in each case. The formula has a high correlation coefficient of 0.87, and therefore claims a high degree of reliability. The price-elasticity of demand obtained in the calculation is 0.185.

Schut has also calculated similar formulae of tin demand for individual countries : U.S.A., U.K., France and Germany. For U.S.A., calculation was also made for the tin consumed in all uses except tinplate.

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Note 11 J.Tinbergen :Statistical Testing of Business Cycle Theories Vol.I,Ch.I.(League of Nations,1939); Richard Stone : The Analysis of Market Demand (Journal of the Royal Statistical Society)Vol.CVIII parts II-IV,1945. For methodological discussion, see J.M.Keynes and J.Tinbergen in EJ.Vol.XLIX,Sept.1939, pp.558-568 and Vol.L, March 1940, pp.141-156.

Note 12. Published by the Nederlandsch Economisch Instituut, nr.31 (Haarlem - De Erven F.Bohn,NV -1940) Ch I and II.

The symbols used are, apart from those indicated above :

$C'$ = total consumption in thousands of long tons.

$c'$ = consumption excluding tin in tinplate in hundreds of long tons.

$I$ = index of industrial activity (1925/34 = 100)

$Z$ = index of building activity (1923/25 = 100)

The results for the U.S. are reproduced here :

2.1 : <u>U.S.Total Consumption</u> :

$$C' = + 0.03A + 0.43B - 0.08P - 2.21T + 109$$

Correlation coefficient + 0.96

Price-elasticity of Demand = 0.271

2.2 : <u>U.S.Consumption other than in Tinplate.</u>

$$c' = + 2.8I + 1.4Z - 0.7P + 2.6T + 23.1$$

Correlation coefficient + 0.88

2.3 : <u>U.S.Consumption other than in tinplate.</u>
<u>(the "abnormal" years of 1933 and 1934</u> interpolated)

$$C' = + 2.3I + 2.0Z - 0.6P + 5.6T - 0.7$$

Correlation coefficient 0.92.

Price-elasticity of Demand 0.427.

In plain English, the formulae mean that :

(1) The trend of total tin consumption, both in the world and in the U.S.A. is declining; but the consumption in the U.S.A. in uses other than tinplate has an upward trend.

(2) Among the factors influencing consumption, tinplate production is by far the most important.

(3) Abstracting from tinplate, industrial activity in general (which, incidentally, would influence the tinplate industry itself), the building activity and automobile productio affect tin consumption in a positive way; but their influence is weak, especially that of automobile production.

(4) The negative influence of price is very small.

For U.K., France, Germany, the results obtained are similar. The respective price-elasticities of demand are 0.099, 0.007, and 0.225.

14. Most of these results are in line with the common-sense approach, except on two points: (a) the upward trend of consumption excluding tinplate, which does not correspond to the fact; (see Note 13): (b) the under-estimation of the influence of price.

The influence of price obtained from Schut's analysis is necessarily a short-run influence because the correlation is between price and consumption of the same years. Similarly, the price-elasticities of demand derived from the calculation are short-run concepts. Long-run effects of price are neglected, or rather, incorporated in the trend, which in the equations 1.1 and 2.1, is rightly found to be a negative item. Moreover, the analysis does not permit us to take

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Note 13. See Table II.4.

account of the influences of the rate of price changes and of the price expectations. These two factors play important roles in the determination of the demand for stocks of tin.

It should also be pointed out that Dr.Schut's calculation relates to the consumption of tin, in the strict sense of the word, not to demand as we understand it. The demand for stocks is left out of account. This is, in the present writer's view, unjustifiable. This shortcoming would not be so serious if the demand for holding stock were a fairly constant percentage of consumption; but in fact it is not so, as we shall see in the next section of this chapter.

It is regrettable that the period observed is too short, and confined to twelve or fourteen years (between 1923 or 1925 and 1936). This is not a criticism against Schut, since every student on tin demand is confronted with the absence of detailed statistics, especially before 1926 or 1927, but the omission of the years 1937 and 1938 is not understandable, since these two years are particularly interesting, 1937 being a peak year, and 1938 a recession year in contrast.

These shortcomings limit the application of Schut's findings in detail, but should not alter its general conclusion with regard to the relative influences of various factors determining the demand for tin to consume.

## (B) STOCKS OF TIN

### I Composition of Stock Figures.

15. Some stocks of tin are held by the consuming manufacturers and some are held by dealers and producers atvarious stages. From the standpoint of the consumer, stocks are more or less liquid - i.e. more or less quickly available to him - in the following order:

(a) stocks of metal in hand.

(b) stocks of metal at the warehouse or landing within the consumer's country.

(c) metal afloat to his country.

(d) stocks of metal at the foreign smelters in order of their distance.

(e) stocks of ores at the foreign smelters.

(f) stocks of ores at the foreign mines.

This order of liquidity applies to the consumer in a country where there is no smelter or mine, such as the American consumers from mid-1920's to the outbreak of the war. If there is a tin smelter within the consumer's country, the stocks of metal at the domestic smelter must be inserted after (b), and the ores afloat to his smelter after (d). The presence of domestic tin mines will also alter the list accordingly.

### Dependence of Demand upon Consumers' stocks.

16. Given the rate of consumption, the consumer's demand

for tin largely depends upon the stock of tin in hand. There is a minimum limit below which working stock cannot be allowed to fall without causing some inconvenience to him. (See Note 14) It is generally assumed in theoretical discussions that the minimum working stock is a percentage of the expected rate of consumption, but expectation is not a uniquely determinate concept, (See Note 15) and the study of manufacturers' past behaviour suggests that the minimum working stock of tin is constantly changing, both in absolute amount and as a percentage of the consumption rate. However, there is no doubt that, over a period of years, as the consumers' stocks fall to a low level, the demand for consumption will be reinforced by the consumers' attempt to replenish their working stocks. On the other hand, there are other instances when the stocks in consumers' hands reach such a high level that there is no doubt that the marginal yield of convenience is negative. In this case, the consumption demand is weakened to the extent of stocks depletion.

## II Digression on the Statistics of Tin Stocks.

17. Statistics of tin related to stocks, shipments, and deliveries were issued, before the war, by three market authorities in London : W.H.Gartsen (or Ricard & Freiwald),

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Note 14 J.M.Keynes : Treatise on Money, Vol I, p.128. J.Tinbergen : "An acceleration principle for Commodity Stock-holding and a short cycle resulting from it" in Studies in Mathematical Economics and Econometrics in Memory of Henry Schultz. (ed. by Lange, McIntyre & Yutema - U.of Chicago Press, 1942. p.256

Note 15 R.G.Hawtrey : "Mr.Kaldor on the Forward Market" (RES.Vol.VII No.3, June 1940) pp.202-205.

A.Strauss & Co. and the London Metal Exchange, all compiled on different bases. They are all unsatisfactory from our point of view, since several items were not included in the published data. (See Note 16). In the 1930's, some improvement resulted from the efforts of such bodies as the International Tin Research and Development Council, the American Bureau of Metal Statistics, and the U.S.Bureau of Mines; and after the war, the International Tin Study Group has carried on the good work, but there are still serious deficiencies. For the period between the wars, published stocks are called "Visible Supply and Carry-over". Visible supply consists of stocks in the warehouses and landing, plus tin afloat to all important consuming countries. Carry-over figures represent the stocks of tin at the Straits Smelters since 1927, and Arnhem Smelter in Holland since 1933.

Consumers' stocks for the world as a whole are not available; but estimates are published for those in U.S.A. from 1926, and for U.K. from 1938.

No information is published of the stocks of tin metal at the U.K. smelters, at Banka, and at European smelters other than Arnhem. Smelters' stocks are computed by the ITRDC and circulated among members of the International Tin Committee. They are treated as confidential. Equally

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Note 16. See below, and London & Cambridge Economic Service: Special Memoranda No.32, Sept.1930, pp.11-13 and No.45, Nov.1937, pp.12-14.

unknown are the stocks of tin ore for most countries.

Usually included in the visible stocks statistics were the stocks of the several International Tin Pools. They were, however, revealed from time to time at irregular intervals. Private pools, which are known to exist, involving large quantities of tin naturally remain secret.

With so many deficiencies, a study of the relation between stocks, consumption and price of tin, is bound to be extremely limited, and conclusions must be subject to reservations. The necessity, even the urgency, of improving statistics in this field is obvious, particularly since it has become more and more realised that the problems of tin must be solved by international co-operation by studies and agreements.

III U.S.Consumers' Stocks.

18. The figures of consumers' tin stocks in the U.S.A., are published by two authorities independently: the Bureau of Mines and the American Bureau of Metal Statistics. The figures published by the official Bureau of Mines are based upon the answers to the questionnaires sent out to industrialists in connection with the Bureau's studies of domestic tin consumption, since 1928. No explanation has been given of the ABMS's figures; but closer examination suggests that they are calculated from the figures of deliveries and consumption: the difference between these, positive or

negative, being taken as resulting in a corresponding change in the consumers' stocks. Both sets of figures started from 1926/7 and show a remarkable measure of agreement with each other, except for the period 1936-1938. In the following table, we use the A.B.M.S. figures from 1926 to 1934; the Bureau of Mines' figures, which probably take account of the "invisible deliveries" (i.e. deliveries made directly to the consumers without passing through the recording market), are preferred for the period 1935-1938. For the earlier period 1921 to 1925, we venture to make estimates on the same basis of calculation as the A.B.M.S. The results are as follows in Column (1):

Table III.2.

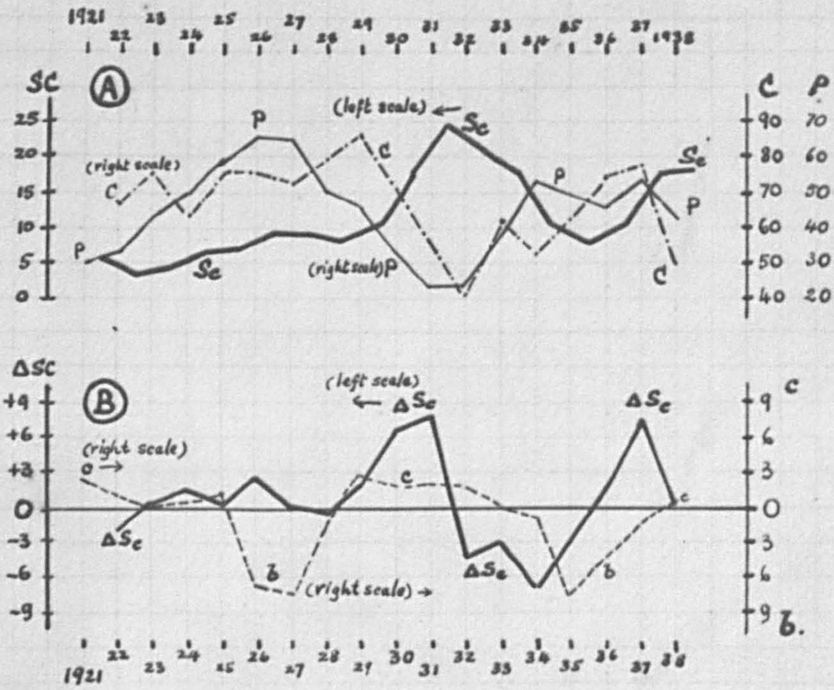
Stocks of Tin in the U.S.A.
(in thousands of long tons)

| | (1) Consumers Stocks at end of year | (2) Consumption | (3) (1):(2) % | (4) Afloat annual average | (5) Warehouse & landing. Annual Average | (6) Total Visible Stocks (4):(5) | (7) (5):(2) % | (8) (6):(2) % | |
|---|---|---|---|---|---|---|---|---|---|
| 1921 | 5.8 | - | - | 3.3 | 2.4 | 5.7 | - | - | 1921 |
| 1922 | 4.4 | 67.0 | 6.6 | 7.1 | 2.5 | 4.6 | 3.7 | 14.3 | 1922 |
| 1923 | 4.9 | 76.3 | 6.4 | 7.1 | 2.7 | 9.8 | 3.5 | 12.8 | 1923 |
| 1924 | 6.2 | 63.3 | 9.8 | 6.9 | 3.4 | 10.3 | 5.4 | 16.3 | 1924 |
| 1925 | 6.8 | 76.0 | 9.0 | 6.6 | 2.9 | 9.5 | 3.8 | 18.3 | 1925 |
| 1926 | 9.2 | 76.0 | 12.1 | 6.1 | 2.2 | 8.3 | 2.9 | 11.0 | 1926 |
| 1927 | 9.2 | 72.6 | 12.7 | 6.2 | 2.1 | 8.3 | 2.9 | 11.4 | 1927 |
| 1928 | 8.6 | 79.6 | 11.2 | 7.0 | 2.7 | 9.7 | 3.4 | 12.2 | 1928 |
| 1929 | 10.6 | 87.0 | 12.2 | 7.6 | 2.9 | 10.5 | 3.3 | 12.1 | 1929 |
| 1930 | 17.2 | 71.6 | 24.0 | 7.0 | 5.4 | 12.4 | 7.5 | 17.3 | 1930 |
| 1931 | 24.9 | 55.8 | 44.6 | 6.5 | 6.2 | 12.7 | 11.1 | 22.8 | 1931 |
| 1932 | 20.6 | 40.6 | 50.8 | 2.8 | 4.3 | 7.1 | 10.6 | 17.5 | 1932 |
| 1933 | 17.5 | 61.1 | 28.6 | 4.2 | 4.4 | 8.6 | 7.2 | 14.0 | 1933 |
| 1934 | 10.6 | 53.3 | 19.9 | 3.2 | 5.6 | 8.8 | 10.5 | 16.5 | 1934 |
| 1935 | 7.8 | 62.0 | 12.4 | 4.6 | 3.4 | 8.0 | 5.5 | 12.9 | 1935 |
| 1936 | 10.2 | 74.0 | 13.8 | 6.9 | 3.1 | 10.0 | 4.2 | 13.5 | 1936 |
| 1937 | 17.7 | 78.1 | 22.7 | 7.9 | 5.1 | 13.0 | 6.5 | 16.6 | 1937 |
| 1938 | 17.9 | 50.6 | 35.4 | 4.7 | 4.7 | 9.4 | 9.3 | 18.6 | 1938 |

Sources: (1) see text. (2) 1922-1926 Metallgesellschaft 1927-38 ABMS. (4) & (5) W.H.Gartsen; annual averages computed from stocks at end of months.

# FIGURE III. 2.

## U.S. CONSUMERS' STOCKS OF TIN
*compared with Consumption and Spot & Futures Prices.*




$S_e$ = Consumers' Stocks ('000 long tons)
$\Delta S_e$ = Changes in $S_e$ ('000 long tons)
C = Consumption ('000 long tons)
P = Price (Spot – average – cents per lb.)
c = Contango (average – £ per ton)
b = Backwardation (average – £ per ton)

The Table shows that during the period observed, consumers' stocks of tin in the U.S.A. fluctuated very widely - between 4,500 tons and 25,000 tons. Expressed in terms of current rate of consumption, they vary between four weeks and six months. A clear-cut distinction cannot be made between the convenient working stocks and the "redundant stocks" or "speculative stocks", as is sometimes supposed in theoretical discussions; but the figures suggest that the minimum working stock in the hand of the consumers is about 12% of the annual consumption rate - or about 6 weeks' consumption. A large proportion of the tin held between 1930 and 1933 can be considered as a surplus above the convenient working stock, whether speculative or otherwise.

Influence of prices.

19. Spot price of tin appears to exert very little influence upon the size of the stock at any point of time. The questionnaires that have formed the basis of the U.S. Bureau of Mines studies of tin consumption since 1928 brought in answers which indicate that manufacturing requirements rather than current price of the metal determine the stocks carried by consumers of virgin tin. (See Note 17) During the depression, large stocks coincided with low price, but they began to be drawn upon in 1932, while price was still very low and declining. On the other hand, while price was high in 1936

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Note 17. Minerals Yearbook: successive years.

and 1937, consumers resumed the accumulation of stocks which had fallen towards a minimum in 1935. (See Note 18)

20. The divergence between spot price and future price usually causes a change in the size of consumer's stocks. Other things being equal, when a big backwardation occurs, i.e. when tin for delivery in three months stands at a price appreciably lower than tin for immediate delivery, the consumers can save the difference by keeping their stocks as low as possible, and covering their known prospective requirements by buying forward instead of keeping the actual metal on hand. This actually happened in the period 1933-1935 (See Chart B). However, there are exceptions which indicate that backwardations and contangoes are by no means a safe guide to the size of stocks. The depletion of stocks which began in 1932 could not be explained by the future price, since there was a substantial contango up to the middle of 1933. Moreover, when the consumers consider their stocks to be precariously low, compared with current and expected consumption, no amount of

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Note 18. J.K.Eastham apparently implied that the demand to hold stocks is fairly elastic when he said that "with given expectations of demand to consume, the elasticity of demand to hold stocks is certainly not zero". (loc.cit.p.13) This is true if the demand is interpreted as speculator's demand, and the relevant price would be the expected price. Consumers may well behave as speculators in certain circumstances, but no simple relation between spot price and stocks is revealed by statistics.

backwardation will persuade him to part with his stocks. During the boom of 1926/1927, a very wide backwardation appeared for two years, but stocks were kept fairly stationary, only declining by a small amount in 1928 when the backwardation margin became narrower.

21. Backwardation and contango reflect the general expectation about price, and it is the expected price, together with the expectation of consumption which determine the size of consumers' stocks. If price is expected to rise, consumers will tend to replenish their stocks and carry them over, taking account of the carrying costs (storage and interest charges), uncertainty premium of expectation, and the convenience yield. (See Note 19). Conversely, if price is expected to fall, the consumers will tend to deplete his stocks. Expectations may be affected by rumours and estimates of various kinds regarding production and consumption. In the case of a commodity subject to artificial control, there are additional factors which come into the consideration. For instance, during 1936, despite the excellent prospects of consumption, consumers in the U.S.A. restricted purchases of their nearby needs because of the change, which at times appeared to them most promising, that the restriction scheme would not be renewed at the end of the year. When agreement to renew the restriction scheme

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Note 19. N.Kaldor: loc.cit.pp.5 - 8.

was announced in November 1936, American consumers bought forward and replenished their stocks by about 6,000 tons in the first quarter of 1937.

22. That American consumers of tin, despite the hedging facilities offered to them on the London Metal Exchange, have often taken a market position as regards tin, is also borne out by the statements of the consumers themselves.(See Note 20) Moreover, the consumers need not always remain passive, and simply react to price. A moderately big stock in their hand may enable them to manipulate deliveries in order to strengthen or weaken the market, especially if they act collectively. (See Note 21). This consideration was probably prevalent among American consumers in the late 1930's. Apart from anticipation of war, the possibility of the stocks as a defensive weapon against the restriction scheme explains the fact that, from 1936 onwards, the stocks carried by the consumers were higher, both in absolute amount and in comparison with consumption, than the period before the slump.

~~Large Stocks.~~

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Note 20. e.g. Testimony of the President of the U.S.Steel Corporation, N.Y., to the Tin Investigation Committee, op.cit. p.1020.

Note 21. There is no evidence to substantiate the last proviso, although producers in 1928 complained that American consumers attempted in this way to depress the price of tin. ("Tin" published by the Anglo-Oriental Mining Corporation, July,1928)

Large Stocks During the Slump.

23. It can be concluded, from the above consideration, that the minimum size of consumers' tin stocks in the U.S.A., is determined by consumption requirements, and that the change in the size, in normal time, with given rates of consumption, depends upon the expectations of price, rather than on the spot price. These considerations are not sufficient to explain the enormous stocks carried by the consumers between 1930 and 1933, which at times attained 25,000 tons, or about six months' consumption. It is not easy to assess the real intention of the manufacturers holding these stocks; but if they deliberately held them for speculative purposes, their accurate foresight has rewarded them with a handsome profit. An alternative explanation is that the consumers might have been misguided into over-optimism by the boom of 1926-1929 and bought heavily, expecting the boom to continue. If so, when the slump came, they found themselves with redundant stocks, carried them over the hard times, and reaped the unplanned profit in the end. Whatever the real motive, the consumers had rendered a service to the producers by supporting a declining market at the beginning of the depression, and a disservice by delaying the up-turn of the price-cycle. In fact, while consumption only declined by 12,500 tons between 1931 and 1932, deliveries fell by 27,100 tons, the difference being the change in the size of stocks. What happened between

1929 and 1933 may or may not recur in the future; but the case considered is an illustration of the difficulties confronting any organisation set up to smooth out the fluctuations in the tin market, and it also illustrates the need for a more complete statistics of consumption and stocks.

IV <u>U.S."Visible Stocks"</u>

24. The quantities of tin afloat and in the warehouses (columns (4) and (5) of Table III.2) are not strictly speaking 'consumers' stocks. They are the "pipe-line" tin which ensures the continuity of supply to the consumers in the second and third orders of availability. It is therefore to be expected that they should show a positive correlation with consumption. This is true of the quantity afloat (compare columns (4) and (2)). Warehouse stocks, on the other hand, show movements opposite to those of consumption: tending to accumulate during the slump and to be depleted when consumption resumes strength. The ratio of warehouse stocks to current rate of consumption varied, during the period, between 3% and 11%. The fluctuations in tonnages, however, were not very large (column (5)). (See Note 22).

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<u>Note 22.</u> K.E.Knorr (op. cit.p.30) mistook the warehouse stocks for consumers' stocks. He was therefore led to conclude that (1) "the cost and risk-if hedging is not practiced - involved in holding tin stocks tends to keep working stocks of industrial consumers relatively small in comparison with consumption" and that (2)"the influence of this demand for the metal (to hold as stocks) is correspondingly limited." These impressions are typical of many writers on the subject. Neither is true, as has been shown in paragraphs 15 and 16.

The two quantities (warehouse stocks and tin afloat) combined showed a remarkable stability throughout the period under observation, representing between six and eleven weeks' consumption. It appears that six weeks'"visible supply" (as it is called) can be taken as the minimum required in the pipeline for the U.S.A., since spot price tended to rise sharply, and backwardation widened as the visible stocks declined to this level. A large stock of ten or more weeks in the U.S.A., especially with big stocks elsewhere, had the effect of depressing price. On the other hand, there is no indication that either the spot price or a discrepancy between spot and future prices exerted any direct influences upon the size of the visible stocks.

V. <u>U.K.Stocks</u>.

25. Figures of consumers' stocks in other countries are not available, not even in estimates. For the United Kingdom, they have been available since 1938, at the end of which year British tin consumers held 2,250 tons, or six weeks' consumption. It is a known fact that U.K. consumers usually carry much smaller stocks than their American counterparts, probably because they are nearer to the sources of supply: the London Metal Exchange and especially the smelters.

Because U.K. was the world market for tin, as well as an important smelting centre, the "visible stocks" in the warehouses and landing in U.K. cannot be regarded as serving the same purpose as those in U.S.A. Table III.3 illustrates this point. During the depression, tin unwanted elsewhere accumulated in the warehouses in U.K., especially in Liverpool (stocks in London and Swansea were more stable). As demand revived, U.K. visible stocks dwindled, and at times reached a level below 1,000 tons. In normal times, they varied between 4,500 tons and 7,000 tons. Table III.3, incidentally, does not include stocks of tin carried by U.K. smelters, which are not published.

Table III.3.

Visible Stocks of Tin in U.K. Warehouses.
annual averages computed from stocks at end of months in '000 long tons.

(Source : W.H.Gartsen - London)

| | | | | | |
|---|---|---|---|---|---|
| 1921 | 7.2 | 1927 | 1.6 | 1933 | 21.0 |
| 1922 | 6.9 | 1928 | 3.2 | 1934 | 5.1 |
| 1923 | 4.6 | 1929 | 9.3 | 1935 | 2.8 |
| 1924 | 4.4 | 1930 | 20.3 | 1936 | 1.0 |
| 1925 | 4.5 | 1931 | 29.1 | 1937 | 2.4 |
| 1926 | 2.0 | 1932 | 32.5 | 1938 | 6.5 |

VI World Visible Stocks.

26. Figures of consumers' stocks for the world as a whole are not available. Attempts have been made by the London and Cambridge Economic Service to estimate the changes in consumers' stocks and by a Dutch writer Ir.P.Hovig to estimate the size of the stocks, on the basis of the difference

between "apparent consumption" (See Note 23) and estimated actual consumption. This appears to be incorrect, since apparent consumption is computed from net imports or published deliveries, plus domestic production, allowing for changes in visible stocks, and not from the figures of actual deliveries. For the U.K. and Europe, deliveries which did not pass through the market, and therefore were not entered in the trade returns, are known to be large, and the margin of error in the estimates is correspondingly widened. (See Note 24). (U.S. invisible deliveries were negligible and this accounts for the fact that the ABMS's estimates of consumers' stocks agree closely with the figures of the Bureau of Mines, obtained from questionnaires - see paragraph 18.)

Our discussion is therefore restricted to the stocks which are published. In Table III.4, visible stocks are divided into two components: stocks-and-carryover and tin afloat; and they are compared with consumption and average price. Stocks in individual countries, other than the U.K. and the U.S.A. are of no particular interest, and the world total is therefore presented here:

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Note 23. For definition of "apparent consumption, see Ch.II, Table II.15.

Note 24. LCES: Special Memorandum No.45, Sept.1937, p.14. Ir.P.Hovig: "De Tin Positie" (Economisch Statistische Berichten Vol.XXIII, 27/4/1938) p.316. Hovig's figures for world consumers' stocks are even smaller than the figures for U.S. consumers in our Table III.2 above. The figures are used by M.J.Schut, op.cit., Ch.III, and should somewhat affect the latter's conclusions.

## Table III.4

## World Visible Stocks of Tin.

Stocks : annual average computed from end/month figures.
Consumption : annual total.
Both stocks and consumption in '000 of long tons.

| | 1<br>Stocks and carry-over. | 2<br>Afloat | 3<br>Total Visible Stocks. | 4<br>Apparent Consumption. | 5<br>(3):(4)<br>% | 6<br>Price £ per ton annual average. |
|---|---|---|---|---|---|---|
| 1922 | 12.5 | 9.4 | 22.0 | 114.3 | 19 | 159 |
| 1923 | 9.5 | 9.5 | 19.0 | 125.5 | 15 | 202 |
| 1924 | 8.9 | 10.6 | 19.5 | 133.1 | 15 | 249 |
| 1925 | 7.8 | 10.9 | 18.6 | 150.9 | 12 | 261 |
| 1926 | 4.3 | 10.6 | 14.9 | 138.3 | 11 | 291 |
| 1927 | 5.0 | 11.0 | 16.0 | 153.8 | 11 | 289 |
| 1928 | 7.7 | 11.9 | 19.6 | 172.9 | 11 | 227 |
| 1929 | 14.5 | 12.7 | 27.2 | 182.2 | 15 | 204 |
| 1930 | 28.4 | 11.8 | 42.2 | 155.2 | 27 | 142 |
| 1931 | 44.6 | 10.8 | 55.4 | 134.7 | 42 | 118 |
| 1932 | 52.3 | 6.1 | 58.4 | 107.4 | 54 | 136 |
| 1933 | 37.3 | 7.1 | 44.4 | 133.2 | 33 | 195 |
| 1934 | 15.7 | 6.4 | 22.1 | 132.4 | 17 | 230 |
| 1935 | 9.2 | 7.7 | 16.9 | 150.4 | 11 | 226 |
| 1936 | 7.2 | 10.0 | 17.2 | 163.3 | 11 | 205 |
| 1937 | 11.9 | 11.6 | 23.5 | 196.0 | 12 | 242 |
| 1938 | 20.4 | 7.7 | 28.1 | 155.5 | 18 | 190 |

Sources: 1, 2 and 3. W.H.Gartsen, London.
4 : 1922-26. ITRDC (underestimated in my view but best available.) 1927-38 ABMS.

Note: Stocks figures do not include Straits carry-over before 1926, and Arnhem carry-over before 1933.

As in the case of the U.S.A., the quantity afloat fluctuates in accordance with the rate of consumption, but movements of the warehouse stocks and smelters' carry-overs are similar to those of the U.K. - i.e. accumulating during the slump and decumulating during the boom. Since the fluctuations of warehouse stocks are larger than those of tin afloat, the combined result is a fluctuation in a direction opposite to that of consumption.

Total visible stocks in normal times appear to be about 15% of consumption, or between seven and eight weeks. In the short-run, the figures of visible warehouse stocks in Column 1 are more important for the determination of price. In 1926 and 1927, warehouse stocks at times were reduced to about 10 days consumption, and spot price was then sharply raised. The same phenomenon recurred in 1935/37. Conversely, a large visible stock exerts a strong downward pressure upon price. The peak level of visible stocks was reached in April, 1932, at 60,547 tons. The average price during the month was £111, despite a drastic curtailment of production.

There is no evidence of any short-run reaction of the size of stocks to price. As in the case of U.S.A., analysed above, expectation about business activities is the predominant factor, and is usually reinforced by the influence of a backwardation or contango.

Opinions have been expressed on the question of the question of the minimum visible stocks necessary for an undisturbed flow of tin from producers to consumers.(See Note 25)

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Note 25. Minerals Yearbook 1930, (U.S.Bureau of Mines), believed that 12,000 tons of visible supply was the minimum. This opinion was questioned by "Tin" April 1930 (AOMC) and criticised as an under-estimation.

In the 1930's, the principal consumers were separated from the smelters by long journeys across the oceans, and a total visible stock of 6 weeks' consumption was then a bare minimum; an amount equal to 8 weeks' consumption would be a comfortable level for working stock. With a large smelter producing in the U.S.A., the minimum stock is reduced to some extent, but the concept of minimum visible stocks has little use, unless more details are known about the invisible consumers' stocks.

# CHAPTER IV

## TIN MINING AND SMELTING

## (A) THE TECHNOLOGY OF TIN MINING (See Note 1)

### I. Mining Methods

1. The most important commercial source of tin is a mineral known as "cassiterite" or dioxide of tin, or more commonly called "Tinstone". Tin ore deposits exist in two main forms :-

(a) Primary deposits: These are in lodes in the form of stanniferous veins, stockworks, and impregnations in granite and contiguous rocks. Tin mined in Bolivia and in the West of England comes almost entirely from primary deposits.

(b) Secondary deposits: These result from the disintegration of the primary deposits through weathering agents (rain, etc.) The tinstone thus detached has often been carried over considerable distances by streams or rivers, and has settled in the river beds or on their banks, as "alluvial" deposits. Secondary deposits are the chief source of tin in South-East Asia and Africa.

"Secondary tin deposit" is not to be confused with "Secondary tin"; the latter phrase means tin which is recovered

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Note 1 The technological information on Tin Mining and Smelting which appears in this Chapter is collected from such standard work as W.R.Jones: Tinfields of the World (Mining Publications Ltd., 1925), C.L.Mantell: Tin(New York 1929), and from more recent publications of the Tin Producers' Association, the International Tin Research and Development Council and the U.S. Bureau of Mines.

from the metal used in tinplate scrap and other products containing tin. In order to avoid confusion, we shall use "lode deposit" to mean "primary deposit" and "placer deposit" to mean "alluvial deposit". Tin directly produced from the mines - both lode and placer mines - will be called "virgin tin", and "second-hand" tin will be called "recovered tin", or following widespread usage "secondary tin".

Of the world output of tin ore before the last war, about 25% came from lode mines, and 75% from placer mines.

2. Lode deposits are generally deep underground; placer deposits, as a rule, are found on or near the surface of the earth. The method of ore extraction, therefore, varies according to whether the deposits lie deep in the ground or near the surface. With rare exceptions, lode tin is mined by the method of shafting, which is seldom used in placer mining. In a placer mine, tin can be won by one or a combination of the following methods: (a) panning, (b) ground-sluicing, (c) opencast, (d) hydraulicking, (e) gravel-pumping, (f) dredging, and in exceptional cases (g) shafting. Most of these methods are not "mining" in the strict sense of the word.

(a) Placer Mining.

3. The general principle of placer mining lies in the fact that tinstone is a heavy material, whose specific gravity is 6.8 to 7.2; it is thus about 3 times as heavy as common

rocks and stones. Tinstone can, therefore, be easily separated from its gangue by means of water, which is an indispensable factor in placer exploitation.

4. <u>Panning</u>. Panning is practised in streams draining tin-bearing grounds. It is the most primitive method of tin winning, requires no initial outlay other than the cost of the pan, and has the further attraction for indigenous peoples that it can be carried out by children and elderly folks. The pan (See Note 2) is a large round dish-like article, frequently made of wood, or thin mild steel, in which by a swirling movement, water is made to carry away the lighter minerals and rocks, leaving the tinstone as a concentrate. Normally, 1 to 1½ cubic yards of earth can be treated by each person per day, yielding 1 to 2 lbs. of tin concentrates. In exceptional cases the yield may be as high as 20 lbs. Panning is the only suitable method of mining in a narrow stream full of large boulders.

Shallow placer deposits on top of tin-bearing hills may be mined by trenching, and the values so obtained are then panned.

5. <u>Ground-sluicing</u>. When the mineral occurs on hillsides where sufficient water is available, and where mine

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<u>Note 2</u>. The pan is called "Dulang" in Malaya; Dulang washing is a fairly important occupation, especially among women and children in most producing countries in normal times.

tailings can be allowed to run into low-lying areas, ground-sluicing used to be the method adopted. It consists of shifting the loose stanniferous deposits into conveniently dug trenches, where the swift-flowing water carries away the lighter materials and leaves the heavier minerals - tinstone- in the upper part of the trenches. The impure concentrates are then removed and cleaned in the small sluice boxes. This is a method suitable for working low-grade deposits that cannot be economically worked by any other method, but recently it has lost favour because the mine tailings damage agricultural land, roads, railways in the valleys below. Various governments have either prohibited ground sluicing or made regulations regarding the disposal of tailings, which render this method more expensive and less attractive.

6. <u>Opencast, Hydraulicking and Gravel-Pumping</u>. A variety of tin-winning methods are included under this heading, ranging from the most primitive method of exclusive hand labour to the more capitalistic methods using water-pressure and pumps. The common idea is to (a) break up the tin-bearing ground, and (b) carry the broken ground to the surface where it is washed in sluice-boxes.

(a) The ground may be cut by the following methods:

(i) by steam navvies, mechanical shovels or drag-lines which make large excavations;

(ii) by hand labour using a kind of instrument like a hoe;

(iii) by water under natural or artificial pressure. Powerful jets of water are made to issue out of a nozzle of a monitor (similar to a large fireman's jet), and to break up the ground. This is "hydraulicking".

(b) The ground is raised to the sluice-boxes

(i) in cane baskets (or in pails if it is too muddy), suspended at each end of a pole which the coolie carries on his shoulder. This is often done by relay, as the height is sometimes as much as 60 feet or more;

(ii) by trams, or small trucks drawn by men, animals, steam or electricity;

(iii) by gravel-pumps, driven by steam or electricity;

(iv) by hydraulic elevators worked by suction.

The material is washed in trough-shaped sluice-boxes. Water is brought into the head of the box, the broken ground introduced at the side. Water carries the earth and other light materials down the sluices, leaving tinstone behind.

The most primitive Chinese mines employ exclusively hand labour with hoes to break up the ground, and coolies to carry the Karang (broken up ground) to the surface. Better equipped mines combine hydraulicking with gravel-pumps or hydraulic elevators. Since 1918, gravel pumps have become more and more popular with the Chinese and native mines in South-East Asia. Gravel pumping has the attraction of being a labour-saving method, and at the same time necessitating moderate capitalisation. Women can be employed, especially to clean up the sluices.

7. Bucket dredging: A bucket dredge is a self-contained floating factory built on a pontoon which floats in the working paddock. An endless chain of steel buckets dig up the soil from the bed of pools or rivers at depths varying up to over 100 feet. The soil thus excavated is deposited in a hopper and cleaned by automatic processes.

The work is performed and the tin concentrates produced inside the dredge. Tailings are cast out behind as the dredge moves along. Most of the early dredges were steam-driven, but modern ones are fitted with electric generators or driven electrically from a central power station. It may be made to work 24 hours a day. The pontoon floats in the rivers with tin-bearing beds; but sometimes the dredge may work out in sea bays. Where sufficient depth of water on land is not available, a big pool is dug for dredges in which they float across a wide expanse of country, taking their pool with them. Sometimes hydraulic dredges are used to help in the digging process.

Most of the bucket dredges in commission in the late 1920's had a capacity of digging about 130,000 cubic yards of sand and gravel per month, producing between 30 and 60 tons of concentrates. In 1930, a new dredge of a Malayan Company had a monthly throughput of 268,000 cubic yards and output of 86 tons of concentrates. Dredges constructed in the United States in 1946 for the Netherlands East Indies have a monthly capacity of about 400,000 cubic yards, and an estimated yield of about 150 tons of concentrates.

The great advantage of dredging is that low-lying deposits in swampy or very wet ground can be worked at a lower cost per cubic yard than by any other method. Extensive low-grade areas not previously economically workable have been treated with marked success by dredging. A well known case is that of the flat lands near Taiping, Perak, in Malaya, where very extensive areas that had previously been partly worked by Chinese and abandoned as being unworkable, have been dredged with excellent results. A modern dredge may successfully operate on a ground with cassiterite content as low as ½ lb. per cubic yard or 1 part in 8000.

A bucket dredge represents a considerable initial cost - in the 1930's it was between £50,000 and £250,000; in 1946 Dutch dredges bought from the U.S.A. were reported to cost $3,000,000 each.

On the other hand, dredging is a labour-saving device. It was alleged that in 1929 on the average, a dredge employed 160 men and that its output of concentrates was equivalent to the amount won by 2,000 Dulang-washers (See Note 3). Comparing the two peak years, 1929 and 1937, in Malaya, we see that in 1937 tin production increased by 12%, with a 16% reduction in employment. Malayan output per head per year has risen from 0.5 tons in the late 'twenties to 0.8 tons in the late 'thirties.

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Note 3. "Tin" (A.O.M.C.) April 1929.

Dredging is unsuitable as a mining method in an area where the surface of the bedrock on which the deposits rest is irregular, unless the deposits are thicker than the dredging depth. The presence of much clay, sunken tree trunks and boulders in the deposit is also a serious obstacle to the working of a dredge.

Bucket dredging was initiated into the tin industry by an Australian in 1907, operating in the bay of Buket Island of Siam. It was introduced into the Federated Malay States in 1912. Since then it has spread throughout Malaya and other alluvial fields. The number of dredges operating in Malaya rose from 2 in 1912 to 18 in 1919, 40 in 1925, 105 in 1929; during the 1930's, owing to the restriction in output, it fell to 23 in 1933 but rose again to 93 in the peak year of 1937. The tonnage of tin produced by dredges in Malaya was as follows:-

| | |
|---|---|
| 1913 | 162 tons = 0.3% of total Malayan output. |
| 1924/5 | 9,000 tons = 20.0% of total Malayan output. |
| 1929 | 25,950 tons = 38.9% of total Malayan output. |
| 1937 | 36,180 tons = 48.2% of total Malayan output. |

Similar trend was shown of the importance of dredging in Siam, N.E.I., Burma and other placer mining countries.

8. <u>Suction-cutter Dredging</u>. In a suction cutter dredge the appliances for cutting and elevating the ground, instead of being buckets, consist of a rotating cutter similar to an ordinary electric fan, only much bigger. The broken ground is sucked up to the pontoon by a powerful gravel-pump. Although

a suction-cutter dredge costs much less than a bucket dredge, and is more efficient in an area with very eroded limestone, it is unsuitable for deposits carrying much tenacious clay. (See Note 4). Producers in Malaya, after some experiment in the early 1920's, decided against it, but a few suction-cutter dredges were still in use in the Dutch East Indies right up to the last war.

9. Shafting: Where the ore-bearing gravel is very deep, underground mining is necessary. This method is rarely used except in Nigeria.

10. The following table for Malaya illustrates the relative importance of the above methods:-

Table IV.1

Relative Importance of Various Mining Methods in Malayan Tinfields.

| Methods | Percentage of Total Output 1928 | 1937 |
|---|---|---|
| Dredging .. .. .. | 30 | 48 |
| Gravel-pump .. .. | 45 | 38 |
| Hydraulic .. .. | 8 | 4 |
| Other open-cast .. | 6 | 4 |
| Dulang washing .. | 2 | 1 |
| Alluvial shafting .. | 0.4 | 0.05 |
| Lode Mining .. .. | 6 | 4 |
| Miscellaneous .. .. | 2 | 0.1 |

Source: F.M.S. Mines Department - Statistics relating to the Mining Industry.

Note 4. W.R.Jones, op.cit. pp.87/88.

Dredging and Gravel-pump mining are the two most important methods; the former has taken the first place from the latter since 1932.

(b) Lode Mining.

11. Lode tin can be won in some cases in the same way as has been described above for placer tin. These are the cases where the rock is much decomposed and where the veins carrying tinstone are narrow. Such cases are, however, rare. The most common method in lode mining is the underground method.

Underground mining is possible in two ways, according to the configuration of the ground. If the deposit is above the general ground level, i.e. if the lode is traceable near the base as well as on the upper portion of a hill, it can be reached by "adits" or tunnels, i.e. horizontally, but if the deposit is below the ground level, shafts have to be sunk vertically. The rock is broken down in the working face by blasting, machine and hammer drills being frequently used to hole the rock for the insertion of explosives. The broken rock is hauled to the surface, thence to the mill.

Given deposits with the same tin content, underground lode mining is more expensive than placer mining (and this, apart from the extra costs of washing and milling lode ores which are generally more complex). The workings have to be kept drained and ventilated, the roofs and sides supported where necessary, and the work must be carried out by artificial light. Moreover there are inherent risks in lode mining which cannot be provided against. The lodes may turn out to be poor, the mineral may change entirely in character, more water may be met with than was expected, and the value of a lode deposit cannot be proved until considerable outlay has been incurred. This is probably an important reason why in lode mining countries such as Bolivia, there are fewer and larger mining units than in other fields.

Moreover, the deeper the shafts go below the water level, and the more the workings are extended, the greater the amount of water which will have to be pumped out. Pumping is a standing cost, whether production is in progress or not. This is a factor in the calculation of the miner when deciding upon whether or not to close his mine temporarily in the face of low prices.

An adit costs much less to drive per fathom than a shaft and no pumping is necessary.

12. Although tin lodes are known to exist in almost all the important tinfields of the world, most of the Asiatic lodes have not been exploited, not even prospected. In Malaya, one of the largest mines, comprises a series of lodes which are exploited both by shafts and adits. Tin winning in the Western Hemisphere, on the other hand, is and has been for a long time, in the form of lode mining, especially in the U.K. and Bolivia. In lode mining, the vein matter must in general carry from 1 to 2% upward tin to be economically workable, compared with .1% in the case of dredging.

## II Ore-dressing.

13. The methods of dressing the ores after mining vary according to the type and source of the ores. The materials from alluvial deposits in the East and Africa do not need elaborate treatment as the tin is more or less pure and free from foreign complicated elements, such as pyrite and wolframite. Nature has already done most of the work and a concentrate of 70% - 75.5% or more tin can easily be obtained by simply separating the tin oxide from earth, stones and other impurities by means of water. Complex ores from lode mines, on the other hand, need crushing, roasting, magnetic or chemical treatments in order to produce a concentrate which has a tin content of 60% or less.

### (a) Placer ores.

14. Washing placer ores is essentially two-stage sluicing with hand jiggling of coarse finishing sluice concentrate. First, coarse material is removed on a screen; the ore is cleaned up by hand on small film sizing tables and hand jigs, and further treated in lanchute sluices. Several streams of water are needed to separate the coarse concentrates from the fine ones, and middlings may have to be worked and reworked several times, but the process is relatively simple and unskilled labour can be used. In dressing placer ores, as in mining, water and a large supply of unskilled workers, who may be women, are the most essential factors of production. With the more widespread use of dredges and other labour-saving methods, the need for labour is lessened, although it still remains very important.

The ores mined by dredging are washed and dressed on the dredgers themselves. Since the late 1920's, the adoption of jigs in place of sluice boxes and then the improvement in the type of jigs used facilitated the handling of a larger amount of ground, and effected a greater saving of tin, thus decreasing the working costs still further.

(b) Lode ores.

15. Lode ores are generally complex. C.L.Mantell in his classic work on tin mining divides complex tin ores into four general classes :-

(i) Sulphide ores, low in lead and silver, but carrying no other metals of economic value;

(ii) ores with high silver values and economic amounts of gold, lead and copper;

(iii) ores containing workable quantities of tungsten and arsenic;

(iv) complex tin, tungsten and lead materials, worked for all three metals.

Some Bolivian ores fall into classes (i) and (ii). Class (iii) is exemplified by some Cornish ores, and Class (iv) by ores in New South Wales, Australia.

The economic significance of this classification lies in the fact that in Class (i) the product concerned is a single commodity, whilst in Classes (ii), (iii) and (iv) tin appears as one of many commodities, jointly produced from the same process. This fact is an element contributing to the inelasticity of the supply of tin with respect to price changes.

The technical process in dressing lode ores consists of two parts: (a) crushing the rock containing tinstone, and (b) separating the impurities from tin.

Cassiterite is often embedded in solid rock. By the process of crushing, which may be done by rock-breakers, stamps, rolls or ball mills, the particles of mineral are set free from the gangue in which they are enclosed. There is always a risk of breaking cassiterite crystals too finely so that a considerable proportion of the tin may be lost. An ore which contains the cassiterite in large crystals with a light gangue can be dressed cheaply with little loss. An ore in which the cassiterite is in very fine particles will yield a lower recovery and cost more to extract.

After crushing, impurities have to be eliminated from tin. Commercial values of these impurities such as lead, tungsten, arsenic, etc., are recovered and sold. Pyritic matter is eliminated by roasting; copper sulphate is removed from the roasted ore by "leaching" the latter with water. If the ore contains wolframite elements, a magnetic separation is needed. The presence of antimony, lead, bismuth, scheelite or sulphides requires chemical treatments, such as heating with sodium salts, or oil floatation.

16. The task of ore dressing is generally performed by the miners themselves, who may dispose of their concentrate in one of the following ways:-

(i) sell the concentrate to a smelting firm (this is the most common practice),

(ii) send the concentrate to the smelter for smelting but remain the owners of the metal, which they subsequently sell,

(iii) smelt the concentrate themselves, as is done by Chinese miners in China and elsewhere (the metal is subsequently sent for final treatment at a refinery).

Whatever the course a miner may take, the revenue per ton of concentrate which he receives will depend on: (1) the percentage tin content of his concentrate; (2) the amount and type of impurities contained in the concentrates. Excessive impurities are penalised for in the calculation of the concentrate value.

(B) MINING PRODUCTION BY COUNTRIES.

General Observations.

17. Tin has been known to be mined and used by man since times immemorial. In early days, Phoenician traders have travelled to the Iberian Peninsula and Cornwall to obtain tin for their bronze and pewter. Cornish tinfields were among the oldest to be exploited, and in the first half of the nineteenth century, they yielded between a third and a half of recorded world tin production. Other old tinfields on record were China the Malay Peninsula and Indonesia. The South American and

African deposits were probably exploited in the olden days by aboriginal peoples, but little is known about them. Bolivian output did not assume a significant magnitude until the 1890's. Nigerian production was stimulated during the first World War, and that of Belgian Congo, twenty years after. Australian production figures were important in the 1870's; but since then, they have gradually declined. World production was probably about 10,000 tons in 1800, it reached 100,000 tons a century later. This last figure was nearly doubled in 1929, and a little more than doubled in 1937. Between the last two dates, during the trough of the slump, occurred a serious drop in production, principally caused by world wide organised restriction of output. World production then fell below 100,000 tons for the two years 1932 and 1933. In the big wartime spurt, world output reached a record peak in 1941 when 238,000 tons of tin were won. After a long period of steady and gradual increase tin production of the world in the twentieth century exhibited two characteristics of rapid and large increases, and wide range of oscillations.

18. The rapid expansion of tin output in the first quarter of the present century was due to the intensive industrialisation of the Western countries, which created an ever-increasing demand for tin for use in machinery and food packing. This increase in demand drove prices up, and thus stimulated pioneer and adventurous searches for tin deposits. The result, when the

success of some pioneer work was made known, was cumulative for two reasons. The deposits were usually concentrated in large areas and one discovery almost automatically led to a number of discoveries in the neighbourhood. Secondly, tin deposits were found in difficult, mostly hitherto inaccessible, areas of the world. Once roads, railways, or even tracks and paths were traced, they opened the way for other less adventurous miners to follow on.

Up to the first World War, the increase in world tin production was effected mainly by the big increase in labour force, accompanied by a moderate improvement in the technique. After about 1910, the increase in labour force slowed down, and later actually turned into a decrease in absolute number at some stages, though production continued to rise.

19. Table IV.2 shows the principal countries in which tin concentrates are produced.

No important consuming country has tin mines within its own territory, except the U.K., whose mining glory is, however, a matter of history. Before 1942, South-East Asia and China produced more than 70% of world output, South America between 12% and 24%, and Central Africa about 9%.

Table IV.2.

Production of Tin Ore.

(in '000 long tons of metal content)

| | 1870 | 1900 | 1913 | 1921 | 1929 | 1932 | 1937 | 1947 | % of World Production in | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 1929 | 1937 |
| Malaya | 9.0 | 43.1 | 51.4 | 36.2 | 69.4 | ж 29.7 | ж 77.3 | 27.0 | 36.0 | 37.5 |
| N.E.I. | 7.3 | 17.6 | 20.9 | 25.4 | 35.9 | ж 15.7 | ж 39.1 | 15.9 | 18.6 | 18.8 |
| Siam# | + | 3.9 | 6.7 | 6.1 | 9.9 | X 9.2 | X 16.5 | 1.4 | 5.1 | 8.0 |
| China | 0.5 | 2.9 | 8.3 | 6.3 | 6.8 | 7.4 | 10.5 | 4.0 | 3.5 | 5.1 |
| Burma | - | - | 0.3 | 1.4 | 2.4 | 2.5 | 5.3 | 0.6 | 1.2 | 2.6 |
| Bolivia | 0.1 | 9.1 | 25.9 | 28.5 | 46.3 | ж 20.6 | ж 25.0 | 33.3 | 24.0 | 12.1 |
| Nigeria | - | - | 3.9 | 5.1 | 10.7 | ж 4.3 | ж 10.8 | 9.1 | 5.6 | 5.2 |
| Belgian Congo | - | - | - | 0.6 | 1.0 | 0.7 | X 8.9 | 14.4 | 0.5 | 4.3 |
| U.K. | 8.9 | 4.3 | 5.3 | 0.7 | 3.3 | 1.3 | 2.0 | 0.9 | 1.7 | 1.0 |
| Australia | 0.2 | 4.3 | 7.8 | 3.6 | 2.2 | 2.1 | 3.6 | 2.0 | 1.1 | 1.7 |
| World | 27.5 | 85.4 | 133.8 | 115.7 | 192.6 | 99.2 | 207.5 | 114.0 | 100.0 | 100.0 |

Sources: 1937 and 1947 ITSG; the rest ITRDC.
- = < 100 tons  ж = subject to quota restriction
# = export figures  + = included in Malaya.
X = subject to flat rate restriction.

The figures for 1947 illustrate the effects of the war and post war conditions. The outputs of all countries in the Far East were reduced by about 60%, compared with 1937 - 90% in the cases of Siam and Burma. Production in Belgian Congo and Bolivia, and in Nigeria to a smaller extent, was greatly expanded during the war, although it has been reduced a little since the end of hostilities.

The picture in 1947 is that of a transition, since the Eastern mines were being rehabilitated and reopened.

I South-East Asia.

Chinese and European.

20 Early mining activities were carried out by panning, primitive shafting and open cast methods employing almost entirely hand labour with simple tools and implements. In S.E. Asia, Chinese particiapation in tin mining dates as far back as the eighteenth century, probably earlier. The skill of Chinese miners was recognised by the native rulers of various states as superior to that of their own subjects, and on several occasions Chinese in Southern China were persuaded and enlisted to go to Malaya and Indonesia to work the mines. Several new towns in Malaya were created bearing Chinese names given to them by these emigrants. It was the violent quarrels among the Chinese miners regarding the ownership of mines in the district of Larut in 1872 which led to an intervention by the British, then in effective control merely of the Straits Settlements. In 1874, Perak, one of the two most important tin mining states in Malaya came under British rule. Since that date, "European",especially British enterprises began seriously to work tin mines in Malaya. (See Note 5 on the next page).

Previously European interests in tin from South-East Asia were mostly confined to trading activities. In Malaya, trading stations to control tin trade were established on the Perak and Selangor rivers in the 17th century by the Dutch. In Indonesia, the (Dutch) East Indies Company obtained a trade monopoly of tin from the Sultan of Palembang early in the 18th century; but mining rights in Banka and Billiton were first ceded to the King of England in 1812, and transferred to the Netherlands government four years later. In Siam, European tin winning did not start until the beginning of the present century.

Since the later part of the nineteenth century and the beginning of the twentieth, the share of "European" enterprises in tin mining in South-East Asia had increased considerably. The Indonesian mines have been exploited under Dutch control - both state and private - ever since 1816. The output from Siam was entirely from native mines in 1900: in 1929 five-eighths of her production was estimated to have come from Australian and British Companies, (See Note 6), the rest being

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Note 5 The first successful European tin mining company in Malaya was a French company: The Société des Etains de Kinta, formed in Paris in 1880. Since then few French companies have been set up in the tin industry in Malaya. In 1929, French interests controlled about 2% of the total Malayan output, equal to the control of American interests. The word "European" used in the text covers, as in common parlance, American and Australian, as well as people from Europe. In the same way "native" is meant to include Asiatic immigrants, such as Chinese in Malaya.

Note 6. William P.Rawles: The Nationality of Commercial Control of World Minerals. (The Mineral Inquiry, American Institute of Mining and Metalurgical Engineers, N.Y., 1933) p.37.

divided between Chinese and Siamese concerns in the ratio 2 : 1. In Malaya, in 1914, the Chinese produced about three-quarters,and the Europeans one quarter of the total output of 50,000 tons. In 1929, when total output was 70,000 tons, European mines contributed approximately 50%, (plus another 11% from their property sub-leased to Chinese) (See Note 7), and Chinese mines proper 36%. In 1940, the proportions were respectively 64%, (8%), and 27%, with a total of 80,700 tons.

The above figures, however, do not fully represent the importance which the Chinese still retain in tin mining in this region. In all types of mines, whether owned by Europeans or Chinese or any other nationality, whether state or private enterprise, an overwhelming proportion of the labourers employed are Chinese. (See Note 8). In Malaya, where more detailed statistics are available, the distribution of labour force in mining, according to nationalities, was as follows :-

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Note 7. European Companies sometimes granted sub-leases to Chinese miners over portions of their properties. The sub-lessee extracted the mineral values and paid tribute to the sub-lessor at rates varying between 10% and 25% of the output.

Note 8. "Anyone who has had any contact with the Chinese mining community of Malaya must be filled with unbounded admiration at the ingenuity of their methods of mining tin, both in the hills and in the plains, and at the assiduity with which they work; and no one will contradict the statement that from the earliest times in which there has been a mining industry in Malaya, the Chinese with their labour have been the backbone." (Sir Lewis Leigh Fermor, Report upon the Mining Industry of Malaya. (Kuala Lumpur 1939) (p.63).

Table IV.3.

Labour in F.M.S. Tin Mining Industry - By Nationalities.

| | Total | Percentages of Total | | | |
|---|---|---|---|---|---|
| | | Europeans | Chinese | Indians | Malays |
| 1922* | 82,000 | 0.4 | 93.0 | 4.6 | 1.9 |
| 1927* | 123,000 | 0.4 | 88.0 | 8.8 | 2.5 |
| 1933 | 39,000 | 0.7 | 86.1 | 8.6 | 4.2 |
| 1939 | 66,000 | 0.8 | 77.5 | 12.6 | 6.1 |

(* Total for all minerals for 1922 and 1927; tin only for 1933 and 1939)
Source: F.M.S. Mines Dept: Bulletin of Statistics relating to the Mining Industry.

The Chinese also form a high percentage of tin mining labour force in Siam, Indonesia, Burma and French Indo-China.

Labour and Productivity of Labour.

21. The number of labourers of all races engaged in tin mining activities increased considerably during the last half of the nineteenth century. The number in Malaya reached an all-time record of about 215,000 in 1907. Since then there was a steady decline, partly due to wartime and post-war slumps, but mainly due to the introduction and improvement of labour-saving machinery. Between 1908 and 1923, the output of Malaya was reduced by one-fifth; but the labour force was more than halved. In 1929, about 100,000 tin mines in Malaya produced nearly 70,000 tons of tin, whereas approximately twice that number was needed in 1909 for an output of 50,000 tons. Allowing for the differenc in the richness of tin deposits mined at the two dates, the productivity of labour must have increased by at least 150%.

During the severe restriction period of 1931-1933, the number of workers in Malayan tin mines shrank still further to about 39,000 at the end of 1933, since which date until the war, it remained between 50,000 and 80,000, surpassing the latter figure by a little in 1937 and 1940. In 1940, 82,500 workers produced about 83,000 tons of tin. The annual productivity per head of labour in Malaya was approximately as follows: (See Note 9)

| | |
|---|---|
| 1909 | 0.25 tons |
| 1919 | 0.37 tons |
| 1929 | 0.70 tons |
| 1940 | 1.00 tons |

Similar increase in productivity can be detected in the case of Siam, but no figures are available, except for 1937, when the annual product of labour in tin mining was slightly over $1^{1}/10$ ton per head. (See Note 10).

In Indonesia, after reaching a peak before the first World War, the number of the tin miners gradually declined while output increased. The average yearly outputs per head were as follows: (See Note 11).

| | |
|---|---|
| 1920 | 0.51 tons |
| 1929 | 0.86 tons |
| 1933 | 1.26 tons |
| 1940 | 1.66 tons. |

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Note 9. Calculated from data in F.M.S.Mines Dept.Bulletin of Statistics. In this and subsequent calculations the numbers of miners include those on development work. This, however, does not seriously affect the trend of productivity shown in the results.

Note 10. = $\frac{\text{Export}}{\text{Labour}}$, labour according to the 1937 census, See Statistical Yearbook.

Note 11. Calculated from data in Netherlands Indian Report: Statistical Abstract,(Centraal Kantoor voor de Statistiek van het Departement van Economische Zekin, Batavia).

## The Use of Machinery and Power in Malaya.

22. The increase in the productivity of labour in South-East Asian tin mining was due probably in a few cases to the discovery of richer deposits, but mainly it was due to the more extensive use of machinery run by steam, oil and electricity. After the failure in the earlier attempts, simple machines were successfully introduced in the Malayan tinfields: the chief attraction was that they could be handled by comparatively unskilled labour and therefore were subsequently adopted by Chinese miners. In 1877, steam engine and centrifugal pumps were suggested by the British Resident at Tupai near Taiping, to supersede the Chinese waterwheel and chain pump. The success of this government experiment induced a large number of Chinese miners to follow and instal similar plants in other districts. The first attempt to work tin mines by hydraulic sluicing took place in 1891 in Perak. In 1901, hydraulic elevators were put into use for the first time by the French Company, the Société des Etains de Kinta; and five years later, the first hydro-electric power station in Perak was established, also by the same company.

Gravel pumps of various sizes were already in use by the turn of the century. Just before the First World War, there started another stage of improvement, taken from the Australian gold mining method, in the form of large gravel pumps installed on barges that could be floated from one part to another of an open-cast mine.

Improvements in the transport system led to the lowering of the mining cost as well as the discovery of new rich deposits. The discovery of rich tin deposits on the Gopeng Hill was due largely to the construction of the first metalled road in Kinta. The adequacy of water supply was ensured by the construction, since 1900, of pipelines whose normal delivery, just before the second World War, was 6,000 cubic feet of water per minute.

But the most profound modification in the industry came with the advent of dredging, which took place in Puket in 1907. In Malaya, since before 1900, the Mines Department made several attempts to encourage the use of dredges; but miners remained sceptical until, after hard struggle, the success was demonstrated by the Malayan Tin Dredging Ltd., in 1912. Since then the number, capacity and efficiency of dredges have increased considerably.

Table IV.4

Dredging Output and Dredging Labour in the F.M.S.

(Source F.M.S.Mines Dept., Bulletin of Statistics.)

| | I Number of Dredges operating at the end of the year. | II Dredging output ('000 tons of metal) | III II as % of Total output. | IV Output per dredge (Tons of metal) | V Labour Force in Dredging ('000) | VI Labour per Dredge. |
|---|---|---|---|---|---|---|
| 1913 | 2 | .26 | 0.3 | 81 | 1.3* | 132* |
| 1921 | 30 | 4.7 | 13.5 | 155 | 5.6 | 187 |
| 1925 | 42 | 9.1 | 19.8 | 216 | 7.5 | 179 |
| 1929 | 105 | 27.2 | 38.9 | 259 | 16.8 | 160 |
| 1933 | 23 | 10.8 | 45.0 | 467 | 6.5 | 284 |
| 1937 | 93 | 36.2 | 48.1 | 389 | 16.2 | 173 |
| 1940 | 104 | 42.2 | 52.4 | 406 | 16.4x | 171x |

* = Figures for 1915 when the number of dredges = 10 (1913 figures not available.)
x = Figures for 1939 when the number of dredges = 96 (1940 figures not available).

The table shows the increase in importance of dredging as a tin mining method in Malaya. Between 1921 and 1925, the increase in total Malayan output was at the annual rate of 3,000 tons; this became 5,300 tons in the course of the next four years, most of the increase being attributable to dredging. 1933 was a year of the most drastic restriction of output by the International Tin Committee, and the corresponding figures in Cols. IV and VI are exaggerated. In 1940 there was practically no restriction.

Columns IV and VI together illustrate the fact that during the period, the average capacity of the dredges was greatly expanded, and at the same time the dredges became more mechanised, in the sense that more output per dredge was obtained with a slight decrease in the number of workers per dredge.

23. Before 1930, most dredges were steam-driven. During the decade before the Japanese war, the tendency was for steam to be superseded by oil and electric power, although in virgin country where firewood was obtainable from the jungle, and transport costs high, portable steam plants were generally employed. In 1931, out of the 120 existing dredges, 80 used steam, 40 used electricity. The respective numbers at the outbreak of the 1942 war were 64 and 63. On board the dredges, the method of ore concentration had also gradually changed since the 1920's from the boxes system to the jigs system. In 1931, 63 dredges used sluice boxes as against 57 using jigs. At the end of 1939, the respective figures became 49 and 78. The use of dredges and jigs in tin mining was admittedly no radical innovation, since dredges, jigs, gravel pumps etc. had all been used in other branches of the mining industry, (See Note 12), but it remains true that the adoption of these mechanical devices made it possible to treat deposits containing values hitherto

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Note 12 Cp. Elizabeth S. May "The International Tin Cartel" in W.Y.Elliott, etc.:International Control in the Non Ferrous Metals (MacMillan, N.Y. 1937) p.315.

regarded as too poor to be commercial propositions, and therefore had the two-fold effects of the increasing output and at the same time decreasing labour requirements.

The rate of increase in mechanisation of tin mining in Malaya is illustrated by the number of active horsepower used for tin mining.

Table IV.5.

Active Horsepower of Machinery used in Tin Mining in F.M.S.
(Source : F.M.S. Mines Dept., Bulletin of Statistics.)

| | H.P. ('000 omitted) | Tin Output (Long tons) ('000 omitted) | H.P. per ton of tin output. |
|---|---|---|---|
| 1905 | 7.1+ | 51 | 0.14 |
| 1913 | 24.5+ | 51 | 0.44 |
| 1921 | 56.2+ | 36 | 1.60 |
| 1925 | 98.1+ | 48 | 2.05 |
| 1929 | 171.2+ | 69 | 2.48 |
| 1933 | 105.2 | 25 | 4.21* |
| 1937 | 278.4 | 78 | 3.57 |
| 1940 | 319.1 | 83 | 3.84 |

+ = estimated, since the figures werenot separated for tin mining until 1930.
* = figure exaggerated by the severe output restriction.

Apart from the larger units of power employed for dredging, there were a large quantity of small power units of 100-300 H.P. employed in a great number of gravel-pump mines. The number of mines using gravel pumps increased rapidly since their introduction in the last part of the 19th century. During the 1914/18 war and post war slumps, the rate of increase was checked and the number probably declined. The increase was resumed in the 1926/7 boom, and by the end of 1929, out of 1,286 tin mines operating in the F.M.S., there were 428 using gravel pumps: this was the peak number before the great depression, during which it fell to 231 out of 1,068 mines operating at the end of 1932. At the end of 1937, the figure was 635.

Table IV.6.

Number of Tin Mines operating in F.M.S. Classified by Methods.

(Source: F.M.S. Mines Dept., op. cit.)

| End of | Total | Gravel Pump | Dredging | Hydraulicking | Open Cast | Others | Small mines No machinery and $< 50$ coolies. |
|---|---|---|---|---|---|---|---|
| Dec.1929 | 1,286 | 428 | 69 | 36 | 18 | 28 | 707 |
| Dec.1932 | 1,068 | 231 | 28 | 38 | 35 | 14 | 722 |
| Dec.1937 | 1,003 | 635 | 68 | 34 | 10 | 25 | 229 |
| June 1939 | 666 | 309 | 38 | 38 | 18 | 9 | 254 |

Table IV.6, which should be read together with Table IV.1, illustrates two points: (a) the increasing importance of dredging, the decline in the relative share (though not in the trend of absolute tonnage) of gravel-pumping, and the sharp decline of all other methods: (b) before 1931 the tin mining industry in Malaya had a highly competitive structure, as indicated by the existence of a large number of small mines. The majority of these small mines disappeared between 1932 and 1940: the total number of all mines in 1939 was only about half of that ten years earlier. There was a strong tendency towards bigger and more highly capitalised companies, as well as towards amalgamations of existing companies. Unfortunately, detailed and comprehensive figures regarding the total capital invested in mining in Malaya are not obtainable, especially with reference to the numerous small producers whose concerns had not been converted into Limited Companies. (See Note 13). For the dredging companies along, the total issued capital was about £13 million in 1929, rising to £15 million in 1931 and declining to £14 million in 1939, but the average issued capital per company increased from about £166,000 before 1929 to £200,000 or over between 1931 and 1940. This was due to a 12% reduction in the number of dredging companies.

Machinery and Power in Siam.

24. The development of tin mining in Siam followed a similar line as in Malaya, with regard to the use of dredges, gravel pumps and power. The number of dredges in operation in Siam started with 1 in 1907, and steadily increased to 12 in 1918, 17 in 1927; since then the increase became more rapid, reaching 39 in 1931. In this period 1927 to 1931, output from Siam made large strides from 7,300 tons in 1927 to 8,500 in 1929 and 12,000 in 1931. In 1936, under the official

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Note 13. c.f. Sir Lewis Leigh Fermor, op.cit. p.69.

restriction scheme, 28 dredges were in operation, with 14 others under construction and temporarily stopping. As in Malaya, the average capacity of the dredges increased as well as their number.

In Siam, gravel pumps played a rather smaller part in tin mining than in Malaya. Just before the outbreak of the recent war, 65% of the total output came from dredging, 25% from gravel pumping, and other alluvial methods, and 10% from lode mining. There were approximately 180 units employing gravel pumping, ground sluicing and open cast methods.(See Note 14).

The development of dredging in Siam is shown by the following table:

Table IV.Z.

Dredge Output in Siam.

(in long tons '000 of tin-in-ore @ 72%)

(Source : Statistical Yearbook of the Kingdom of Siam.)

| Year April/March | 1916/7 | 1921/22 | 1925/26 | 1930/1 | 1937/8 |
|---|---|---|---|---|---|
| I Total Output | 8.8 | 6.1 | 7.9 | 12.0 | 15.7 |
| II Dredge Output | 2.9 | 3.1 | 2.9 | 7.0 | 9.9 |
| III (II) as % of (I) | 33% | 51% | 37% | 58% | 63% |

At the outbreak of the recent war, there were about 30 "European" companies working with 40 dredges and 3 lode mines.

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Note 14 J.J.Croston "Siam's Mining Industry offers new Opportunities". Engineering and Mining Journal, Vol.147, No.12, p.61.

One of these was Danish, two were registered in Straits Settlements, and the rest almost equally distributed between British and Australian nationals. There were also in operation five dredges owned by Siamese and Chinese concerns. Small "native" mines numbered approximately 250. Capital invested in tin mining companies "so far as can be estimated" was about £10 million.

Machinery and Power in Indonesia.

25. Although the process of large-scale mechanisation in Indonesian tin mines was somewhat slower than in Malaya and even Siam, a large proportion of output was obtained by simple mechanical methods in the form of gravel pumps and sluice pumps since before 1914.

In the early 1920's, 67% of the output of Banka was obtained by means of sluicing pumps, 11% by machine cutters, and 21% by hand labour and elevating belts. In 1926, about 80% of the output was obtained with the help of mechanical appliances and 20% by labour using simple tools. The total number of gravel pumps in operation on Banka rose from 120 in 1920/21 to just under 300 on the eve of restriction. Since the adoption of dredging in 1927/8, the share of output by this method had increased greatly. Starting with 470 tons or 2% of total output in 1927/8, it became 14% in 1929, or approximately 2,800 tons. During the ensuing low price period, production was concentrated in dredging, which proved to be the cheapest method. The share of output by dredge rose to 24% in 1931. During the subsequent recovery, still more dredges were commissioned, and at the outbreak of the second World War, there were in Banka nine bucket dredges of various sizes and capacities, as well as three suction cutter dredges.

In Billiton, tin mining was more mechanised than in the Government mines of Banka. By 1934 there were 7 dredges at work. The number had doubled by 1940. As in the case of Banka, dredge output rose relatively to total output during the depression, at the expense of lode output, as underground mining was suspended while price was low.

The capital invested in tin mining in Indonesia increased considerably between 1924 and 1929, and again during the boom of 1937. The book value of the assets in the Government's Banka undertaking, excluding stocks and storehouse goods, nearly doubled between 1920 and 1929, the increase being more rapid during the last five years when it rose from 13.5 million guldens to 20.4 million. The total capital of the Billiton Joint Mining Company (N.V.Gemeenschappelijke Mijnbouwmaatschappij, Billiton), formed in 1924, was 16 million guldens, all paid up. Singkep, the smallest island of the three, was operated by N.V.Singkep Tin Exploitatie Maatschappij, whose original paid up capital was 4 million guldens. Since 1933,this Company was amalgamated with the Billiton Maatschappij (Billiton Co.) and the issued capital was increased to 5 million, of which only 1/5 was paid up.

II Africa: Nigeria.

26. Modern mining in Nigeria did not begin until the first decade of the present century, when several explorations were undertaken by the Niger Company, and the Imperial Institute.

The Niger Company began by mining and smelting tin ore in small quantities, but later it confined itself more to prospecting and proving ground for sale, and to the management of outside flotations, while retaining half the mineral rents and mineral royalties. In the early stages, the commercial life expectation of the tin deposits was estimated at no longer than five years, consequently only primitive mining methods were employed with small capital investment. In the 1920's, after more extensive study of the field, there was complete change of opinion about the future of tin mining on the Bauchi Plateau. The deposits were very complex, and local geology remained as difficult as ever to unravel. Another great difficulty was the shortage of water for mining purposes; mining was possible merely during the wet season which only lasted a few months in a year. The lack of wood fuel and the high transport costs for coal, oil, machinery and tin ore made mining technically difficult, as well as unremunerative. The complexity of tin deposits led to the adoption of several mining methods on the same property, and mining companies had to take leases over very extensive areas in order to ensure long working life.

The scarcity of water supply excluded dredging and hydraulic methods from most mines, and steam shovels and draglines were adopted instead as mechanised means of removing the sometimes considerable depth of valueless over-burden covering the ores. The high cost of fuel and transport kept output down to the level of 4,000 - 5,000 tons a year until the latter part of the 1920's, when the combined effects of high tin price and the completion of a few railway lines and roads made it possible to step up production until it reached the peak of nearly 11,000 tons in 1929.

The most important improvements in the transport system occurred in 1927 when a railway line was opened linking the tin areas directly to the coal-fields in the South, halving the cost of coal, and in 1932 when the completion of a railway bridge reduced the freight for ore by more than 30%. The erection of two hydro-electric power plants, which were completed in 1925 and 1930, also contributed substantially towards the lowering of production costs.

27. The Nigerian deposits were mostly of the placer type but in many cases the ores were overlaid by such great depths of valueless ground that the best method to deal with them was the underground mining, or lotoing. In general, despite the increase in mechanisation in Nigeria, tributing and labour-intensive methods still contributed the largest proportion of ore recovered at the end of the recent war. The availability

of cheaper power since the 1920's brought gravel pumps to the fore as the most important mechanised method. Dredging was not as successful here as in S.E.Asia, although it was used whenever climatic conditions, especially water-supply, allowed, and wherever used, the cost per cubic yard of earth treated was the lowest. More suitable to the drier Nigerian conditions than dredges was the use of steam shovels and draglines to strip the overburden. The steam shovel was initiated in 1925; three years later there were twelve in use and several more were installed subsequently. Draglines were subsequently considered more effective as excavating machines than steam shovels, whose scope of cut was narrow and which were unsuitable for wet ground. These machines were driven by electricity, diesel engine or steam engine; electricity becoming more and more popular. Hydraulicking and ground sluicing were also employed in various places. The contribution of lode mining was not important.

28. The tin mining industry in Nigeria was composed of a large number of small concerns until the second part of the 1920's. There were in 1922 eighty-three mining concerns, about 45% of which were individual holdings, the rest medium-sized limited liability companies. The number rose to 140 in 1928. The process of amalgamation started in 1926, and by 1935 there were 36 companies and 39 private ownerships. In 1938 the numbers became 31 and 39 respectively. The aggregate capital issued of tin mining companies was, at its peak in 1928 about

£10 million. (See Note 15). All tin mining interests were British, except one or two not very important French companies.

29. Notwithstanding the increase of mechanisation in tin mining, the bulk of output still depended on hand labour, especially during the depression when miners resorted to the tribute system, and plants were left idle in favour of more primitive working which had the advantage of the lowered wages. The majority of the African labourers were not indigenous of the Bauchi Plateau, although many of them were born there. The labour fòrce in tin mining industry (including the production of by-products) amounted to nearly 14,000 in 1921. During the prosperous years, it increased to a peak of 39,300 in 1928. Sharp reductions occurred in the depression until it was reduced to below 15,000 in 1933, rising again to 36,000 in 1937, and to a record of 68,200 in 1944. Approximately 1/3 to 2/5 of the labour force were tributers.

The productivity of labour in Nigerian tinfields compared adversely with that in South-East Asia, and the general trend in the inter-war period was a declining one, despite increased mechanisation. The following is the average annual productivity per head, reckoned in tin content:

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Note 15. Cp. S.H.Frankel: Capital Investment in Africa.(R.I.I.A. O.U.P. 1938) pp.162 and 155; also Lord Hailey: An African Survey R.I.I.A., O.U.P. 1938) p.1322.

0.39 ton in 1922
falling to.. .. 0.22 ton in 1927
rising to .. .. 0.37 ton in 1931
falling to.. .. 0.25 ton in 1934
rising to .. .. 0.40 ton in 1936
falling to.. .. 0.19 ton in 1945.

(The last figure, of course, did not provide fair comparison, since low grade areas were worked during the war).

Belgian Congo.

30. The Belgian Congo (including the mandated territory of Ruanda Urundi) was the latest newcomer to the list of large producers of tin. Small parcels of less than 100 tons were produced during the 1914-18 war, at the end of which annual output was still less than 400 tons. This reached 1,000 tons in 1925, only to be reduced to 200 tons in the bad year of 1931. Since 1933, progress has been rapid. Favoured by high prices secured by the International Agreement, which Belgian Congo joined at a much later date, and only with a generous flat rate and later a high standard tonnage, the country's tin production rose to nearly 9,000 tons in 1937. In 1938 it outpaced Nigerian output for the first time, whereas in 1929 it was less than 10% of the latter. During the second war, such spectacular progress continued, and in 1943 output reached a record of nearly 17,500 tons, or almost 13% of world production. In 1946, while the Far-Eastern fields were still struggling in the

process of rehabilitation, Belgian Congo with an output of over 14,000 tons (16% of the world total), ranked second after Bolivia.

Although both lode and placer deposits were known to exist within the territory, the bulk of output so far has been secured from alluvial sources. Working conditions are very similar to those in Nigeria, but, unlike Nigeria, tin was not the principal mineral product in the Belgian Congo: in terms of value, even in the last years of the 1930's, it was only the third mineral produced after copper and gold, and preceding in importance diamonds which it surpassed in 1933. For several companies, such as the Union Minière du Haut Katanga, the chief output was copper, not tin.

The leading tin producer in the Belgian Congo in later days was Géomines (Compagnie Géologique et Minière des Ingénieurs et Industriels Belges, S.A.), mainly engaged in tin mining and smelting, although it owned coal deposits and was also interested in diamonds and other minerals.

Because tin was, in most Congo mining companies, a secondary product, it is impossible even to estimate the amount of capital invested directly for tin. Professor S.H.Frankel estimated that the capital invested for mining industry as a whole was, at the outbreak of the first World War, about £13 million. (See Note 16). To this figure, Lord Hailey added £17 million representing the increase up to 1938. (See Note 17).

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Note 16. op.cit.p.167.
Note 17. op.cit.p.1322.

Perhaps a third of this increment - or about £5 - £6 million can be assumed to have been invested in tin. The stimulus given to tin production during the war probably added another £2 - £3 million. In any case, the fact that the Congo tin industry developed as an important undertaking long after copper and other minerals, allowed it to benefit from the external economies provided by the other activities in the form of hydro-electric power stations, roads and railways, dams and general amenities, as well as availability of workers. This fact contrasts with the conditions under which tin was produced in Nigeria, and was one of the chief reasons enabling Belgian Congo tin output to advance with great speed.

There were in 1932 five tin mining concerns in the whole territory. The number rose to 29 in 1938, and further to 36 in 1943. According to a Belgian study, out of 10 tin mining companies founded between 1910 and 1935, there were 3 concerns yielding annual average profits higher than 20% (one of which was as high as 87% and another 54% - but, in the words of the author cited "they were newer companies and not representative"), one concern yielding 10 - 20%, 3 yielding 5 - 10%, one yielding 0% and two had negative yields. (See Note 18).

III America: Bolivia.

31. Tin mining in Bolivia remained unimportant until the 1880's, when annual output rose from 300 tons to 1,6000 tons. This became 9,000 tons by the close of the century and advanced

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Note 18. A.de Villenfagne de Loen: Etudes sur les Problèmes Coloniaux. (Bruxelles - Etablissements Emile Bruÿlant,1946) to nearly 26,000 tons in 1913. The peak output was reached in 1929 when over 46,000 tons were exported. This is now generally considered to be the maximum capacity of Bolivia, irrespective of prices, and during the war, the most that Bolivia could produce, in the face of tin shortage, was just under 42,500 tons in 1945. During the last part of the 1930's, partly owing to output restriction schemes, the level of production was about 25,000 tons; in 1947, output declined from the high wartime level to 33,300 tons.

The mining areas of Bolivia consist of a high plateau stretching nearly 500 miles long and over 100 miles wide, from Lake Titicaca to the Argentine border, at an altitude of 12,500 ft. above sea level. The tin mines are at elevations of about 12,000 to nearly 20,000 feet, mines at the higher altitudes being in a ragged snow clad country where conditions are severe. The deposits are widely distributed over some ten districts. Virtually all production has been from lodes; alluvial mining has been unimportant.

Owing to the situation and climatic conditions of the Bolivian tin mining areas, and the type of the deposits worked, the miners were confronted with problems which were different from those in Africa, and the Far East. Major problems for Bolivian miners were the low grade of the concentrates, the high cost of transport, the intensive capitalisation needed for working lode mines and the shortage of labour and fiscal complexities.

32. Although the assay values of the Bolivian mines were comparatively high, averaging 3% in 1930, declining to 1.8% before the war as against 1/50% or less tin in alluvial fields, the average assay values of the concentrates produced by Bolivia was only about 60%, and in some cases the percentage was as low as 20% - 30%. In trying to enrich the output up to 60%, more than half of the tin was lost in concentration. This was due to the complex nature of the ores, the high content of sulphides, chiefly of pyrrhotite. The production and export of lower grade ores were, up to 1923, penalised by the system of export duties assessed on the basis of 60% metal. Since 1924, the scale of export duties on tin barilla (concentrates of black tin) was altered and graduated in accordance with the degree of richness to which the concentrates were dressed. This resulted in the general decline of the tin content of the barilla exported, although it made possible an increase in the gross tonnage exported. The decline in the tin content, however, meant a higher transport cost in terms of tin metal, as well as higher returning charges. The combined charges for smelting and freights alone, on 20% concentrates, were higher per ton of tin than the total cost of producing tin from alluvials. (See Note 19.)

Because the mining activities were carried on on the barren Altiplane, where no fuel was to be found and little

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<u>Note 19</u>. Mining Journal (London), 4th September, 1937, p.801.

food stuff could be produced, all machinery and nearly everything else had to be brought up from the outside world, and the ores had to be transported by long rail journeys - 400/500 miles - to Pacific ports in Chile, or Peru, for trans-shipment to foreign smelters. The absence of good roads and the consequent monopoly position of the railway company in the southern district resulted in the cost of transport being extremely high, especially for the upward traffic. For the same distance, the freight charge on Bolivian lines was three times, and in some cases twelve times, as much as that on the Peruvian lines. (See Note 20). In 1928, out of the 54,000,000 bolivianos spent by the mining companies in their operations, taxation accounted for over 10 million, or nearly 20%, and transport and agency expenses another 13%, or 7 million bolivianos. (See Note 21).

33. Tin mining from lode deposits in such geographical and climatic conditions necessitates heavy capitalisation. For this reason, it was very highly centralised in Bolivia. There were, at the beginning of the recent war, three big organisations producing altogether 80% of the total Bolivian output. The rest was shared by a large number of medium and small producers.

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Note 20. Mining Journal (London), 22nd November, 1930, p.914.

Note 21. Annual report of the Banco Central de Bolivia, 1929, p.57.

The "Big Three" were the Patino group which, with £6,500,000 issued capital included the biggest mine, not only of Bolivia, but of the world. The Patino group was mainly financed by Bolivian capital, with some U.S., and to a smaller extent, Chilean interests. The next largest group was that of Hochschild, in which Bolivian, Argentine, Chilean, British and French interests were represented, with a total capital issued of about £4 million. The third group, the Aramayo, with head office in Geneva, capitalised 20 million Swiss francs, embodied Bolivian, French, Swiss and British interests. Some of the medium sized companies were entirely or mostly American or British, but the small mines were worked for the most part by Bolivians who sold their products through the State-controlled Banco Minero. On the whole, the capital in tin mining was predominantly Bolivian.

34. Another big problem of the Bolivian tin industry was the chronic shortage of labour, with the exception of the depression period 1930/32, when there was serious unemployment. The rigorous climatic conditions of the high ground confined the supply of mine workers chiefly to "Indians" of the Altiplano. Would-be immigrants, especially the white workers, were discouraged, moreover, by the low standard of life on the Plateau and the poor transport system connecting it with the plains. Since 1932, the conscription of workers of serviceable ages into the Army for the Chaco War aggravated the man-power

problem. The Government attempted to draft workers from Chile where many were unemployed, but apparently failed to do so. At the end of this war with Paraguay, not only were a large number of the Indians and Cholos killed or failed to return for Paraguay, but the effect on the repatriated natives of their return to the cold climate after several years in the tropical swamps of the Chaco was to show that many of them might be permanently incapacitated for hard work in the high altitude, enfeebled as they were with fever and tropical complaints. At the same time, mining improvements in Chile and Peru prevented would-be immigrants from crossing the frontiers. Output during this period fell considerably, and Bolivia was struggling to fulfil her international restricted exportable quota, falling short of it at times by nearly 30,000 tons. At the beginning of the recent war, about 70,000 persons (See Note 22) were engaged in mining in Bolivia, many of them seasonal workers, leaving the mines in the spring and summer to engage in agriculture. Approximately 70% of the work in the mines was done on a contract basis, workers being paid day wages plus bonus on high grade ores, or per metre of progress on development work. At the end of the war, this shortage of labour still persisted, coupled with a series of serious strikes with many threats of violence, which caused

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Note 22. U.S.Tariff Commission: Mining and Manufacturing Industries in Bolivia. (Washington 1945).

foreign technical personnel to leave the country, thus making the management of various properties even more difficult. (See Note 23).

35. The external economy of Bolivia and the Treasury of its Government have in the past leant heavily on the tin mining industry as the almost exclusive earner of foreign exchange and the main source of national finance, especially during the Chaco War. The result was, on the one hand, a strict system of exchange control which restricted the rights of tin exporters to dispose of their foreign currency, and on the other hand, a complicated network of export duties and other taxes which added enormously to the already high cost of Bolivian mines. From time to time, exchange regulations were altered and currency policy keyed up to provide miners with some incentives and to help them in difficult times; for a short period in 1932, for instance, the exchange value of the Boliviano was made to vary with the London price of tin, but, in general, tin mining had the responsibilities and liabilities of being the most important industry in Bolivia. It bore the main burden of war expenditure as well as of peace-time administration. Attempts to push further with the economic development of the country, coupled with the closer economic co-operation with the U.S.A. resulted in the formation, in 1943, of a Bolivian Development Corporation, financed and controlled jointly by the Bolivian Government and

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Note 23. U.S.Dept. of Commerce: Office of International Trade Economic Conditions in Bolivia 1946. (International Reference Service, vol.10, No.75, December 1947.)

the United States Export-Import Bank. Its programme was to "survey and develop national resources in order to cushion, if possible, the shocks of post war adjustment". There is little information to date of the operation of the corporation.

IV Minor Producers.

China.

36. Other tin mining countries in Asia were, in order of importance in the late 1930's: China, Burma, Japan and French Indo-China. Their combined output in 1940 was about 15,000 tons, less than 8% of world output.

China's output has been stationary at the level 6,000-11,500 tons per year since the end of the first war. This is one of the oldest deposits worked, and today primitive methods still predominate, although here and there modern methods have been introduced. The bulk of the output (over 90%) came from the province of Yunnan, where 150 small mines were operating. The biggest mining company was the Kotchiu Tin Company, owned and operated by the Government of the Province, and producing about 10% of the total output as well as operating a smelter. The miners employed in the area numbered something like 80,000-100,000 (See Note 24). The Yunnan Tin Mines had from time to time been the object of ambitious development schemes, but partly owing to the unsettled political conditions, and partly because

Note 24. Reliable information on the tin industry in China is scanty. For more details see the Mining and Metallurgy of April and May 1931.

the central and local governments had always been opposed to the establishment of foreign-owned firms, the progress here had been extremely slow. According to the mining regulations of 1932, all mines were the property of the Chinese government, and foreign capital was not allowed to participate unless at least 51% of the capitalisation represented Chinese interests, and unless the majority of the directors, the Chairman of the Board, and the General Manager were Chinese.

Burma.

37. In Burma, tin production on a substantial scale began only after the first World War: her output rose from 140 tons in 1910 to 1,078 tons in 1919, 2,500 ten years later, and 5,500 tons in 1939. The bulk of the output was from the Tavoy district, the balance from the Southern Shan States and Mergui. The working conditions were similar to Siam and Malaya. Most deposits were alluvial, worked with dredges (the number was 7 in 1929 and 10-12 all through the 1930's), and gravel pumps, with a few lode mines, the first of the latter being exploited in 1928. In many mines, tin was produced in the form of mixed tin-tungsten concentrates. The mixture of these two metals occurred in other mining areas as well, but it was more general and unseparable in Burma than elsewhere. About 20% of the output was produced by Chinese and Burmese miners, the rest by British companies. Capital investment in tin mining in Burma increased in the 1926-27 boom, and again from 1935 when price was supported by

drastic output restriction, which Burma did not join. During this period, several new large electric dredges were put into commission and hydro-electric power plants installed in Tavoy.

Other Asiatic Producers.

38. Japan's production of tin ore exceeded 250 tons just before the first World War, it reached 1,000 tons in 1930, 2,000 tons in 1935, at which level it remained until recent hostilities. The ore was extracted from lode mines, one of which was British-owned and the rest Japanese-owned.

Output from Indo-China was from alluvial and lode deposits in Tonkin and Laos. There was no large producing concern, the chief producers being 3 French companies whose annual output in the late 1930's was 300-500 tons each. The production in the whole country first reached 100 tons in 1917, 1,000 tons in 1932 and 1,500 tons annually before the war. Deposits here are not known to be as rich or as extensive as in the neighbouring countries.

Australia.

39. Tin deposits in Australia are widely distributed in Tasmania, New South Wales, Queensland, Victoria and West Australia. Most of the output came from the first three named. Both lode mining and alluvial working were in existence. Australia's annual tin ore production reached its peak of just below 13,000 tons in the 1880's; since then it gradually

declined to 7,000 tons before 1914, and to 1,450 tons in 1930. In recent years it remained at the level 2,000-3,000 tons. With a London price below £200, the mines tended to be closed down, to be reopened as the market revived. Some of the mines only carried on by reason of the State taking over the tin smelters and supporting the miners. The main reasons for the decline in Australia's tin industry were the high wages paid to white labour on the one hand, and the general exhaustion of rich deposits on the other. Some of the mines had been working for 75 years and there had not been any important producing area of recent origin. Australian energy and initiative in tin mining, however, were transferred to newer enterprises elsewhere, especially in the Malay Peninsula.

<u>Europe</u>.

40. In Europe, tin mines existed in the United Kingdom, Portugal, Spain, Germany, Czechoslovakia and Italy. Except for the U.K., Portugal and Spain, output was negligible, having never exceeded 100 tons in any one year of the present century. Spain's output was 550 tons in 1929; in 1945 it was 1,200 tons. Annual production from Portuguese mines fluctuated between 400 and 800 tons, except for the year 1937 when it reached 1,150 tons, and during the war up to 1943, when it was maintained at 2,000 tons. In Portugal, British, American, French and Belgian, as well as Portuguese interests were represented in tin mining. Practically the whole of the output came from shallow alluvial deposits which were easy ground for dredging, and where,

accordingly, bucket and suction cutter dredges are used. The tinfields were situated near the North-western border of Spain into which they extend.

In Great Britain, the Cornish tin mining industry dated back to pre-historic times, and Cornwall, with the western part of Devon, was, for centuries, the most important mining region in the world. These mines annually produced about 700 tons in the sixteenth century, between 2/3,000 tons in the eighteenth, and the peak of output was reached at 10,000 tons a year in the period 1860/1880, when Great Britain was supplying about 40/45% of world tin output. This percentage became less than 2% in 1929 and less than 1% in 1940. The tonnage produced fell to 4,000 at the close of the nineteenth century, to 2,500 tons in the 1920's and further to 2,000 tons in the 1930's. During the low prices of 1921/24 and 1931/33, operation was suspended in many mines, the critical price level being £200 per ton. Output during those years fell to 300-600 tons. All the existing mines are lode mines which have been worked to great depths, and only a few could long survive a period of sustained low price.

<u>South Africa</u>.

41. There were before the recent war, a few regions in Africa and America economically producing small tonnages of tin ore. These were: The Union of South Africa, Tanganyika, Uganda, Portuguese East Africa, Argentine and Peru. The

importance of these areas as tin producers in the past scarcely deserves more than mention; but high prices and war conditions recently stimulated their production to some extent. In the Union of South Africa, the Transvaal mines increased their output during the 1914/18 war under the benefit of high price ensured by Government contract, and annual output reached 2,000 tons. After the termination of Government subsidy in 1921, output was maintained at the 1,000 ton level only during the 1924/29 boom. Normally it remained about 500 tons. Generally, the cost of production exceeded £250 per ton.

<u>Argentina</u>.

42. A country whose tin mining activity was encouraged by the high prices during the 1930's restriction schemes was Argentina, whose production virtually began in 1933 and nearly reached 2,000 tons before the recent war. Tin was reported to be found in both lode and alluvial deposits and big expectations brought in Patino, (U.S.) National Lead, American Smelting and Refining, and other interests. Later experience showed that expectations were somewhat over-optimistic. During the war, Argentina's annual production fluctuated between 750 and 1,000 tons: in 1947 it was 850 tons. The Argentine government, however, have shown their serious intention to encourage both tin mining and smelting within their territory, and the target for tin ore output in the Five Year Plan announced in 1947 was set at 2,600 tons a year.

Availability of Tin Ore Reserves.

43. According to the estimates of G.M.Davies, the total amount of tin which had been produced, down to 1916, was about 1½ - 2 million tons from Cornwall, 2,300,000 tons from Asia, 300,000 tons each from Australia and Bolivia, and 100,000 tons from the lodes of Saxony and Bohemia which "were now practically exhausted". (See Note 25). Since 1916, the following tonnages have been extracted: 2 million tons from Asia, 800,000 tons from Bolivia, 100,000 tons each from Cornwall and Australia, and 500,000 tons from Africa. Even allowing for some inaccuracy in Davies's estimates, it is clear that within thirty years of our times, as much tin has been produced as during the past centuries altogether.

The fact that the bulk of the tin ores mined in the Far East was from placer deposits, the extent and depth of which can be more closely estimated by boring than lodes, and the fact that production from these sources in modern times has been on a scale hitherto unheard of, led several authorities to venture the opinion that the shortage of tin was imminent. A leading British geologist stated in 1925 that "it is an interesting and very significant fact that ten to twelve years hence the bulk of the rich secondary deposits of the Dutch East Indies, of Malaya, of Siam, and of Lower Burma will have been exhausted". (See Note 26)

Note 25. Tin Ores: (London 1919)
Note 26. W.R.Jones: Tinfields of the World (Mining Publications Ltd., London 1925) p.231, also p.vi. in the Preface. (Jones's italics).

This important statement in the words of the same authority, was made "from his intimate knowledge of the known deposits in the Malay Peninsula, and from a close study of the reports of the various companies operating these deposits in the Far East". Twice twelve years have nearly passed, and even allowing for the fact that production was restricted by the international control scheme and by war, the prediction is clearly shown to be false. Apart from new discoveries of deposits, the ore reserves in the old deposits turned out to have been under-estimated, and the adoption of new technique made it possible to treat poorer and previously discarded ore values.

Consequently, speculation as to the availability of tin in the future is very precarious. Only the North American and European Continents can be said to have been subject to thorough and reliable prospectings. It can confidently be said that substantial output cannot be expected from these two continents. Since before the last war, the U.S.S.R. has been known to possess four tin bearing districts and six more prospective ones; but information regarding them has been scanty Bolivia and Nigeria are believed to have reached the peak of their possible production during the war, but even here predictions are risky, especially when one considers the complexity of the deposits in Nigeria and the difficult high-altitude land formation in Bolivia. No optimist had dared to expect that the tin production from the Belgian Congo would have reached the high level which it did during the war, and it is not possible even now to say how far it could be expanded. Even after the placer deposits of S.E.Asia have been exhausted, it would still be impossible to predict how rich are the lode deposits in this part of the world, and how cheaply tin can be produced from them. Finally, there are hitherto non-producing areas in Africa, Asia and South America which might or might not be potential producers: only time, development work and periods of high prices will show. Attempts at looking into the future are necessarily confined to the next few decades, during which we can say with some confidence that the known deposits will not be exhausted. (See Note 27). Meanwhile, one of the reasons put forward by advocates of restriction schemes, namely the danger of exhaustion caused by unlimited competitive production, must be rejected as fallacious.

## (C) PRODUCTION OF TIN METAL.

### I. Smelting and Refining Virgin Tin.

#### (a) Smelting Technique.

44. The concentrate produced by the miner is a compound of tin and oxygen ($SnO_2$). The smelting process rids the mineral of its oxygen. This can be done by various methods;

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Note 27. Cf. Sir Lewis Fermor's guesses or "crude estimates" of ore reserves in F.M.S. in his Report upon the Mining Industry of Malaya (1939), p.119/120. Sir Lewis put the reserves then at 1½ million tons of metal which would last 30 years at an average exploitation rate of 50,000 tons per annum.

but the most common method is that of reduction by carbon at high temperatures. Smelting furnaces are of two types: the blast or shaft furnace (vertically set) and the reverberatory furnace (horizontally set). Primitive furnaces are fired with charcoal; the fuel used in modern reverberatory furnaces may be coal, oil or gas. The smelting time of the larger furnaces is usually 10 to 12 hours at temperatures of 1,200° to 1,300°C.

Another method is the electrolytic process. It has the advantage of enabling complex ores carrying considerable impurities of sulphides and arsenides to be reduced without preliminary roasting, and metallurgical treatments, which are necessary in the thermal process. Bolivian ores, smelted in the U.K. by reverberatory process, are usually diluted with purer placer concentrates.

Furnace smelting produces slag with so much tin that it must be retreated before being discarded. Higher temperatures are required in this second stage than in the first, and 16 to 18 hours is the time for reverberatory slag smelting.

After smelting, the metal is still too impure and contains too much iron, antimony, copper, lead, bismuth and other objectionable elements. A third stage in the smelting process is therefore necessary. This is the refining stage. The most common method is the thermal process which is based on the differential melting points of the various metals. Not all the impurities are eliminated, but the final product contains 99% tin or upwards; in some cases 99.99%. After refining, tin is cast into pigs, ready to be sent to the market.

Usually smelting and refining are done at the same works. Primitive Chinese smelters, however, lack refining facilities, and in such cases modern smelters in Hong Kong, Singapore, etc. complete the work.

(b) The Purchase of Ore by Smelters.

45. The common practice of tin smelters is to buy tin concentrates outright from the miners. Sale of concentrates is chiefly done by contract, usually on the basis of one to three years, calling for delivery of a certain definite tonnage, although some of the smelters make a definite practice of buying small parcels whenever offered for sale.

The procedure involved in calculating the amount of payment for the ores differs somewhat with the different smelters. Payment for all the tin is made, the smelting losses and other factors being taken care of in the treatment charge - commonly called the "returning charge". In some cases the value of tin is determined by taking the average of the prices ruling on the London Metal Exchange for "spot" and "three-months standard" tin, as quoted during the second calendar month after the shipment is made. This means that if a shipment be made on January 14th, settlement would be based on the average quotation for March. In other cases, the smelter bases his purchasing price on the spot price ruling at midday of the same day, and sells his tin concurrently against his ore intake or hedges it on the London Metal Exchange, so to eliminate the risk of price fluctuations.

In either case, the smelter's position is covered, and his earning consists purely of the returning charge.

46. The price of tin concentrates received by the miners can be expressed by the formula:

$$P.c. - (D + S + I + L)$$

where P = the price of metallic tin at the date used as basis for settlement quotation.

c = the percentage of tin content of the concentrates.

D = the duty (export and others) paid to the government.

S = the smelting charge.

I = the penalty for impurities.

L = miscellaneous local charges.

The penalty is charged for sulphur, iron and other impurities. One percent of sulphur and arsenic and 0.75% of copper are usually allowed free; above that they are penalised. Other undesirable constituents such as lead, antimony, bismuth, are usually not penalised specifically, but an increased treatment charge is made to cover costs occasioned.

The smelting charge is a flexible item. Not only it varies through time, according to the cost and degree of monopoly, but at any point of time it varies positively with the price of tin, and negatively with the grade of the concentrates. Before the recent war, the scale of smelting charges related to the grade of ores was as follows: (See Note 28).

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Note 28. Mining Journal (London) Sept.4th and 18th and Oct.2nd. 1937.

| Concentrates % tin content. | Smelting Cost per ton of tin | = | per ton of concentrates. |
|---|---|---|---|
| 60% | £15 | = | £9 |
| 50% | £25 | = | £12½ |
| 33% | £44 | = | £14 |
| 20% | £70 | = | £14 |

(c) Smelting by Countries.

47. The output of tin by smelters in various countries from 1921 to 1947 is shown in Table IV.8. It will be seen that not all the mining countries have their own smelters: the most conspicuous absences being Bolivia, Siam and Nigeria. Holland and Belgium, who have no tin mines, but whose colonies are mining territories, however, are among the more important smelting countries, although they consume little tin. The U.K. occupies a unique position in the fact that she is one of the most important producers of the metal as well as one of the most important consumers, and also a minor mining producer.

## Table IV.8

### Tin Smelter Output by Countries.

### (A) in thousands of long tons.

| | British | | Dutch | | Belgian | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Straits Settlements. | U.K. | NEI | Holland (a) | Belgian Congo | Belgium (a). | China | Australia. | Germany (a) | Japan | USA | World |
| 1921 | 41.9 | 12.1 | 13.3 | - | - | - | 6.1 | 3.0 | 2.3 | 0.3 | 10.3 | 89.8 |
| 22 | 66.3 | 21.8 | 15.6 | - | - | - | 9.0 | 2.7 | 4.1 | 0.3 | 8.1 | 129.4 |
| 23 | 69.9 | 30.9 | 15.0 | - | - | 0.3 | 7.9 | 3.1 | 1.7 | 0.3 | 6.7 | 138.3 |
| 24 | 80.7 | 35.5 | 15.5 | - | - | 0.6 | 7.0 | 3.2 | 2.7 | 0.3 | 0.4 | 146.8 |
| 25 | 79.1 | 38.7 | 14.5 | - | - | 0.9 | 8.9 | 3.2 | 1.0 | 0.4 | - | 147.5 |
| 1926 | 76.3 | 37.6 | 16.4 | - | - | 0.8 | 6.5 | 3.2 | 2.3 | 0.5 | - | 144.6 |
| 27 | 83.5 | 38.1 | 15.6 | - | - | 1.2 | 6.2 | 3.0 | 5.3 | 0.7 | - | 154.5 |
| 28 | 98.8 | 48.0 | 14.0 | - | - | 1.0 | 7.0 | 3.1 | 6.8 | 0.7 | - | 180.5 |
| 29 | 105.7 | 55.2 | 13.6 | 1.3 | - | 0.9 | 6.8 | 2.3 | 5.5 | 0.7 | - | 192.3 |
| 30 | 96.8 | 48.0 | 14.6 | 1.9 | - | 0.7 | 6.5 | 1.5 | 5.5 | 0.7 | - | 174.7 |
| 1931 | 87.4 | 35.6 | 12.9 | 2.8 | - | 0.2 | 6.2 | 1.7 | 3.2 | 1.0 | - | 151.4 |
| 32 | 49.9 | 28.5 | 8.2 | 4.0 | - | 0.8 | 7.1 | 2.0 | 3.0 | 1.0 | - | 104.7 |
| 33 | 46.9 | 23.0 | 8.9 | 5.1 | - | 2.7 | 8.2 | 2.4 | 0.8 | 0.9 | - | 99.1 |
| 34 | 49.6 | 25.4 | 10.5 | 13.6 | - | 3.9 | 7.9 | 2.3 | 0.6 | 1.2 | - | 115.3 |
| 35 | 60.5 | 30.0 | 11.3 | 16.0 | 1.6 | 5.2 | 8.4 | 2.8 | 0.8 | 2.0 | - | 136.0 |
| 1936 | 84.6 | 34.0 | 12.9 | 21.5 | 2.0 | 4.6 | 9.6 | 2.7 | 0.9 | 1.8 | - | 175.0 |
| 37 | 95.4 | 34.5 | 13.9 | 27.6 | 2.3 | 6.4 | 9.0 | 2.9 | 3.9 | 1.8 | - | 196.0 |
| 38 | 63.7 | e36.0 | 7.5 | 25.3 | 2.3 | 7.0 | 10.6 | 3.2 | 3.6 | 2.0 | - | 160.5 |
| 39 | 80.5 | e35.0 | 13.9 | 14.4 | 4.1 | 4.0 | 9.9 | 3.3 | e3.6 | 2.0 | - | 170.5 |
| 40 | 126.9 | e37.0 | 22.0 | 1.2 | 7.8 | e1.5 | 6.5 | 4.0 | 0.7 | 1.8 | - | 211.0 |
| 1941 | 125.0e | e40.0 | 23.0 | - | 11.8 | - | 4.5 | 5.0 | 0.3 | 2.0 | - | 215.0 |
| 42 | 10.0e | 37.3 | e8.0 | - | 14.0 | - | 3.6 | 3.0 | 0.8 | 3.9 | 15.9 | 101.0 |
| 43 | 15.0e | 31.6 | e12.0 | - | 11.1 | - | 2.0 | 2.6 | 0.9 | 2.1 | 21.0 | 105.5 |
| 44 | 5.0e | 28.6 | e3.0 | - | 10.0 | - | 1.6 | 2.4 | - | 0.8 | 30.6 | 88.5 |
| 45 | 2.5e | 27.5 | - | - | 8.5 | - | 1.6 | 2.4 | - | 0.1 | 40.6 | 89.5 |
| 1946 | 11.5 | 28.7 | - | 0.9 | 4.2 | 1.4 | 1.3 | 2.2 | - | e0.2 | 43.5 | 97.0 |
| 47 | 30.0e | 27.5 | - | 8.8 | x3.6 | 12.1 | e3.6 | e2.0 | - | e0.6 | 33.3 | 124.0 |

### (B) % of World Production.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1921 | 46 | 13 | 15 | - | - | - | 7 | 3 | 2 | 0.4 | 11 | 100 |
| 1929 | 55 | 29 | 7 | 0.7 | - | 0.5 | 4 | 1 | 3 | 0.4 | - | 100 |
| 1933 | 47 | 23 | 9 | 5 | - | 3 | 8 | 2 | 1 | 1 | - | 100 |
| 1937 | 49 | 18 | 7 | 14 | 1 | 3 | 5 | 1 | 2 | 1 | - | 100 |
| 1947 | 24 | 22 | - | 7 | 3 | 10 | 4 | 2 | - | 0.5 | 27 | 100 |

Sources: Up to 1935: ABMS; after: ITSG.
(a) = computed on the basis of net ore supply.
e = estimated.
x = export (production figure not available)

48. By far the most important smelting country before the war was the Straits Settlements where production was (and still is) concentrated in the hand of two big British concerns: the Straits Trading Co., of Singapore and Penang, and the Consolidated Tin Smelters (formerly the Eastern Smelting Co.) at Penang.

The Straits Trading Co. founded in 1887, was the first important enterprise to introduce large scale smelting into the Far East. It controls a subsidiary company operating near Liverpool in the U.K. - the British Tin Smelting Co.Ltd. Before the last war, the capacity of the Singapore and Penang works of the Straits Trading Co. was about 90,000 tons of tin per annum.

The Consolidated Tin Smelters Ltd. is a big combine which will be described in Chapter V.

Apart from the two giants, there are a few smaller independent smelting companies operating in Great Britain.

49. Next in importance before the last war were the Dutch interests. In the East Indies, the Dutch Government owns the tin smelters as well as the mines at Banka. In Holland, the Arnhem smelter of the N.V.Hollandsche Metallurgische Bedrijven (H.M.B.) was built in 1928, starting with a small capacity, and was enlarged since 1933/34 to reach a capacity of some 60,000 tons of concentrates in the late 1930's. This smelter was also under the control of the Dutch Government.

50. In the Belgian Empire, there are two important groups of smelting interests: The Union Minière du Haut Katanga (UMHK); and the Géomines. The U.M.H.K. has a 50% interest in the Société Générale Métallurgique de Hoboken, with smelting factories at Hoboken, Oolen and Reppel in Belgium. The Géomines, on the other hand, operates its smelter in the Colony, at Manono, Tanganyika district: it is an electric smelter plant, started in 1934.

51. These three Empires: British (even excluding Australia), Dutch and Belgian, together in 1937 produced over 90% of the world's metallic tin. The British share had declined somewhat during the 1930's, reaching 60% of world output just before the war. In 1929 it was 85%.

(d) <u>The Trade in Tin Ores</u>.

52. During the inter-war period, the flow of trade in tin concentrates from the mines to the smelters was very much influenced by political and organisational factors. The case which draws much attention, especially among the Americans, is the cessation of smelting activity in the U.S.A. between 1924 and 1942. There are indeed valid economic reasons for the absence of a smelter in this biggest consuming country; i.e. the high costs of smelting Bolivian ore due to high wages and expensive fuel in the U.S.A. (compared with the U.K.), but there are very important political reasons as well, since smelting operation would have been much simplified and costs

correspondingly reduced, if placer ores from Malaya and elsewhere had been made available, on a free trading basis, to be mixed with Bolivian ores. In fact, alluvial ores were prevented from going to the U.S.A. by the preferential tariff in the case of Malaya and Nigeria, and by the vertical combination between the mining industry in the colonies and the smelting industry in the metropolis in the cases of Dutch and Belgian ores. The result was that Bolivian, African and Indonesian ores, which ultimately would go to the U.S.A. for consumption had to be shipped to Europe for smelting, and then shipped again across the Atlantic to the U.S.A. (See Note 29).

The Patino ores from Bolivia went to the British smelters in the U.K.largely because the two interests were interlinked. Other Bolivian ores went to Holland, Germany and Belgium, as well as to the U.K. U.K. smelters, moreover, treated, apart from the Cornish ores, the whole of Nigerian output, and occasionally insignificant quantities of ores from South-East Asia. Ores mined in the Belgian Congo were smelted partly in the Colonies and partly in Belgium. The same applied to the Netherlands East Indies ores after 1933. Previous to that year, some ores from Banka, the whole of Billiton and Singkep outputs were sent to the Straits smelters

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Note 29. See the excellent maps showing the traffic of tin ores and tin metal in 1938, in C.K.Leith, W.J.Furness and Cleona Lewis: World Minerals and World Peace (Brookings Institution, Washington, D.C., 1943) pp.80-81; also reproduced in K.E.Knorr, op.cit., facing pp.60/61.

and were sold as "Straits" tin. Since 1929, when the Arnhem smelter began production, the tonnage of Indonesian ores going to the Straits Settlements gradually declined until it became nil from 1933 onwards to the beginning of the European war. The Straits smelters also treated the whole output of Malaya, Burma, and Siam, and parts of Indo-Chinese and Chinese ores.

(e) <u>Tin Smelting in the U.S.A.</u>

53. In the United States of America, earlier attempts at setting up tin smelting industries were unsuccessful and short-lived. Just after the turn of the present century, the International Tin Co. was formed, sponsored by the U.S.Steel Company, largest tinplate producers, to smelt Malayan tin concentrates. The plant was erected in Bayonne, New Jersey, but production never started. In 1903, the British Government placed a prohibitive ad-valorem export tax on tin ores sent to smelters other than British. (See Note 30). During the 1914-18 war, circumstances and the availability of Bolivian lode ores occasioned two further attempts in the U.S.A. In 1916, the American Smelting & Refining Co. constructed a smelter at Perth Amboy, New Jersey, with a capacity of 11,000 tons per annum and treated exclusively Bolivian ores. The ores were low-grade and had a great amount of impurities: it had to

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<u>Note 30</u>. This discriminatory export tax is in addition to, and not to be confused with, the normal export duty for revenue purposes. The duty is on a sliding scale, which, at a price of tin of £230 per ton amounted to £30 per ton of metal. The additional tax on tin ore is at the rate of £60 per ton of ore.

be given a preliminary roast. Both the reverberatory and electrolytic processes were used. In 1917, the Williams-Harvey Co.Ltd. of Great Britain, the National Lead of U.S.A. and Senor Simon I.Patino of Bolivia co-operated to form an American corporation bearing the name of Williams, Harvey Corporation which erected another smelter at Jamaica Bay on Long Island. The works were completed and started production in 1918, with a capacity of 12,000 tons per annum. As in the case of the Perth Amboy Smelter, the raw materials came exclusively from Bolivia.

The two smelters continued operation until 1923, when they were closed down, owing to high wage and fuel costs. Between 1923 and 1942, practically no virgin tin was smelted in the U.S.A.

54. The desire to have a tin smelter in the U.S.A. remained very strong among the Americans (See Note 31). Tin is, apart from nickel, which is available from Canada, the only base metal of importance which the U.S.A.lacks. The loss of smelters in Holland and Belgium, and the menace and risks in communication lines with the Far East and Great Britain in the early stages of the last war, made it a necessity to establish

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Note 31. The U.S.Tin Investigation Committee (op.cit.pp.21/22) regarding the "Smelting as an element of production and market control". The report goes on to say that the sentimental control of the smeltery over the miners is "a very real element" in its monopsonistic position, and that at the same time, "the smelter has monopolistic powers over the consumers of tin".

a smelter in the Western Hemisphere. The site chosen was Texas City, Texas, on the Gulf of Mexico, on account of the low costs of natural gas, ample supply of hydrochloric acid and cheap ocean freights. The new smelter, which came to be known by the name of Longhorn, is a government enterprise, designed along the lines of the Arnhem smelter in Holland: the construction and management was entrusted to the Tin Processing Corporation of New York, a subsidiary of the N.V.Billiton Maatschappij. Construction began in July 1941, and the furnaces started production in April, 1942. It cost $7,650,000. The capacity was originally proposed at 18,000 tons of tin per annum, subsequently increased to 52,000 tons; the latest estimate of the capacity is 90,000 tons if only high-grade ore were used. The best record output to date is 43,500 tons in 1946. Almost all the output is of Grade A tin.

The raw materials treated were in the first instance the purer ores from Indonesia, accumulated in the stockpile, as well as the low or medium grade ores from Bolivia and the Belgian Congo. When the stock of pure Indonesian ores was exhausted, changes in the producing process were made to deal with lower grade ores.

The U.S.Government has since 1940, by long-term contracts, secured ores from Bolivian mines (other than the Patino output which continues to be smelted in British smelters, also on long term contracts). The purchasing contract was revised and renewed on several occasions: the latest renewal was in December 1947. Under the present arrangement the Reconstruction Finance Corporation of the U.S.A. agrees to buy all the concentrates from Bolivia, with the exception of the Patino production, and of 8,000 tons per annum required to fulfil outstanding commitments covered by the Bolivia-Argentine Trade Agreement. The contract terminates at the end of 1949.

With the resumption of the Belgian smelters, some ore supplies from the Congo have been diverted from America to Europe, but the R.F.C. has made an agreement with the Dutch government, whereby the U.S.A. would receive in 1946, 1,000 tons and in 1947 not less than 25% of the N.E.I. production in concentrates. Since the beginning of 1947, the Longhorn smelter has also received high grade concentrates from Siam both from stocks and from current production, according to the U.K.-U.S.-Siam agreement of December,1946.

Efforts to secure ores from the British Empire for the U.S.A.smelter on the same footing as British smelters, have resulted in the 1947 Geneva Tariff Agreement, according to which the Malayan export tax on tin ore was removed at the end of June, 1948, on the condition that the Texas City, or any other smelter in the U.S.A. ceases to be subsidised. If the latter condition is not fulfilled, the Malayan Union Government may impose a new duty equivalent to the value per ton of the subsidy.

## II. The Recovery of Secondary Tin.

55. Big consuming countries with no access to tin ores, either through mining or imports, can also produce tin metal by recovering it from tin-containing materials. This source of supply provides several thousands of tons of metal per annum. It is an important addition to the flow of virgin tin.

Secondary tin may be recovered in the form of pig (pure) tin or in the form of alloys and chemical compounds. Two general processes may be used: (a) the pyrometallurgical operation which produces alloys of more or less definite tin content for use as bearing metals, solders and bronzes: and (b) the chemical and electrolytical operation, used in "detinning plants", which produces both high grade pig tin, comparable in every way with the best virgin tin, and tin compounds of any desired grade or degree of purity. The raw materials for both processes may be, in theory, various forms of tin-bearing scrap; tin bearing alloys, tinplate clippings, melting pot drosses, etc.

In practice this is true of the pyrometallurgkcal operation only. The detinning plants exclusively use clean tinplate scrap, although sometimes old tin-coated containers may be used. Clean tinplate scrap is obtainable from tinplate works, and can factories, who are glad to be able to dispose of their clippings in this remunerative way. Contrary to popular impression, a very small proportion of the recovered tin is reclaimed from used tin cans or other junks. (See Note 32).

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Note 32. See next page.

Apart from the fact that old cans yield much less tin than clean tinplate clippings, the most important obstacle to the employment of used materials is the high cost of collection and cleaning. Even for clean tinplate clippings, the cost of transport is several times the value of the clippings. (See Note 33).

56. The high cost of collection and transport thus sets a limit to the availability of the "raw materials" for the recovery of secondary tin. Within these limits, although the profits in the recovery of tin are affected by the markets, for the by-products such as steel, lead, copper etc., the quantity of secondary tin produced fluctuates with industrial activity and the price of virgin tin. (See Note 34). In this sense, secondary tin can be regarded as a substitute for virgin tin. The substitution, however, is not perfect, since most of the tin recovered is reclaimed, not as (general purpose) pig metal, but in alloy and chemical form; and even though the pig tin recovered is purer than most virgin brands, negligible quantities are used in the manufacture of tinplates, collapsible tubes, foil and tinning.

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Note 32. W.R.Ingalls: The Economics of Old Metals, especially copper, lead, zinc, tin.(Address before the Mining & Metallurgical Society of America at the Columbia University Club, N.Y., 1935) reprinted in "Tin", TPA.Dec.1935 and Jan.-Ap.1936.

Note 33. Tin Investigation Committee, op.cit. p.683. Statement of W.J.Buttfield, President of the Vulcan Detinning Co.

Note 34. See Table IV.9. Col.V.and VI below; and K.E.Knorr; op.cit., Chart 5, p.41.

57. Apart from the U.S.A. whose recovered tin output is given in Table IV.9, there are very few detailed figures published on the subject of secondary tin. It is, however, estimated that the total output of recovered tin outside the U.S.A. amounted in normal pre-war years to about 10,000 - 15,000 tons, of which Germany, the U.K., and late in the 1930's Japan, were the most important producers. This, added to the 24,800 tons which is the average U.S.A. annual production between 1935 and 1939, makes a total of 35,000 - 50,000 tons per year, or 20% - 30% of world production of virgin tin.

## Table IV.9.

## Recovery of Secondary Tin in the U.S.A.

(I, II and III in '000 long tons.)

| | Secondary Tin Recovered | | | III as % of Tin Imports and Domestic Production | Index : 1936 = 100 | |
|---|---|---|---|---|---|---|
| | as pig tin | as alloys & chem.comp. | Total | | Index of III | Index of Price in New York of Straits Tin |
| | I | II | III | IV | V | VI |
| 1921 | 4.8 | 10.3 | 15.1 | 40 | 60 | 65 |
| 22 | 5.9 | 11.6 | 17.4 | 25 | 70 | 71 |
| 23 | 7.0 | 19.9 | 27.0 | 38 | 108 | 93 |
| 24 | 6.9 | 21.1 | 27.9 | 43 | 111 | 109 |
| 25 | 7.1 | 20.5 | 27.6 | 36 | 110 | 126 |
| 1926 | 8.7 | 21.1 | 29.8 | 38 | 119 | 141 |
| 27 | 7.9 | 25.1 | 32.9 | 46 | 132 | 138 |
| 28 | 7.3 | 24.6 | 32.0 | 41 | 128 | 109 |
| 29 | 6.6 | 24.0 | 30.6 | 35 | 122 | 98 |
| 30 | 5.0 | 18.4 | 23.4 | 29 | 94 | 70 |
| 1931 | 4.9 | 12.8 | 17.7 | 27 | 71 | 52 |
| 32 | 4.2 | 9.0 | 13.2 | 38 | 53 | 48 |
| 33 | 6.5 | 13.3 | 19.7 | 31 | 79 | 85 |
| 34 | 7.4 | 14.9 | 22.2 | 55 | 89 | 113 |
| 35 | 8.6 | 16.3 | 24.9 | 38 | 99 | 109 |
| *1936 | 6.5 | 18.5 | 25.0 | 30 | 100 | 100 |
| 37 | 7.4 | 19.7 | 27.1 | 31 | 108 | 117 |
| 38 | 4.3 | 16.7 | 21.0 | 42 | 84 | 91 |
| 39 | 4.0 | 22.1 | 26.0 | 36 | 104 | 109 |
| 40 | 4.5 | 25.1 | 29.7 | 24 | 119 | 109 |
| 1941 | 5.3 | 32.2 | 37.5 | 27 | 150 | 113 |
| 42 | 5.2 | 28.7 | 33.9 | 79 | 136 | 113 |
| 43 | 4.7 | 29.1 | 33.8 | 99 | 135 | 113 |
| 44 | 3.8 | 25.3 | 29.1 | 66 | 116 | 113 |
| 45 | 3.3 | 28.1 | 31.4 | 68 | 126 | 113 |
| 46 | | | | | | |
| 47 | | | | | | |

Sources: I - III U.S.Bureau of Mines.
IV Minerals Industry (up to 1940)
VI From 16th August, 1941 to 12th November, 1947: Official Maximum Price.

* Prior to 1936, the figures include secondary tin recovered from tin scruff at tinplate plants. This quantity has been excluded since 1936.

58. It is clear from Table IV.9 that the output of recovered tin in the U.S.A. fluctuates in the same direction as the price of virgin tin. As the latter rises, there is a tendency to use more secondary tin as a substitute for virgin tin and the high price makes it possible and more profitable to collect and use more tin scraps etc. The correlation is closer between recovery of secondary tin and consumption of tin. This is shown below. This closer correlation is to be expected, because the availability of tin-bearing scrap naturally increases and decreases with the consumption of tin:

Index 1936 = 100

| | Recovery of Secondary tin in U.S.A. | Consumption of tin in the U.S.A. |
|---|---|---|
| 1927 | 132 | 98 |
| 1928 | 128 | 108 |
| 1929 | 122 | 118 |
| 1930 | 94 | 97 |
| 1931 | 71 | 75 |
| 1932 | 53 | 55 |
| 1933 | 79 | 83 |
| 1934 | 89 | 72 |
| 1935 | 99 | 86 |
| 1936 | 100 | 100 |
| 1937 | 108 | 108 |
| 1938 | 84 | 72 |
| 1939 | 104 | 99 |
| 1940 | 119 | 117 |

Sources for consumption 1927-34 ABMS. 1935-1940 Bureau of Mines.

59. The importance of secondary tin for the U.S.A. is indicated by Column IV in Table IV.9. Apart from abnormal war period, the supply of recovered tin formed about 25% to 55%

of the supply of virgin tin, or between 1/5 and 1/4 of the total tin supply available to the U.S.A. If the production of secondary tin were included with the total production of virgin tin, the U.S.A. would rank as a very important producing country. Compared with the mining countries, she would be the 3rd largest producer in the 1930's, after Malaya and the N.E.I. Compared with the smelting countries, she would rank as fourth, after the Straits Settlements, the U.K. and Holland.

60. During the 1930's, the shortage of tin and the preparation for war caused a great deal of concern in the U.S.A. regarding the increasing quantity of tin plate scrap exported, mainly to Japan. A bill was passed by Congress in 1934, but not signed by the President until the beginning of 1936, providing for an embargo on the export of tin-bearing scrap except under licence of the Secretary of State. The Faddis-Barbour Tin Act, as it is called, is still in force; and in the period between 1936 and the beginning of the war, all licences issued under the Act named Japan as the country of destination.

# CHAPTER V

## FINANCIAL CONTROL AND GOVERNMENT INTERESTS IN THE TIN INDUSTRY.

### (A) FINANCIAL CONTROL

1 Immediately before the recent Japanese War (See Note 1) about 40% of the World output of tin ore was directly controlled by three big groups, British, Dutch and Bolivian, in most cases separately, but in several companies jointly. Another 20% of the world mine output was produced by a number of medium-sized organisations, principally of British, Bolivian, Australian and Belgian nationalities. The rest was distributed among a much larger number of small Chinese, Bolivian, European, Australian, American and other producers.

Among the major groups, the share of direct control was as follows: In 1940, the London Tin Corporation produced about 26,000 tons of fine tin in ore, corresponding to about 11% of world output; the Patino group 19,500 tons or 8%; and the Dutch 42,860 tons or 18%. Since the Dutch Government had 5/8 shares in the Billiton mines as well as the exclusive ownership of the Banka mines, the Dutch interests may be sub-divided into: Government 14% and Billiton Company proper 4%.

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Note 1. The situation since then has not altered materially. Most figures in this section refer to the year 1940, the last year for which complete data are available.

I Big Organisations.

2. The London Tin Corporation had direct control over 22 mining companies in Malaya, 6 in Siam and one each in Burma, Nigeria and Japan. These figures are not strictly comparable since most companies in Malaya and Siam were smaller units than those in Burma and Nigeria. The Tavoy Tin Dredging Co. in Burma was the amalgamation of four companies, and in the Amalgamated Tin Mines of Nigeria were merged over 20 companies, some of which were among the biggest mines in the country in the 1920's. The total issued capital of these companies, which included development companies, exceeded £9,000,000, and the mechanical equipment included 64 dredges. The companies were managed by three subsidiaries wholly owned by the L.T.C. The outputs in individual countries in 1940 were as follows:-

Malaya : about 18,000 tons of tin in ore or 21% of Malayan output.
Siam : about 1,100 tons of tin in ore or 7% of Siam's output.
Burma : about 1,000 tons of tin in ore or 20% of Burma's output.
Nigeria : about 5,400 tons of tin in ore or 45% of Nigeria's output

The L.T.C., as it stands today, is the outcome of the development of a group of interests with which the names of the Tin Selection Trust and the Anglo-Oriental Mining Corporation were closely associated. Among its other associations, there were the Yuba Associated Engineers (of the U.S.A.), the New Consolidated Goldfields, the Amalgamated Metal Corporation, and the British (Non-ferrous) Mining Corporation. (See Note 2).

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Note 2. Please refer to the end of this chapter.

3. <u>Senor Simon I.Patino</u>, whose death occurred in 1947, was reputed to be one of the richest men in the world and one of the most influential men of Bolivia. About 1905 he acquired the control of two groups of small mines on the Hill of Uncia: In 1924, with the help of the National Lead Co. of the U.S.A., which invested $1,500,000 in the Llallagua property, the two undertakings were merged under the name of the Patino Mines & Enterprises Consolidated, registered in the State of Delaware, U.S.A., with a capital of $50 million. For the whole year of 1924, the two concerns produced together about 15,000 tons of tin, which amounted to about 50% of the country's output, or over 10% of the worlds. 70% of the capital was Bolivian (Patino), and 30% U.S.A., including 8% belonging to the National Lead Co. (See Note 3). Subsequently the group was further enlarged by the acquisition of the Compania Minera y Agricola Oploca de Bolivia, and the Sociedad Empresa de Estano de Araca, both registered in Chile. In 1936, the Bolivian Tin and Tungsten Mines Corporation was formed in Bolivia by this group with an authorised capital of £3 million, to acquire a number of mines from the private portfolio of Senor Patino. In the late 1930's, owing to the increase in output of new companies, the share of the Patino group in Bolivian tin production slightly declined to about 48%.

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<u>Note 3</u>. The National Lead Co. is among the largest tin consumers in America. It entered the tin smelting industry during the first World War, and became closely associated with Patino. Its Directors have individual holdings in the Patino Mines and Enterprises Cons.Inc., whose vice-president is the Chairman of the board of the National Lead Co.

The business of the Patino Mines and Enterprises Consolidated, Inc., included the working of two railway lines, built in 1921 and 1935. During the last war, two further subsidiary companies were created: one in Delaware, U.S.A. called the Smelters Development Corporation, and another, the Patican Co., whose object was to investigate properties in Canada.

4. Tin mining organisation in Indonesia, unlike that in Malaya or Bolivia, has been concentrated in a few hands since the beginning. Banka has been operated by the Netherlands government from 1815 up to the present day, bar the Japanese war years.

On the island of Billiton, the N.V.Billiton Maatschappij (The Billiton Co.) obtained the exclusive mining rights from 1860. In 1924, a new arrangement was made by which the government became the senior partner in the new company: N.V.Gemeenschappelijke Mijnbouwmaatschappij Billiton (The Billiton Joint Mining Company), created with a capital of 16 million guldens, of which 10 million were owned by the Government, and the rest by the Billiton Company. The number of directors of the Joint Mining Company was five, three representing the Government and two the Billiton Co.

Since 1934, the Billiton Joint Mining Co. has been in complete control of the third tin island: Singkep.

Since the middle of the 1930's, there has been a movement towards further merging of interests between Banka and Billiton. This, however, was interrupted by the war. In the beginning of 1948, an agreement was arrived at between the N.E.I. Government and the Billiton Joint Mining Co., by which the latter was entrusted with the management of Banka for a period of five years.

5. In the earlier part of the 1920's, these three big organisations, Dutch, Patino and London Tin, existed as separate entities. Since 1929, their interests became fused, mainly through the establishment of the Consolidated Tin Smelters Ltd.

Previously there were few financial links between the mining and smelting industries. The Dutch Government controlled both the mines and the smelter at Banka from the beginning; but Banka Smelter was then small and some of the Banka ores were shipped, together with Billiton ores, to the Straits for smelting. Patino became interested in a British Smelting Company since 1921; but had no complete control over it. Competition was the rule in the tin smelting industry.

At the end of the tin boom in 1926, the smelting industry had expanded out of all proportion to the mining output, which itself had greatly increased. At the same time, vertical integration took place. The Billiton Joint Co. formed the Hollandsche Metallurgische Bedriven (H.M.B.) in 1927 to operate the new smelter at Arnhem. In the same year Patino acquired the whole share capital in Williams Harvey & Co., whose smelter at Liverpool was reconstructed and enlarged. The London Tin Corporation Group also bought the Penpoll smelter at Bootle about the same time and erected a large smelter nearby.

In the summer of 1929, attempts were made to integrate the smelting industry. Complete integration failed; but an amalgamation of Williams Harvey, Penpoll, Cornish Smelting (all in U.K.) and Eastern Smelting (Straits) was successfully carried out. The new company was registered with the name of the Consolidated Tin Smelters Ltd., in December 1929; 32% of the capital was held by the Patino interests, nearly 10% by Dutch interests and the remainder by the British. The C.T.S. in its turn acquired some shares of the H.M.B. Arnhem Smelter.

The interests of the London Tin Corporation and the Patino group were merged in a number of tin holdings and mining companies, among which were : the British American Tin Corporation (1929-1932) dealing in large blocks of tin mining and smelting shares as well as tin metal, and its successor the British Tin Investments Corporation Ltd., with a capital in 1937 of £2¼ million; the General Tin Investments Ltd., formed in 1936, with a capital of over £2 million in 1937. These companies control a large number of mining companies in Malaya and Siam.

Jointly with the Billiton interests, the L.T.C. formed in 1932 the Anglo-Siam (or Anglo-Thai) Tin Syndicate, operating in the south of Siam. All the "Big Three" interests, as well as those of the National Lead Co. of the U.S.A. were represented in the British American Tin Mines, a holding company registered in 1934 and controlling a few mining companies in Siam.

II Medium-sized Organisations.

6. There were, in 1940, nine companies and groups of companies each producing 1% or more of the world output, apart from the "Big Three". They were: in S.E.Asia, the Tronoh-Malayan Tin Group (over 5% of world output), the Gopeng Group (just over 3%), the Austral-Malay Group (1¼%), the Pacific Tin (1¼%); in Nigeria, the Gold and Base Metals Group (1%); in Bolivia, the Hochschild Group (3½%), the Aramayo Group (1¼%); in the Belgian Congo, the Géomines and the Symétain (1½% each).

7. The group sometimes known as the "London Group", which comprised the Tronoh Mines Co. (established in 1901), the prosperous Malayan Tin Dredging Co. and Southern Malayan Tin Dredging Co., and nine other concerns, as well as a few financing companies, had command over about £2,500,000 of issued capital, and produced, in 1940, 12,000 tons in Malaya (plus a small tonnage in Siam), which amounted to about 14½% of the Malayan output. The Tronoh Mines Co., moreover, had substantial holdings in the Gopeng Group of companies.

8. The Gopeng Group, also called "Redruth" from its association in Cornwall, included thirteen mining companies all operating in Malaya, with an aggregate issued capital of over £2,250,000. Its 1940 output was about 7,300 tons of tin,

which was about 9% of the whole Malayan output. The leading company of the group was the Gopeng Consolidated Ltd., registered in 1912 as an amalgamation between the Gopeng Tin Mines and the New Gopeng Ltd. This group is one of the oldest tin mining organisations in Malaya, and has large following in the tin mining industry of the colony. Together with the Tronoh Group, it led an opposition to the L.T.C.

9. The Austral-Malay was a group of Australian-owned mines operating in Malaya, Siam and Burma. The Austral Malay Tin Ltd. was founded in 1920; by 1940 the aggregate issued capital of this group amounted to over £1 million, and the combined output in 1940 was just under 3,000 tons.

10. The Pacific Tin Consolidated Ltd. was an American Company, controlled by the Guggenheim interests, with several officials of the American Smelting & Refining Co. on its Board of Directors. Founded in 1907 under the name of the Yukon Gold Co., it changed into the "Yukon Pacific Mining Co." in 1938, and next year it combined with the Pacific Tin Corporation to adopt the present name. Its issued capital was in 1940 (US) $1,060,000, and it owned two subsidiary mining companies registered in Malaya, with the combined issued capital of (S.S.) $6,110,000. The combined output was about 3,000 tons of metal.

The Guggenheim interests in tin mining extended also to Bolivia since the early 1920's, where they spent several millions of dollars on development and mining works. The Empressa Minera Caracoles, which they owned, was sold in 1933 to the Aramayo Group, for whom moreover the firm of Guggenheim Bros. acted as technical managers.

11. In Nigeria, <u>the Gold and Base Metal Group</u> which produced in 1940 about 2,650 tons of tin, or 22% of the Nigerian output, was associated with the National Mining Company of the Latilla group.

12. <u>The Hochschild group</u> of mines which was a relative newcomer to the Bolivian tin mining industry and soon became the second biggest tin producer in Bolivia, controlled about 25% of the total output of the country in 1940. It consisted of four tin mining companies, of which the most important, the Cia Minera Unificada de Cerra de Potosi was associated with the Central Mines and Investment Corporation of S.Africa.

The Hochschild group represented a combination of Bolivian, Argentine, Chilean, French and British capital, which amounted to just under £4 million.

13. <u>The Aramayo Mines</u> were among the oldest mines in Bolivia. The present company, the Compagnie Aramayo de Mines en Bolivie, S.A., was incorporated in 1916 in Geneva to acquire

the older Aramayo Francke Mines Ltd. In 1940, its output was about 3,000 tons of tin or 8% of the Bolivian total, and the capital 20,160,000 Swiss francs. The capital was predominently Bolivian, although Swiss, French and British interests participated. Its relations with the (U.S.A.) Guggenheim interests have already been referred to in paragraph 10.

14. In Belgian Congo and Ruanda-Urundi, two companies produced in 1940, together, about 7,500 tons or 50% of the country's output. They were <u>the Géomines</u> and <u>the Symétain</u>. The Géomines - Compagnie Géologique et Minière des Ingénieurs et Industriels Belges, S.A., - was formed in 1910 with a capital of 200 million Belgian francs. Besides having an electric smelting plant in the Colony, the Géomines owned a large interest in three other tin mining companies: It was also interested in coal mines and a diamond company.

The Symétain was a late-comer in the field, but its output rose rapidly after 1934. It is a subsidiary of the Syndicat Minier Africain (SYMAF) founded in 1929 and associated with the Allard banking group. Its field of activity was in the Kivu and Ruanda-Urundi areas.

III <u>Other important smaller producers.</u>

15. Some of the smaller producers are fairly important household names in the tin mining industry. Among these were the Pahang Consolidated Co.Ltd., the only lode mining concern

of consequence in Malaya; the Mawchi Mines Ltd., the largest tin-wolfram producer in Burma; and the Kotchiu Tin Company of China. Other smaller producers were: in Malaya, the Ipoh group; the French company, Société Anonyme des Etains du Kinta, and the Chinese Hong Fatt Mine; in Nigeria, the Naraguta Group, the Kaduna Group and the Jos Tin Area and Lower Bisichi Group; in Bolivia, the Fabulosa Group controlled by the Bolivian General and Tin Trust, the International Mining Corporation and the Cia Minera Montserrat: in Belgian Congo, the Union Minière du Haut Katanga, and the Simkat-Sermikat combine.

Finally, there were a large number of small independent units mining in Malaya, Siam, Burma, Bolivia, Nigeria, etc., individually controlled by Chinese, Bolivians and British principally. The number of these small units had decreased considerably since the depression, but in 1940 they still produced something like 20-25% of the total world output.

(B) GOVERNMENT INTERESTS

Comparative unimportance in occupational distribution.

16. Immediately before the Far-Eastern War, about 285,000 people were directly engaged in the tin mining industry throughout the world. Of these about 82,500 were in Malaya, 44,300 in Indonesia, 55,000 in Bolivia, 31,900 in Nigeria and 20,000 in Siam. Judged from employment figures, tin mining was far from being the most important industry providing for the livelihood of the people in various countries. Even in

Bolivia, whose dependence on tin is proverbial, the number of tin miners only formed less than 2% of the total population - or about 6% of the working population. Agriculture was still by far the most important occupation even in "mining countries".

The real importance of the tin mining industry to these countries, however, lies in two respects: (a) the balance of international payment, and (b) public revenue.

Trade Importance.

17. The industrial development in the major tin producing countries has to date been negligible. Consequently all or almost all the tin they produced was sent abroad, and in all these countries, tin was among the leading export commodities. In terms of value, in the years before the second World War, it was second in the export list of Malaya, third in that of Indonesia, first for Bolivia, second for Siam and alternately third and fourth for Nigeria.

In normal years the balance of payments of the principal tin producing countries showed a surplus which varied according to their indebtedness abroad, the foreign investments in their territories, and other commitments. These surpluses of exports over imports were used for the payment of interests, dividends and the repayment of loans abroad etc. A decline in the price of tin meant for them a large reduction in the trade surplus, and consequently a default in external commitments or a decline in imports, or both.

18. The case was most conspicuous for Bolivia. In the 1920's and 1930's, the value of tin ores exported from Bolivia averaged about 65% of the total export. During the war it reached nearly 80%. As an earner of foreign currencies, tin provided a special interest for the government.

In the cases of Malaya, Siam and Nigeria, the share of tin in the total value of exports varied between one-sixth and one-fourth. The average figure for the N.E.I. was 7%. The percentage for the Belgian Congo has risen from 2 to nearly 20 in the past fifteen years.

Budgetary Importance.

19. The treasuries of the chief tin mining countries also depended largely on the prosperity of the tin industry. The latter provided large annual sums of money for the national revenue in the form of mining and prospecting fees, royalties, export duties, profit and income taxes, and other forms of revenues.

20. The extreme example in this respect is again Bolivia. In 1928, the tin mining industry paid approximately Bs.10.7 million to the government in the form of import duties for machinery etc. (2.8 mn.), export duties for ores (5.5 mn.) and other taxes (2.4 mn.). (See Note 4). Total government revenue in the same year was 41.6 million Bolivianos. During

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Note 4. Report of the Banco Central de Bolivia, 1929 (La Paz) p.57.

the period 1900-1939, between 10% and 30% of the total government revenue was derived from export taxes, almost the whole of which was contributed by the tin ores. Since 1940, export duties have increased even more in importance: their proportion to the total revenue has been maintained above 60%. It is estimated that between the two wars, about 20% of the c.i.f. value of exports of tin was taken by the Government as taxes, in addition to various internal imposts on tin mines and concentrating plants. (See Note 5). The export duties on tin ores in Bolivia are not only heavy - they are higher in normal times than the total production cost per ton in some of the companies in S.E.Asia - they are also levied according to a very complicated system, with a basic schedule supplemented by a number of surtaxes and extraordinary, sometimes temporary, taxes. By the end of 1939, there were nearly a dozen export levies on tin ore, with more than 25 separate laws dealing with the export duties on minerals, starting from the standard tax in 1924, including statistics tax, and specific local imposts to finance various public works. The depreciation of the Boliviano, the establishment of the International Tin Research and Development Council, the Chaco War, etc. all provided occasions for introducing a new levy on tin. The tightening up of the exchange control since 1939 also gave rise to a new

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Note 5. U.S.Tariff Commission: Economic Control and Commercial Policy in Bolivia. (Washington 1946) p.31.

"impuesto adicional", computed on the basis of the percentage of foreign currency which tin exporters were required to surrender to the government at the official exchange rate.

21. In the N.E.I., apart from the export duty on tin, which amounted to about 1 million guldens per annum, the government received, during prosperous years, between 15 and 55 million guldens as profit from Banka, and another 2 to 8 million guldens as dividend from Billiton and Singkep. These incomes from tin formed about 5% - 12% of the total government revenue. During the depression, these were considerably reduced, and in one year, 1932, there was actually a small net loss for the government.

In the Belgian Congo and Ruanda-Urundi, the Belgian system prevailed, in which the State retained large shares in mining companies instead of a system of royalties or taxation. (See Note 6). The Belgian Government thus had a direct interest in the prosperity of the tin industry.

22. In Malaya, most of the contribution by the tin industry to the government was in the form of an export duty, supplemented by a small cess levied for the contribution to the ITRDC. The proceeds of the duty on tin and tin ore between 1921 and 1940 varied from (S.S.) $3.6 million in the slump year of 1932 to $23.3 million in 1940. On the average, it amounted

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<u>Note 6</u>. Lord Hailey, op.cit. pp.1506, 1516 and 1530; S.H.Frankel, op.cit. pp.292-4.

to about $12 million per year, or between 12% and 18% of the total government revenue. (See Note 7).

In Nigeria, the tin industry yielded a much smaller percentage of the total revenue to the government - only 1% or 2% between the wars. The absolute amount was, on the average, £100,000 per year - £170,000 during the boom, £8,000 during the bottom of the slump, and £260,000 during the recent war years. The bulk of the revenue was collected in the form of royalties on tin exported, plus a negligible duty for the government's contribution to international tin research.

The Siamese Government received from the tin mining industry an average of 2 million Baht during the 1929/33 slump, and 4.5 million Baht during the next five prosperous years. Most of these came from the royalties on tin ore exports. These constituted between 2% and 6% of the total government revenue.

23. More specifically, the governments in most tin producing countries were interested to see that tin prices remained high. This was due to the widespread practice of graduating the rate of duties progressively with the London price or Singapore price of tin. The Malayan export duty, for instance, started with the rate of $2.40 per picul at a price not exceeding

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Note 7. Malayan Mines Department : Bulletin of Statistics relating to the Mining Industry, 1946.

$41 per picul, increasing by 12 cents for every dollar of the increase in price. The Siamese tin royalties were on a similar sliding scale. The Nigerian royalty was at the rate of 2% on the value of tin exports at the London price below £180 per ton, gradually increasing to 10% at the price of £300 or above. The Bolivian schedule of basic export duties of 1924 started with Bs.3.25 per quintal of tin ore at price up to £100 per ton, advancing to Bs.28.25 when price reached £300 etc.

Conversely, during the depression and low prices, not only did the governments lose a large part of their normal revenue, but the pressure of the miners in distress was brought to bear upon the fiscal policy. Concessions and suspensions of export duties, and royalties, and sometimes even subsidies were granted to tin mining industry, thus making it more difficult for the governments to balance their budget. (See Note 8.)

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Note 8. See Ch.VI, paragraph 14.

Note 2.(See page 197). In 1920, a private company was registered under the name of the Anglo-Oriental and General Investment Trust. Eight years later, it was converted into a public company, the Anglo-Oriental Mining Corporation with the authorised capital of £1,750,000, "with a view to the consolidation and further advancement of the widely spread and important tin and other mining industries". In 1937, it was decided to transform the AOMC into a small financial proposition, capitalised at only £100. The control of the industry was carried on through the sister company, the London Tin Corporation

The London Tin Corporation was, between its formation in 1925,and 1930, called the London Tin Syndicate, Ltd. Its capital originally £50,000, rose to £1 million in August 1929, was doubled four months later and trebled in 1930. Since 1937, it stood at £4,200,000, of which about £3,620,000 was issued and fully paid.

The activity of the L.T.C.-A.O.M.C. group during the tin boom (1926-1928) is well described in the Chairman's speech, at the 1929 General Meeting of the L.T.S., in which he said

> "....(in 1925) their energies were directed towards the reawakening of the ancient tin mining industry in Cornwall. By the middle of 1926, however, they already had one foot firmly planted in Nigeria, and early in 1927, they obtained a footing also in the F.M.S., deploying into Siam and Burma, and later into Japan. By the end of 1927, the ever-increasing production coming under the Syndicate's control had impelled them to look more closely into the smelting side of the business, and so began their association with the Penpoll Smelter. Needing in that connection adequate supplies of high-grade Nigerian oxide, early in 1928 the Board were once more applying energies and resources towards the broadening of their sphere of influence in the tinfields of that colony .... Realising the importance of co-ordination within the industry, they redoubled their efforts towards rationalisation in Nigeria, as a stepping stone in the direction of a much wider rationalisation.... The current year marked the definite attainment of their first big objective in Nigeria, arrangements being concluded....whereby the "Associated" Companies had become largely interested in the Kurra Falls Hydro-Electric Concession."

Primarily a financial group and a comparative newcomer to the tin mining industry, the Group's influence was at first much under-estimated. The Editor of the Mining Journal referred to it in 1927 as having "very little acquaintance with the industry", yet the A.O.M.C.-L.T.C. were the chief force behind the formation of the Tin Producers' Association in 1929, and later played a very important role in the organisation of both the voluntary restriction scheme of 1930 and the International Control Schemes of 1931-1946. The "Group" was also engaged in speculative holding of tin metal.

Since 1930, the Boards of Directors of the L.T.C. and the A.O.M.C. were all but identical. In 1937, among the eight directors of the A.O.M.C., and the seven directors of the L.T.C., five served on both boards. Captain O.Lyttelton was Chairman of the L.T.C. from 1937 until 1940 (when he took a ministerial post), as well as being managing director and director of other metal and mining companies.

Prominent among the founders of the "Group" was J.H.C.E.Howeson, who was the Chairman of the A.O.M.C. up to 1934 and of the L.T.C. from 1930 to 1934. Mr.Howeson was, by career, a financier. Besides controlling a dozen tin companies, of several of which he was the Chairman, he was a director of other big mining concerns such as the New Consolidated Gold Fields Ltd., the Consolidated Gold Fields of South Africa, as well as of the Consolidated Tin Smelters Ltd. During the early stages of the inter-governmental tin restriction scheme, he was a technical adviser to the International Tin Committee, and represented Nigeria on the Buffer Stock Committee. After the "Pepper Crisis" in 1935, in which he was implicated and received a court sentence, his name disappeared from various directorates.

# CHAPTER VI

## ANALYSIS OF SUPPLY

## (A) THE PRODUCTION PLAN OF TIN MINING CONCERNS

### I The Elements of Production Plans in Tin Mining.

1. The activities of tin mining concerns vary in detail according to the locality, the type of deposits, and the size of the properties, but they can be classified under four broad headings which are common to all types of production: (a) development, including prospecting, assaying, sampling, (b) actual mining, (c) benefication which includes milling, concentrating and smelting, (d) marketing, including transport. For a big organisation all the four groups of activity and other auxiliary activities such as the provision of power, machinery, etc., are carried out within the organisation, but division of labour is generally the rule. Prospecting, smelting and marketing are usually done by specialists. The miner's job proper is confined to actual digging and cleaning of ores. Often a development section forms an integral part of the mining company.

Given the amount of capital and the technological conditions governing his means of production, the mining entrepreneur in his decision regarding his production plan, is confronted with four main considerations: (a) the life of his property, (b) the cost of production, (c) the price of his product. These three subjects are inter-related and all governed by an overall consideration (d) risk and uncertainty.

2. The amount of capital under the company's command at any point of time, the cost of the equipment, the availability of labour and the necessary organisation are the factors which set limits to the annual (or monthly) output capacity of a mine. Mine property is a wasting asset; the area of land leased for mining purposes must cover several times that necessary for a year's (or month's) output. The optimum area under lease is determined in each case by the capital as well as by the type of deposit. In tin mining practice, although no fixed general rule can be made, experience has established that normally fifteen years is the life for which alluvial deposits to be worked by dredging are equipped. Where, as with lode deposits, it is not possible to have knowledge of the limits of the deposit before production begins, it is the scale of working chosen which determines the life of the property. (See Note 1). The geological conditions of the deposits also determine the size of the property which is to be leased: the more complicated the deposits, the larger is the area required to ensure a given scale of working capacity and a given length of life. This is one reason why larger tin properties tend to be held in Nigeria than in Malaya; (See Note 2), and the amount of locked up capital

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Note 1 S.J.Truscott: Mine Economics (Mining Publications,Ltd., London 1937) pp. 159-160 and 172.

Note 2 About 300 acres constitute an average Malayan tin mine; in Nigeria the area normally varies between 2,000 and 3,000 acres (Mining Journal: Annual Review Number for 1930, p.(33)).

necessitated by the larger ground rent, results in a larger overhead cost in mines with more complex deposits.

In an area acquired by a mining concern, the richness of the deposits is usually far from uniform. The existing equipment determines the volume of the digging during a period of time and the output in terms of tin metal or tin concentrates depends on the tin content of the earth. In order to give the company's shares a good market value, the output, and not the throughput, must be steady enough. Moreover, with fluctuations in price, and assuming that the throughput capacity is worked to the full, the miner can maximize his profit over a length of time by working a richer portion of the deposit during a period of high price, and conversely. For these purposes, exploration and sampling have to be made over the whole or a large portion of the property in advance, whereby the richer sections become known and separable from the poorer, and these again from the barren. (See Note 3). The more complicated the deposits, the higher the costs of exploration and development.

Each individual piece of mining property has a limited life, but the life of a company need not be so limited. A mining concern can make further acquisition of area, either continuously or from time to time. It is the practice of "European" mining companies to have continuous survey and

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Note 3. S.J.Truscott, op.cit., p.6.

development in normal times. An amortization fund is charged for this purpose from the annual earnings, and this forma an element in the overhead costs, generally non-existent in the case of small "Chinese" mines which do not observe this practice. However, for some reason or other, a number of "European" mining companies, during a period of depression, usually do not set aside the amortization quota and are more anxious to pay out in dividend whatever sum is available. In such cases, the dividend paid out must be considered as consisting partly of principal being returned, and partly of interest or profit on the capital embarked. For mines with long life, such as most lode mines, the amortization problem need not be dealt with regularly: any proper annual deduction on this account would be small, but amortization is more urgent in alluvial properties. Malayan tin mines in general regularly write down their properties and build up a repletion reservoir. (See Note 4). In a new and extensive tinfield, the life of a company, as distinct from that of the property it holds at any moment, can be considered to approximate permanence. This tends to decrease as the number of concerns exploiting the same region increases, or as restrictions on prospecting and development are imposed by state or local authorities.

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Note 4. The British Income Tax Law admits no deduction from annual surpluses on account of amortization, but it was stated in the House of Commons in September 1948, that the Treasury has appointed a committee to consider the matter.

(b) <u>The cost items</u>.

3. In tin mining, the following items are the elements of the full cost, which is to be compared with the price per unit (lb. or ton) of metallic tin to give the net profit margin:

(1) "mining" or "operating" cost: the cost of the actual operations of breaking, raising, washing, milling, concentrating, and subsidiary operations such as pumping and ventilation necessary for production in lode mines.

(2) User cost, which is "the reduction in the value of the equipment (and property) due to using it, as compared with not using it". (See Note 5).

(3) Rail, road and sea freight and insurance.

(4) Royalties and/or export duties and other cesses, plus, in the case of output restriction, the price of quota certificates purchased in excess of those allotted to the company.

(5) Return (smelting) charges.

(6) Administrative costs and expenditure on marketing, including standing charges, such as pumping in lode mines during idle periods.

(7) Exploration and development costs.

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<u>Note 5</u>. J.M.Keynes: General Theory of Employment, Interest and Money (Macmillan, London, 1936) pp.66-73, also pp. 23 and 54.

(8) Equipment depreciation and amortization for property, which are gross depreciation and gross amortization less the user cost.

(9) Mining leases and other fixed rents and fees.

(10) Interest on debentures and other fixed commitments.

This classification is made to suit our analytical purpose and diverges somewhat from the practice of mining companies in their cost accounting. The sum of all the items makes up the long-run full (see Note 6) cost of production. The first five items form the prime cost in the sense that they are incurred because production and sale take place, and they vary directly and positively with the output and sale. The rest of the list can be called overhead costs with the following qualifications. (Item 6) Administrative and marketing expenditures are fixed overheads in so far as they are incurred in lump sums, irrespective of output or sale. If they are on a commission basis, varying with output on the value of the sale, they must be treated as prime cost, or a mixture of the two, but the expenditure incurred for pumping the mines during idleness, together with the items (9) and (10), rents and fees, and interest on loans, are normally fixed, inescapable overheads.

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Note 6. "Full cost", not "all-in" cost is used here, since the "all-in" costs as used in business reports are not actually all-in. See paragraph 4 below.

Items (7) and (8), development, depreciation and depletion allowances are expenditures which could be escaped in the short-run, e.g. during the lean years, but not in the long run, unless it is decided to allow the capital value of the concern to deteriorate over time. If full allowances for (7) and (8) are made year by year, they form part of the overhead costs, and can be determined uniquely per ton of output. (See Note 7).

Over a long period, the total full cost must be covered by the total receipts and the excesses, positive or negative, of the annual receipts over annual full costs, form the stream of annual surpluses or deficits. It is the present value of this stream that would be maximised if maximisation of the profit margin were the sole criterion of the company's policy. In the short run, however, only the prime cost needs to be covered by gross receipts. In actual practice, the receipts could even go below the prime cost. For one thing, the user cost, an important element in the prime cost of a mining concern, is rarely and inadequately taken into account. For another, there is some extra expenditure incurred in closing down a mine and reopening it again in the future. This consideration, together with the expectation regarding the course of price in the near future, may lead the directors of a mine to go on producing even when price has fallen below the prime, or working, cost.

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Note 7. On the other hand, some items which are normally regarded as prime costs would more properly be considered fixed overheads in the very short run if they are under long term contracts. Labour contracts for a period of, say, a year, in which wages are fixed on a time-rate basis would come under the category of fixed charges.

4. The methods used by tin mining companies in their reports are varied, and the figures for costs or revenues rarely fit in with our theoretical classification. There are many pitfalls for unwary students. A wide-spread practice, for instance, is to give the receipt figure not as price per ton of metal, but as "net receipt" per ton of concentrate; i.e. (the price of metal x % of tin content of the concentrate) - (freight + insurance + returning charge + duties). This means that several items of cost are already deducted from the receipt, and the remaining figures of cost alone cannot be taken as "full cost" in our sense of the word, i.e. the cost which is to be compared with the price of tin for long-term policy analysis. The most common cost item given in reports is the mining cost (or operating, or working cost), which corresponds to our item (1). Sometimes, "all-in" costs are given which, however, include items (1) to (5) plus administrative and London expenditures (part of (6)). Even mining cost itself is expressed in various ways, which need to be converted to a common basis for the purpose of comparison. Most Malayan alluvial mining costs are in pence or Straits cents per cubic yard of throughput, which is not a true reflection of the cost per unit of tin, since the metal content of the throughput varies in time and place. Lode mining companies generally record their working cost in shillings per ton of the ore milled. Nigerian companies' cost figures are usually the f.o.r. (free-on-rail Bukuru or other centre) cost per ton of

concentrate. Dutch undertakings in Indonesia report their cost in guldens per picul or quintal of metal including depreciation and amortization (6% of capital), which is the full cost in our sense.

When, in later sections of this chapter we come to discuss the cost schedule and cost range in the industry for the period under study, we shall need two sets of figures: the prime costs and the full costs per ton of tin metal. Because the practice of cost accounting in tin mining companies differs from our analytical conception of cost, and because we are dependent on the published figures for our data, a compromise has to be made by which the published figures can be utilised as much as possible and be converted as nearly as possible to our analytical concepts. (See Note 8.) The ideal case would be when each individual item can be calculated from the published reports, but in all cases, the user cost for machinery is unidentifiable, although the user cost with respect to property can be roughly worked out from the royalty and rent figures. Our resultant prime costs therefore necessarily exclude at least part of the user cost. In some cases the individual items for freight, insurance, royalty and returning charges cannot be obtained;

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Note 8. Referring to the behaviour of business men in general which deviates sometimes from the logical theoretical course, Marshall said: "The analytical economist must follow suit, if he would keep in close touch with actual conditions. These considerations tend to blur the sharpness of outline of the theory of value: but they do not affect its substance." (Principles 8th edn. Book V, Ch.V, para.6, p.376).

the average figures for the same tinfield have to be used instead. In converting the cost per ton of concentrate to those per ton of metal, true assay values are employed as far as available: where they are not, 75% is used for Malayan and Indonesian concentrates, 72% for all other alluvian concentrates, and 60-65% for lode ores in Bolivia and Cornwall. Where full cost figures cannot be obtained directly, they are calculated from the following formula: Full cost per ton =

$$\text{price of tin} - \frac{\text{total net profit from mining operation}}{\text{tons of output}}$$

or="net value"+freight+insurance+returning charge+duties- net profit
(as given in Co.reports) (all per ton)

where : "net value"= price-(freight+insurance+returning charge+duties)

and net profit = gross profit-(depreciation+amortization)

For some companies which derive their profits from their investments in other companies as well as from their own mining operations, and which do not publish them separately - The Tronoh Mines is a case in point - it is impossible to calculate the costs from the above formula.

(c) <u>The price of tin</u>.

5. Given the length of life of properties between one year and infinity, and given the cost function, the production plan of a tin mining company depends on the present price and the expected prices. Profit maximisation means here the maximisation of the present value of the stream of the annual surpluses - i.e. the surpluses of price over full cost,

discounted to the present day. (See Note 9).

Granted a steady price of tin, the present value of a property having a fixed throughput capacity can be maximised by mining from the richest portion gradually to the poorest portion, in order of time (See Note 10). This is indeed what usually happens in the normal course of events. No mine ever maintains a given rate of depletion right to the end: it gradually fades away. (See Note 11).

With fluctuating prices, and with reasonably good foresight, it would appear from the point of view of maximisation of the present capitalised value, more profitable to mine richer portions during times of high price, and to restrict output during low price, or shut down altogether as price becomes lower than prime cost less the extra cost of closing down and reopening the mines. What usually happens in practice is that during the period of high prices, poorer material, which otherwise would be unpayable, is mined; and during times of abnormally low price, big mines with large ore reserves endeavour to work richer ore and maintain their profits, although it is true that small mines with small reserves of ores close down or drastically restrict their output. The

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Note 9. J.R.Hicks: Value and Capital (O.U.P.1939) p.193. and Ch.XV passim.

Note 10. provided that the extra cost of moving equipments backward and forward over the whole property is negligible.

Note 11. S.J.Truscott: op.cit. p.172.

chief reason for adopting such a policy is that it is deemed desirable for the mining concern to show its stability and its ability to adapt itself to the changing circumstances, and to survive as one of the fittest in the industry. (See Note 12).

(d) The risk and uncertainty factor.

6. The tin mining industry is subject to a number of risks and uncertainties, some of which it has in common with other enterprises, especially heavily-capitalised industries: such as the variation in cost, the variation in demand and the consequential variation in price, risks of accidents, collapse of mines, flood, explosion, etc. Tin, as a raw material of industry, is subject to wider oscillations of price than finished consumers goods. These "measurable risks" are to a certain extent insurable by means of "consolidation" and "specialisation". (See Note 13). Dredges constructed in Europe or America are towed through the hazards of high seas to the Eastern Tinfields and have been known to be destroyed, or to have capsized on the way. However, such losses can be

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Note 12. ibid. p.172. The "liquidity-solvency motive in business", (R.A.Gordon's term in A.E.R. June 1948, p.271), in contrast to the profit maximisation motive is the subject of a recent controversy in American journals concerning the reality and applicability of the marginal analysis. See the articles of R.A.Lester, Fitz Machlup, G.J.Stigler, H.M.Oliver and R.A.Gordon in the American Economic Review of 1946,1947 and 1948. Also K.E.Boulding's review - article on P.A.Samualson's Foundations of Economic Analysis in J.P.E.,June 1948,pp.193-195

Note 13. Terms used by Irving Fisher (Nature of Capital and Income, p.288) and by Frank H.Knight (Risk, Uncertainty and Profit. Ch.VIII).

insured against in the ordinary commercial way. The risk of short-term price oscillations can be guarded against by hedging in the futures market. This method of risk elimination is normally employed by the smelters who immediately sell forward the tin which they purchase. In practice, the miner, however, sells his ores to the smelter or middle man on the day-to-day price basis, thus bearing the risk of price fluctuations, although it is theoretically possible for him to avoid it. This is specially true of small Chinese miners in the east.

The uncertainty peculiar to tin mining, as well as to the other non-ferrous mining enterprises, but not applicable to manufacturing industries, arises from the uniqueness and relative uncertainty of the mass of raw material on which it works. Although geological survey methods have improved and there are available experienced specialists in prospecting and surveying whose service brings the expectancy of ore reserves within reasonable approximation to realisation, the uncertainty regarding the metalliferous content and the expected life of properties cannot be entirely eliminated. Moreover, whereas in manufacturing industries relatively small stocks of raw materials need be bought at a time and replenished when necessary or opportune, in mining,a large size of property must be secured at the beginning. Even a small degree of uncertainty regarding the deposit would thus involve a large sum of capital, and it is this characteristic which makes tin mining a highly speculative business.

Another element of uncertainty was peculiar to the tin industry in the period between the wars, when technical progress in tin mining was very rapid. It is a well-known fact that, with reasonable maintenance, tin dredges have very long life. They often outlast the life of an average-sized property. A tin company which spends, say, £100,000 on a dredge is committed to that type of dredge for a long period of time, and will not be able to take advantage of the lower running costs afforded by later types of machines. Tin dredges and other machines used in tin mining are of specific nature, having little value for other purposes. The scrap value of such machines is accordingly very small.

The special risk and uncertainty in the tin mining industry thus arise out of three main facts; the wide oscillations of price, the speculative nature of non-ferrous mining, and the large sum involved in the acquisition of property and machinery.

## II The Long-term and Short-term Plans.

### (a) General Considerations.

7. It is evident from the above analysis that the objectives pursued by tin mining concerns in their long-term and short-term plans may be quite different in emphasis. In the long-term plan, the chief aim is the maximisation of the present value of the surplus, which is the sum of the annual expected surpluses discounted by the rate or different

rates of interest commensurate with the risk and uncertainty factor. (See Note 14). In the short-term plan, while maximisation of profit is still the rule, the emphasis in practice is placed on the "soundness" or "stability" appearance of the company: regular dividend payment, strong reserve position, vast liquid resources, etc. This, in fact, apart from purely accounting measures (such as the postponement of depreciation and amortisation), is the negative side of short-term profit maximisation - i.e. the minimisation of short-term losses during the depressed years, but the two plans are not mutually consistent, and in practice it is the short-term plan which is adopted in most cases.(See Note 15).

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Note 14. Cp. J.R.Hicks: Value and Capital, Ch.XV and Mathematical appendix thereto, pp.325-326. Hick's formula for the capitalised value of surpluses on p.326 can be applied here. However, the risk allowed for in this formula is only the risk of inaccuracy in price expectation (see pp.125-6), and the rate of discount used is a single "accumulate rate of interest". In mining, greater accuracy can be gained at the expense of simplicity, by adopting the Hoskold's two-rate formula in which the two rates of interest are the ordinary accumulative rate and the higher risk-rate of interest (Hoskold's "Engineers Valuing Assistant - published 1877, also Louis: Mineral Valuation (1923): see S.J.Truscott, op.cit., Ch.XII)

Note 15. This point can be generalised for all types of production plans, and constitutes a severe limitation to the usefulness of the marginal analysis as applied to business policy. See the articles, cited above, of K.E.Boulding and R.A.Gordon.

We are here talking about the aims of the mine owners. In the cases where the production plan is conceived and carried out by salaried managers, the personal interest of the latter in the security of the post held, may influence the policy of the concerns in favour of a longer life.

Not only do production plans conflict with each other in time, the variance may exist also between the production plan of an individual mine within a big, especially an international, organisation and that of the organisation itself. For instance, whilst an individual mine, acting independently, might stop producing as the price of tin falls below its prime cost, this consideration might be against the interest of the organisation wishing it to carry on production, even at a loss. This will happen if, for instance, the mine in question is situated in a country in which the organisation wants to "obtain a footing" and to maintain it, and/or, if as long as the mine goes on producing, the organisation is likely to be able by that very fact to influence the policy of the government of that country, or obtain a larger production quota if restriction schemes are in existence, or are expected. In such cases, it is the long-term over-all profit of the organisation, not that of the mine, which is being maximised.

8. The broad outline of policy governing the production plans of a tin mining concern can be thus summarised:

There is a general tendency to work a mining property from the richest portions to the poorest. After an initial period during which annual (or monthly) output increases rapidly, the tendency is for output to fall away very gradually at first, and rapidly towards the end. In the meantime, the output may be maintained or even increased only with further acquisition and working of new properties.

With cyclical price fluctuations, a company with limited ore reserves will work on the richer portions during the period of high price, and on the poorer portions during the period of low price, or stop work altogether when price falls below prime cost minus the extra cost of closing down and reopening. Full throughput capacity may or may not be maintained; but even if full capacity is maintained, the output will fall during the period of low price. Sound financial appearance may be aimed at by paying dividends at the expense of depreciation, amortisation or development quotas. When times are really bad, and it becomes manifest that mining companies generally are incurring losses, dividend payments are suspended and the principle of minimum loss applies. In the case of a company with vast ore reserves, the policy regarding the portions of the property which are worked may be reversed. Opportunity of high prices may be seized upon to mine the poorer sections or the tailings which would not otherwise pay, and during the depression, the richer portions will be mined and profit margin maintained as far as possible. When depression has gone far enough, the same practice regarding dividend payment and depreciation-amortisation-development policy as in the case of firms with smaller properties will be applied. With large international organisations, the continuation of production at a price lower than prime cost may be due to politico-economic considerations.

The variation of working areas in the same property or group of properties is limited by the cost involved in the variation. In general, open cast, gravel pump and hydraulic methods are more conducive to adaptation and movement to new sites than dredges and draglines, although in recent years, "walking" draglines have been initiated in Nigeria to facilitate movements at lower costs. Furthermore, lode mining is more rigid in this respect than alluvial mining; but flexibility obtains in lode mining when the mine comprises several pits and is worked at much less than full capacity.

Finally, the decision as to the variation of working areas according to the values content depends largely on the expectation of the future course of price, and on the duration and intensity of the boom or depression. Reactions to different expectations will obviously vary.

(b) Substitution and Complementarity over Time.

9. The successive outputs of a mine are at the same time substitutes and complementary over time. (See Note 16). With regard to the given volume of ore reserves, they are substitutes: but with regard to equipment capacity installed, they are complementary.

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Note 16. cp. J.R.Hicks, op.cit. pp.207-210.

That products in mining are substitutes over time clearly arises from the wasting-asset character of the property. A small output today will leave larger reserves for the future, and conversely, but in the short period the "spurt" in output is limited by the producing capacity of existing equipment, the availability of additional means of production and the highest values-content of the property. The diagram in Figure VI.1 is adapted from Hicks's Figure 24 on p.207 of his Value and Capital. Assume that the stream of output planned on the basis of existing price is AA', and either that output can easily be increased or decreased, or that stream AA' is below full capacity, then if at date L price is expected to rise momentarily at date M, the output stream may assume the shape of AECGA' or AFCHA' or AECHA', according to the technical production possibilities. The effect is the same in each case:

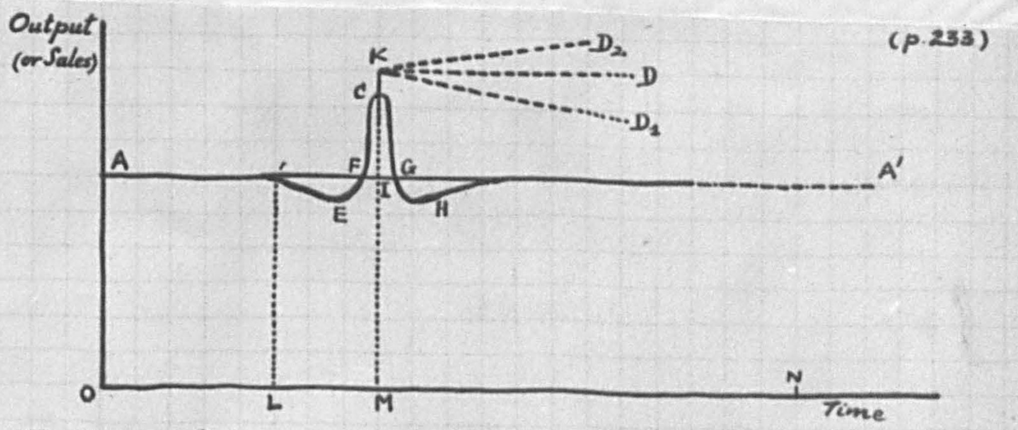


FIG. VI.1. : Substitution and Complementarity of Output over Time.

the increase in output at M is made at the expense of the output at E, or H, or both, without bringing forth new equipment. The height of C would depend on the capacity of the mine to increase its output in the short period. With regard to the sales, assuming that stocks of the output can be carried through time, and the producer is willing to take up a speculative position, the stream of sales between L and M will be kept as low as possible, and at M, the stocks accumulated will be liquidated,(bringing point C much higher up than in the diagram).

If, instead of a small momentary rise in price it is expected at date L that the rise at M will be considerable, or alternatively that the high price will be maintained, or improved,for a sufficiently long period of time, extra equipment will be installed, and more labour hired, in order to increase the output at date M onwards. The output stream between L and M will be small; and from date M, assuming that the addition to productive capacity is then completed, the output stream will follow the course KD or $KD_2$ or $KD_1$ according to the technical possibilities and the elasticity of expectation. If LM is too short a period for the increase in productive capacity, then the point K will, of course, be further to the right. If the curve represents the sales,then the stream of output sold during the period LM will be very small and the increase of sales will take place beginning from date M.

The shape of the new production-stream curve, as stated above, depends on the price expectation as well as on the technical conditions of production. The more elastic the expectation, the higher the output stream curve will tend to move, and conversely. Further, there is the case of complementarity over time in the sense that the existence of the additional equipment facilitates an increase in output at other dates in the future. If at date N, the price of tin reverts to the same level as existed before M, it is extremely unlikely that the output stream will resume the AA' course. This point will be taken up in the next paragraph.

Most of the preceding exposition is familiar to the readers of Hicks' work. There is, in production involving wasting assets, a further factor which enters into consideration of the shape of the curve: that is the life of the property. With fixed ore reserves, the higher the output stream goes, the shorter will be the life of the property measured along the horizontal axis. If the diagram represents, not the output stream of a particular property, but that of a company whose prospecting and development activities are carried out continuously, the time limit is then remote.

(c) <u>Non-reversibility of the long-run supply curve.</u>

10. Complementarity of production through time has a consequence, important in the supply analysis, which is the non-reversibility of the supply curve. Once a certain price expectation - either a rising trend of price or a large

momentary price rise - has altered the output stream, say from AA' to AIKD, it would be a pure accident for it to move back to AA' level, should the expectation prove to be false or should the conditions return to the old "normal" set of expectation. Since extra productive capacity has been installed, the investment made must be treated as bygone in short-term calculation, and the fixed overhead costs taken for granted. The production plan from then on is governed by the new considerations regarding prime costs. This is illustrated in Figure VI.2, which combines the long-run and short-run supply curves.

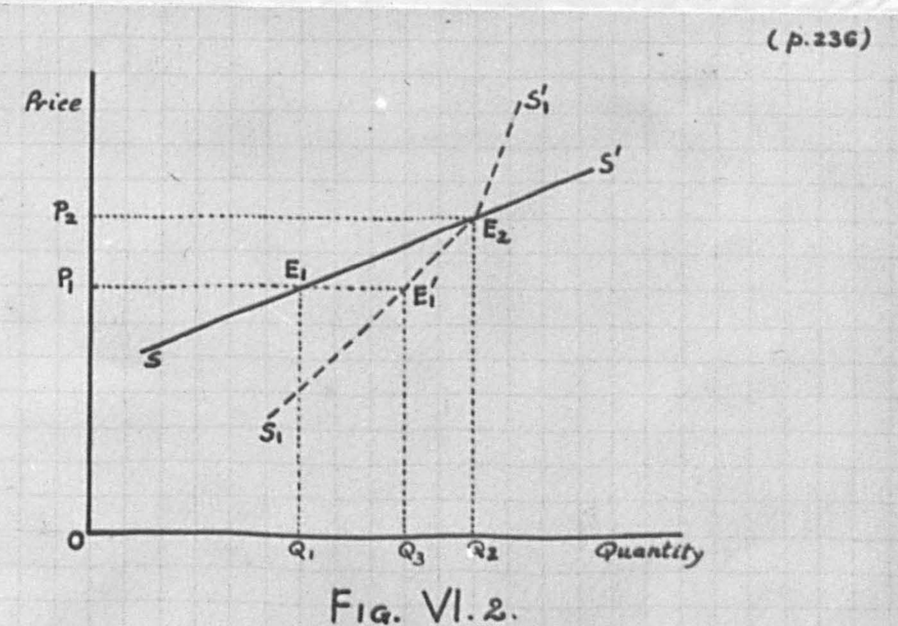


FIG. VI.2.
Non-Reversibility of the long-run Supply Curve.

SS' is the long-run supply curve, in the sense that if price rises from $P_1$ to $P_2$, after a period of adjustment in supply, the quantity produced and sold will move from $Q_1$ to $Q_2$. In the process of expansion, additional output capacity will have been created. Suppose in the next period, contrary to the previous price expectations, a reverse in demand causes price to move back from $P_2$ to $P_1$, then the new point of equilibrium will not move back from $E_2$ to $E_1$, along the long-run supply curve, since by reason of the increase in output capacity, the short-term supply condition has changed and the appropriate supply curve may take the shape of $S_1S_1'$. This means that corresponding to each price, the quantity of output will be somewhat larger than before. At price $P_1$, $Q_3$ instead of $Q_1$ will be produced. This is due to the short-run consideration of equating price to marginal cost. In order to return to the position in which $Q_1$ will be produced at price $P_1$, enough time must elapse to allow enough productive capacity to be ousted from operation; this is unlikely to happen.

(d) The Input Time-lag.

11. In the tin industry, the period of supply rigidity, or, as Hicks calls it, the "input lag", is an important factor. After mining, ore has to be shipped from South America, Africa and sometimes Asia, across the seas to Europe to be smelted; following which much of it is shipped across the Atlantic to the United States. Tin being an expensive material, miners tend to avoid the cost and risk of storing more stocks than

the absolute minimum, although, as we have seen in an earlier chapter, smelters and consumers carry considerable stocks. With an unexpected small increase in demand, and the consequential rise in price, it usually takes some time before the increase in supply, even without the necessity of increasing output or output capacity, can be called forth. In the late 1920's and early 1930's, at the Nigerian tinfields, poor communications caused a three months' wait between production and sale of ore - i.e. before smelting. According to J.K. Eastham, "the period during which the rate of supplies to the market is rigid is not greater than two and a half months, but this does not mean that the mines can increase their output, and that the increased supply of ore can appear on the market within that period...The Straits smelters sell at 60 days c.i.f. Europe and America, which means that they can increase the supply of metal on the market within that time by reducing their ore stocks. The increased rate of supply could be maintained provided that mines could increase their rate of working before ore stocks (at the smelters) were depleted." (See Note 17). This amounts to saying that, for a reasonably small increase in supply, between two and two and a half months are necessary. With big increases in demand, relative to the existing stocks, which often occurs in the

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Note 17. "Rationalisation in the Tin Industry", Review of Economic Studies p.28, Vol.IV, No.1, October 1936.

upward trend of the cycle, the increase in mine output will not be large or rapid enough to come forth before the stocks are exhausted. Moreover, once the full capacity of the mines is reached, the period of "supply resistance" will be much longer, since, in the case of dredges, for instance, it normally takes between eighteen months and two years, or sometimes more, to order, build, tow across the oceans and put to work in the East, a new machine. For lode mines, the extension of capacity would normally take about the same time, if not more. For opencast and more labour-intensive methods, the time taken is shorter, but correspondingly small increases can be achieved.

12. When the time lag in increasing production is taken into account, we have the situation which is illustrated in Figure VI.3. Assume that at a given moment of time, the short-term supply function is $SS_o$, composed of two sections, SA more elastic and $AS_o$ less elastic, denoting some degree of supply resistance as production approaches full capacity and stocks become low. The long-run supply curve - which does not take account of the time lag, is represented by $SS_L$. Suppose a Demand Function $D_o$ which moves up and down during the course of the business cycle. (See Note 18). At date 0, the conditions of Demand are $D_o$ and Supply $SS_o$, and equilibrium price (and quantity) is indicated by $P_o$. As

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Note 18. Ref. CH.III. paragraphs 8 - 10 above.

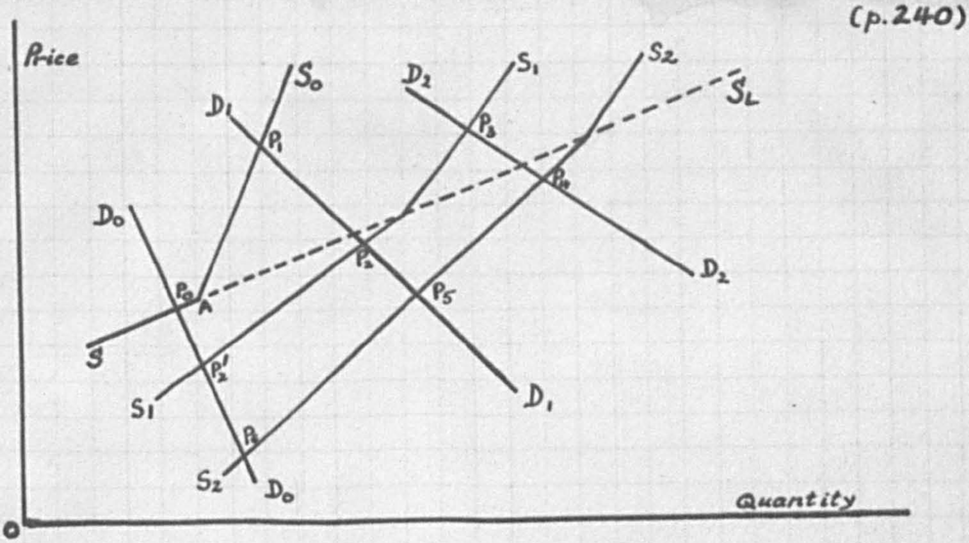


FIG. VI.3. : Time-lags and the Movements of the Supply & Demand Curves

As demand increases from $D_0$ to $D_1$, assuming supply conditions remain unchanged, price will be driven up to $P_1$. After an expansion of mining output, the short-run supply curve becomes $S_1$, and the equilibrium position is $P_2$. If the demand schedule now falls back to the $D_0$ level, the new equilibrium position will be $P_2'$, not $P_0$. If demand moves further up to $D_2$, and then downward, the sequence of equilibrium positions will be $P_2$, $P_3$, $P_4$, $P_5$, $P_6$, ..... What actually happens depends on the relative movement of the Demand and Supply conditions. For instance, the position $P_2$ may not be reached if the movement of D is so rapid that price rises from $P_0$ to $P_1$ and on $P_3$, etc. If the supply movements are more rapid, we might have the sequence $P_0$, $P_2$, $P_5$, $P_4$, etc. On the other hand, the time lag necessary to bring forth heavy equipments such as dredges may be so long that a year or two after the Demand curve has moved downward, there is still an increase in the quantity and capacity of equipments. (See Note 19). In such cases the price sequence may be $P_3$, $P_2$, $P_6$...., and depression is thus deep and protracted.

13. The above analysis (see Note 20) helps to illustrate two points regarding the price and supply of raw materials. First, when the price of a produce oscillates widely, each boom period leaves an aftermath of "excess capacity", and during the depression which follows, while the demand conditions may not be worse than in the previous slump, the drop in price tends to be sharper and more lasting. This, even in the absence of technological improvement, which would reduce costs still further, is sufficient in itself to explain the "long-term downward trend in raw produce prices", detected by statistical analysis. Secondly, such "excess-capacity" created during a boom and maintained chiefly by an expectation of a return to higher price in the future (since the

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<u>Note 19</u>. This was the case in Malaya, where the number of dredges increased from 70 at the beginning of 1928 to 108 at the end of 1930, with 11 more still under construction.

<u>Note 20</u>. This analysis differs from the "Cobweb Theorem" expounded by Henry Schultz, and U.Ricci in that, in the Cobweb theorem, Demand and Supply are long-term functions. It does not deal with the case where Demand Curve Fluctuates, nor does it take account of the non-reversibility of the supply function.

inelasticity of short-run supply curve is chiefly one to the sub-marginal mines producing at a net loss, but at a gross profit over prime cost) has to be eliminated before the price reverts to "normalcy" (i.e. Supply curve returns from the short-run shape to its long-run course $SS_L$). This elimination cannot be brought about automatically by "free competition" (See Note 20a), since the conditions creating the excess-capacity still remain. On the other hand, the short-run supply curves can be rendered more elastic, e.g. the slope of $AS_o$ reduced, by the existence of a stock of larger size than that which is customarily carried.

## (B) THE COST SCHEDULE OF TIN MINING UNITS THROUGH PROSPERITY AND DEPRESSION.

### (a) Positive Correlation between Price and Costs in "European" mines.

14. Costs in tin mining are very flexible, and move in sympathy with the price of tin to some extent. Many items of cost which are "escapable" in the short run, are avoided in times of declining revenue: less exploration, less development, less written off as depreciation and amortisation, management and men are more efficient and alert, lower prices for essential stores are pressed for. In times of prosperity, more work that is not immediately productive is undertaken

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Note 20a. Whether free competition is desirable from the social point of view is another question.

in the mine. (See Note 21). Further, not only overhead costs are escaped, unit prime costs are also very flexible. As referred to earlier, the grade of ore milled, and earth dug out can be varied so that in times of low price, higher grade is worked and consequently the cost per ton of output is lowered. However, this does not apply to all mining concerns, and those which can afford to do so are big companies with large ore reserves.

Mining wages are among the most important items of expenditure which are flexible. Trade Unionism and collective bargaining were almost unknown even in 1941 in most of the important tinfields. In the Far Eastern areas, miners are predominantly Chinese; in Nigeria and the Belgian Congo, the "native" labourers are not indigenous. Faced with a reduction in mining wages, these immigrants find few alternative jobs to turn to, especially when there is a depression in all lines of occupation. In Bolivia, where miners are principally the Indians of the Altiplano, adapted to the climatic conditions of the high ground, the elasticity of supply of labour too is small, since the soil of the Plateau is barren. Approximately 70% of the work in Bolivian mines is done on a contract basis, with day wages and bonuses: the rest of the labourers are seasonal, leaving the plateau in the spring and summer, to engage in agriculture, thus treating mining wages

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Note 21. S.J.Truscott, op.cit. p.166.

as pocket money or a source of income from which taxation can be paid. With very few exceptions in economically more advanced countries, tin mining wages in general are greatly flexible, and the movement is as large as 50% at times. (See Note 22).

Among the subsidiary costs, rail and sea freights are the only items which, in general, do not vary with the price of tin, but have a definite declining trend over time, as transport systems improve. Royalties, duties and smelting charges usually are determined in sliding scales, in which they are made dependent on tin price. For instance, a typical contract for the smelting of tin concentrates contains a clause such as this: "....treatment charge to be £5:17:6d. per ton of concentrates net dry weight, of 70% tin on the basis tin at £160 per ton....an addition of 6d. to be made to the returning charge for each £ that the tin price exceeds £160. No deduction for price of tin below £160 per ton or for assays above 70% tin...."(See Note 23) Such graduations of duties

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Note 22. e.g. Hausa pick and shovel men in Nigeria had their weekly wages cut from 5s.6d.to 3s.9d. in 1931. The statement that "collective bargaining is almost unknown" should be qualified for Malayan miners since the recovery of the mid-1930's also for Bolivian miners since the war. Strikes for higher wages have been successful in these countries, but they are so only during the more prosperous periods, thus still supporting the thesis that mining wages are flexible and positively correlated with price.

Note 23. The figures refer to the charges in the 1920's. In 1941 smelting charges were about £4:8:6d.per ton 70% tin at price £160.

and smelting charges may be regarded as affecting the shape of the cost curve or supply curve in such a manner as to render it less elastic. In practice, in addition, the position of the curve is shifted upwards and downwards in booms and slumps respectively by the fact that various concessions are granted to the miners by governments and smelters during the slump. In the bad years of 1929-1932, these charges and duties were revised downward everywhere. The Malayan export duty rates on tin and tin concentrates were revised twice, raising the minimum price of tin below which the sliding scale of rates would not apply. In Nigeria in 1930 and 1931, the government gave various concessions to the miners such as the waiving of all labour obligations on mining leases and mining rights, in addition to an 80% reduction in the rents of mining titles etc. In Siam, in 1930, similar relief measures were adopted until the price of tin reached a level of output about £173½ per ton. In Bolivia, the government resorted to indirect relief by devaluating the currency, and varying the exchange rate in favour of tin exporters and producers etc.

15. The ability on the part of tin miners to carry on production at low prices can be illustrated by the cases of producers in Cornwall, Nigeria and Bolivia (high-cost producers in the depression of 1929-1931.(See Note 24). Of the Cornish

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Note 24. The quotations in this paragraph are from the Minerals Industry (New York) 1929 and 1930. The author quoted is E.Baliol Scott, editor of the (London) Mining Journal.

miners in 1929, the report runs: "No where perhaps has the ability to keep going at price levels far below what was generally considered supportable been more strikingly manifested. Several of the newer concerns closed down: but as these were for the most part shallow propositions, the reopening of which in better times should not require any very great outlay, the explanation is not very far to seek. Older mines like East Pool, South Crofty, Wheal Kitty and Levant, however, with their inheritance of a llarge extent of underground workings involving great unwatering programmes should they close down, have continued to operate and show remarkable resistance to adverse economic conditions." In 1930, it was further reported that the concerns closed down in Cornwall included Polhigey, the Kittys, South Crofty, Levant and Geevor; at the end of the year, East Pool was alone operating, with South Crofty deciding to continue pumping operations. Of Nigerian mines, "the maintenance of production in 1930 was in some ways more unexpected than almost anywhere else, and nowhere perhaps has the ability of the industry to make ends meet, or at least to avoid stoppages been more noticeable. Wages came down greatly and the natives on contract worked more intelligently". There were also other economies, including the result of the completion of the Kurra Falls Power Station. Of Bolivia, "tin values or rather those towards the close of the year (1930. were such as no Bolivian enterprise had ever had to face at any rate on the grade of ore worked today....There were repeated rumours of closing down, especially by small concerns, but....the more established mines gave no signs of stopping". The average grade of concentrates exported from Bolivia was raised from 55.26% in 1929 to 56.20% in 1930, with the average for December 1930 of 59.31% metal. Total duty received by the government was greatly reduced from Bs.6,500,000 in 1929 to just under Bs.3 million in 1930. The cost per ton of tin of the Patino mines were as follows:

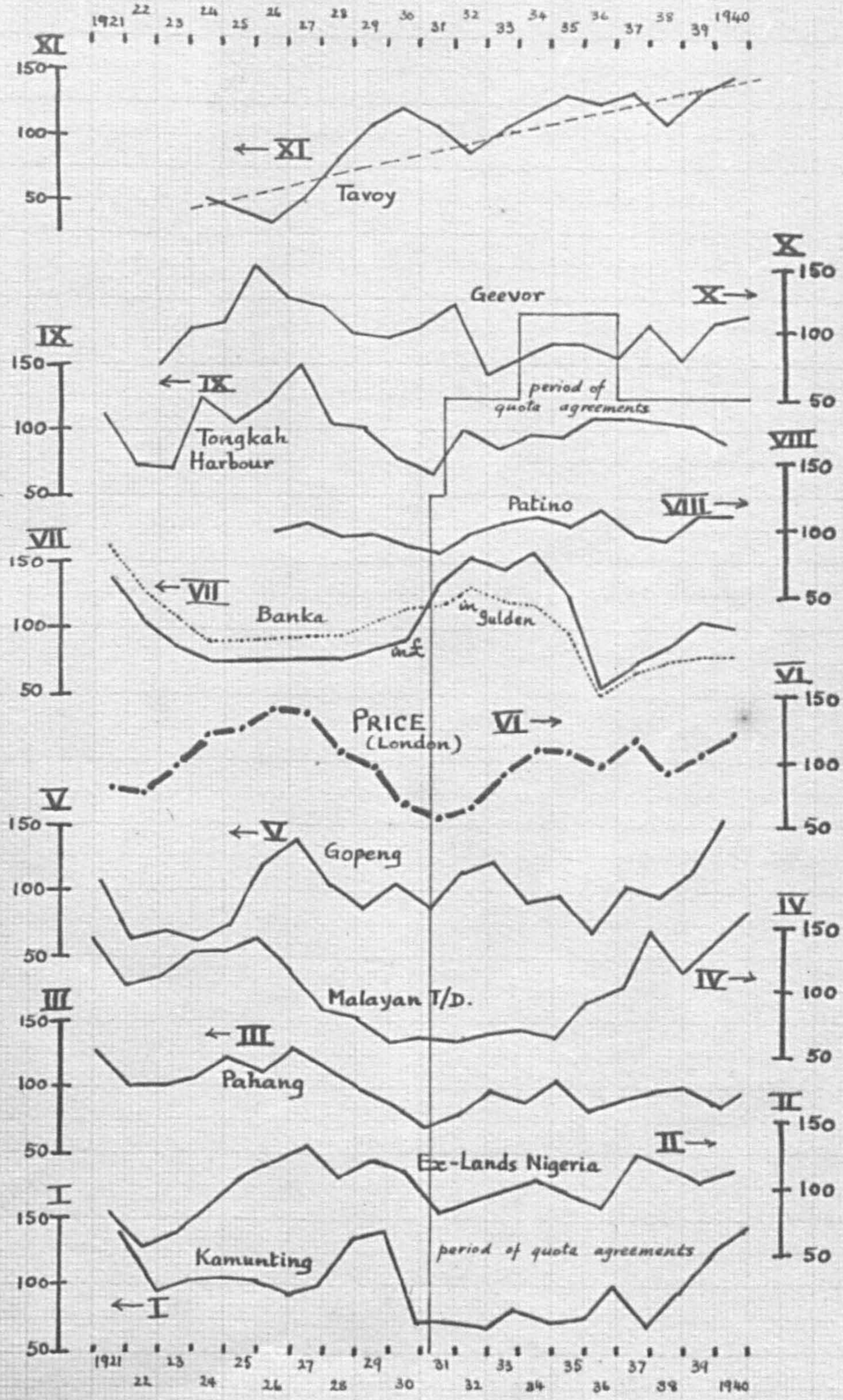
| | ex-depreciation | cum-depreciation |
|---|---|---|
| Year 1929 | £134 :15 :3d. | £154 : 5 :9d. |
| Year 1930 | £118 : 9 :5d. | £142 :15 :0d. |
| Last quarter 1930 | £109 :16 :7d. | £135 : 2 :6d. |
| Year 1931 | £101 :11 :10d. | £130 :13 :5d. |

16. The movements of costs in sympathy with the price of tin is illustrated by the chart in Figure VI.4. The costs taken are the "full costs" in the sense explained in para.4 above. The concerns selected comprise 4 leading companies in Malaya (one of which also operated in Siam), one in Bolivia, a government undertaking on Banka, and a company each from Nigeria, Siam, Cornwall and Burma. Both alluvial and lode mines are represented, and of the former, various "European" producing methods are included.

When the flexibility of costs in tin mining is taken into account, the diagram in Figure VI.3 needs to be modified. The system of supply curves, long-run and short-run, is not only made to move with the physical mining capacity, the

# FIGURE VI. A.

Correlation between the Price of Tin and the Full Costs of Selected Mining Companies.
(Average of Period = 100)



position of the curves is also determined by the cyclical condition of business. During prosperous years, costs are higher and the curves more nearer to the price axis on the left; during the slump they move down to the right. The effect is even more violent price fluctuation than otherwise would be.

Notes to Figure VI.4.

(a) The Lines:

VI = Price of tin : London Standard, annual average.

Full costs: I = Kamunting Tin Dredging, Ltd.: Malaya and Siam: Dredging: Year ending 30th June.

II = Ex-Lands Nigeria, Ltd.: Nigeria: Gravel pumping, ground sluicing, calabashing, tributing: Calendar year.

III = Pahang Consolidated Co.Ltd.: Malaya: Lode: Year ending 31st July.

IV = Malayan Tin Dredging Ltd.: Malaya: Dredging Year ending 30th June.

V = Gopeng Consolidated, Ltd.: Malaya: Hydraulicking: Year ending 30th September.

VII* = Banka Mines (Dutch Government): Indonesia: all alluvial methods: Year ending end of February up to 1930, thereafter calendar year.

VIIIø = Patino Mines and Enterprises Consolidated: Bolivia: Lode: Calendar year: Established 1924.

IX = Tongkah Harbour Tin Dredging Ltd.: Siam (and Malaya): Dredging: Year ending 30th September up to 1939 - thereafter 30th June: reorganised 1939 from the Tongkah Harbour Tin Dredging, No Liability.

X = Geevor Tin Mines, Ltd.: U.K.: Lode: Year ending 31st March: operation suspended from Dec.1920 to March 1922 "owing to fall in price and increased costs." 'voluntary' output restriction in 1931/32.

XI = Tavoy Tin Dredging Corpn.Ltd., Burma: Dredging: Calendar year: Established 1923: Rising trend of costs: Free from compulsory output restriction all through the period.

* The costs of VII are converted into £ from gulden at each successive exchange rate throughout the period. Since the gulden did not go off the gold standard until 1936 - 5 years after the £ -, the rise in costs from 1931-1936 as shown in the plain line of the graph is exaggerated, compared to the costs in gulden (in dotted line).

ø The costs of VIII for 1936-1940 are partly in £, and partly in Bolivianos: the latter being converted into £ at the "de facto" rates.

(b) <u>The correlation</u>: It appears from the chart that a strong positive correlative exists between the London price and each individual cost. <u>The Patino costs</u> (VIII), while moving in sympathy with price to some extent, were more stable throughout the period, reflecting the financial and ore reserve strengths of the world's biggest mining company. <u>The Banka enterprise</u> (VII) being a government concern, appears to behave differently from all others: falling when price rises and conversely, and this in spite of the higher productivity per labourer during the depression (when the mines became more mechanised). This peculiarity of Banka was shared to some extent by Billiton. The reason is threefold: (a) the higher value of the gulden in terms of £ as noted above; (b) the high overhead cost per unit of output owing to the restriction (Banka's 1931-1933 output was about 40% of that in 1927-1929); (c) the concentration of work on the poorer parts of mines during the depression, and conversely (long-term maximisation of profit), which is usually not practised among British miners. <u>The Tavoy Tin Dredging</u> (XI) was one of the lowest cost producers in the mid-1920's, but since then lower values were being worked on, and the costs followed a definite rising trend. Cyclical oscillations, once the trend was eliminated, would show the same pattern as the price curve (VI).

All costs were high in 1920/21, owing to the abnormal post-war conditions.

(c) <u>Effect of the output restriction</u>: In all the cost curves, except XI, there was a general tendency to exhibit a declining trend after heavy investments in 1925/26. This tendency was halted, and in many cases reversed, after 1931 when higher overhead costs per ton of output, due to restriction, caused full costs to rise, in spite of the decline in operating costs. To take an example from another Malayan Company not represented here, the Ulu Klang, Ltd., the cost per ton of metal in 1930 was

£92: it was estimated that in 1931, without restriction, it would have been reduced to about £70; but the cost of maintaining the plant, property and staff during temporary periods of non-production amounted to fully half the cost of running to full production capacity. Assuming that there were no other causes tending to affect the cost level, it was estimated that the cost would be raised to about £110 on a restriction of 20%, and to £135 per ton on a restriction of 50%. (Chairman's speech: in Mining Journal 5th September 1931, p.689). Examples could be multiplied.

(b) The Tribute System.

17. When tin price reaches such a low level as to make further reduction in cost impossible, "European" firms can still go on producing some ores by sub-leasing parts of their areas to "natives" (which essentially means Chinese in the Eastern fields). This is known as "tributing". Working on tribute exists in normal times as a by-product of dredging, when portions of the areas held by the dredging company have been dredged and expose a pinnacled lime-stone bottom unsuitable for the operations of dredges, the area may be subleased to Chinese miners who usually open up a gravel pump mine and pay tribute to the dredging company, at rates varying from 10% to 25% of the value of the tin ore recovered. (See Note 25). In many cases, the European company purchases

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Note 25. Sir Lewis Fermor, op.cit.p.110. Sir Lewis added: "Subleases and subleases of subleases, and so on, are much favoured by the Chinese section of the mining community; but if carried too far, with too heavy a tribute, they must be regarded as harmful to the industry, excessive tribute rendering ground uneconomical to work, that otherwise could be worked at a profit. They may also be harmful if a small lease is split up into two or more subleases, the degree of harm depending on the size of the ultimate fraction."

the ore and pays the Chinese miners the difference. In the Federated Malay States, the percentage of output of tin ore won by tributers was 11% in 1929, declining to 7-9% in the late 1930's. In Nigeria, the number of African tributers was about 5,000 in the 1920's, increasing to 12,000 in 1934 and to 30,700 in 1946.

It can thus be said that the reason for the tribute system is twofold : (a) the technical and partly traditional conditions of work, which were strengthened in the depression by (b) the low price of tin. Tribute production is not always cheaper than dredging, but the flexibility of costs is greater in the former than in the latter. This leads us to consider the cost conditions of Chinese and other "native" enterprises in general.

(c) Chinese and other "native" small enterprises.

18. The cost analysis in the earlier parts of this chapter applies primarily to modern mining business of the Western pattern, normally referred to as "European", which has become more important and more extensive only since the first World War. In the Federated Malay States, even in 1936, "European" output accounted for little more than 60% of the country's total, the rest being shared by Chinese and other miners acting either as direct lessees or tributers. Of the whole world, in 1940 large "European" mines probably accounted for 75%; thirty years earlier, the percentage was perhaps less than 50%. The numerical importance of the small

mines in 1940 was, as far as leading countries were concerned, as follows: 730 gravel pump mines and 150 mines employing less than 50 coolies and no machinery in the F.M.S., producing about 35% of the Malayan output; 250 mines in Siam producing 30%; about 50 mines in Nigeria, and a large number in Bolivia producing about 15-20% of Bolivian output. This leaves out of account those in Indonesia whose produce appeared as the output of Banka and Billiton.

Very little is known about the cost accounting method and production plan of these small mines. Not being organised as public companies, they do not publish their balance sheets, and few data are accessible. The only country which has some statistics to throw some oblique light upon the activities of the small "native" mines in Malaya, and even here it is not possible to go farther than the figures of the aggregates. (See Note 26). The figures are from the Quarterly Bulletin of Statistics published by the Mines Department, unless otherwise stated.

19. Before the first World War, as high a proportion as 80% of the F.M.S. output of tin came from the Chinese mines. With the advent of dredging and large investment by "European"

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Note 26. In his book: The Chinese in Malaya (RIIA and IPR 1948), Victor Purcell stated that the chapter entitled "The Chinese in Malayan Industry" "is very like a slip of paper placed on the shelves of a library to show where a missing book ought to be". Dr.Purcell was a member of the Malayan Civil Service from 1921 to 1946.

companies, the proportion of Chinese output fell till 1929, when it was surpassed by "European" output, never to catch up again during peace time. The Chinese share deteriorated further during the 1930's until it was 28% in 1940.

Table VI.1.

Annual Chinese Tin Output in F.M.S. 1921-1940
Compared with Price.

| | I<br>Price of Tin. Ann. Average £ per ton. | II<br>Chinese Output '000 tons metal. | III<br>Index of I | IV<br>Index of II | V<br>II as % of total F.M.S. output. |
|---|---|---|---|---|---|
| | | | (average = 100) | | |
| 1921 | 165 | 21.0 | 79 | 103 | 61 |
| 22 | 159 | 21.9 | 76 | 107 | 62 |
| 23 | 202 | 21.1 | 96 | 103 | 56 |
| 24 | 249 | 24.2 | 118 | 119 | 55 |
| 25 | 261 | 25.7 | 124 | 126 | 56 |
| 26 | 291 | 25.7 | 138 | 126 | 56 |
| 27 | 289 | 30.8 | 137 | 151 | 59 |
| 28 | 227 | 31.7 | 108 | 155 | 51 |
| 29 | 240 | 25.5 | 97 | 125 | 39 |
| 30 | 142 | 23.0 | 67 | 113 | 37 |
| 1931 | 118 | 18.7 | 56 | 92 | 35 |
| 32 | 135 | 9.9 | 64 | 49 | 34 |
| 33 | 195 | 8.1 | 92 | 40 | 34 |
| 34 | 230 | 11.1 | 109 | 54 | 34 |
| 35 | 226 | 14.0 | 127 | 69 | 34 |
| 36 | 205 | 21.1 | 97 | 103 | 33 |
| 37 | 242 | 24.4 | 115 | 120 | 32 |
| 38 | 190 | 13.5 | 90 | 66 | 33 |
| 39 | 226 | 13.6 | 105 | 67 | 31 |
| 40 | 257 | 23.0 | 122 | 113 | 28 |

In absolute tonnage, the trend of Chinese tin output was also declining, starting from nearly 39,000 tons of metal in 1912, down to 21,000 tons in 1921; the boom of the mid-1920's brought it up to almost 31,700 tons in 1928; since then the decline was more rapid, reaching the minimum of just over 8,050 tons in 1933 (year of severest official restriction) The subsequent revival again raised the figure to 24,360 tons in 1937, which was the rate at which they were working at the time of the Japanese invasion.

It is interesting to note in Table VI.1 that during the slump of the early 1920's, the Chinese output was kept steady at 21/22,000 tons per annum. In 1922, when price reached a minimum of £139, the Chinese miners slightly increased their output, both in absolute tonnage and in relative share, compared to the previous year, during which price also declined sharply. On the Chinese-owned mines, the coolies had been willing to work for bare board and lodging, and to suspend wages until better times, rather than face entire unemployment. According to the Chairman of the FMS Chamber of Mines, in his speech reviewing the industry in 1921, the average cost of production from an average mine, owned by the Chinese and worked by Chinese methods, was between $80 and $85 per picul of metal (about £155-£160 per ton), though many could produce for a limited period at $70. This was undoubtedly an underestimation of the flexibility of the Chinese costs, although it is true that in normal times, European mines were mostly working at lower costs than Chinese mines. Even in European mines, in general wages fell during 1921 by between 15% and 20%, and in 1922 they fell still further owing to the depression in the rubber industry.

In the meantime, the Chinese miners' attention was more and more drawn towards the gravel pumping method, with small oil power plants, which was adopted increasingly as a means of reducing costs. With the revival of the tin market in 1924, 300 gravel pumps were already used in 42 mines : Chinese output rose about 16%, but their share in the total was reduced, owing to the even more rapid increase in dredge output from European mines. During this year wages rose 20%. The number of gravel pumps rose further to 550 in 1925. The very high price in 1926, reaching the peak of £321 in the last part, failed to bring forth an immediate substantial increase in output, either from European or Chinese mines, because of the time lag necessary for equipment installation and labour mobilisation, but in 1927, as price began to decline, the increased number of Chinese immigrants, together with the utilisation of more gravel pumps, raised Chinese output by 20%. The increase from European mines was slower, although the number of dredges rose from 50 to 70, and dredge output advanced 35%. In all, the Chinese percentage of total output became 59, compared with 56 in the last year. In 1928, price fell still further; but output from Chinese mines still advanced; and that from European mines, especially from dredging companies, rose even faster. It was indeed the spectacular progress in dredge output which was responsible for the price fall after 1928, because consumption was still increasing. The share of Chinese output in 1928 fell to 51%. By the end of the year, the number of mines using gravel pumps reached 383: the maximum number reached before the official restriction was 428 at the end of 1929.

20. The year 1929 started with tin price around £225, from which it fell steadily until in April, it passed the £200 level for the first time since 1923. Beginning in 1928, rumours were abroad that many Chinese mines would have to stop work owing to low price: that "Chinese hand-worked properties ceased to be profitable when the metal falls below £210, whereas dredging companies could subsist at £140", (See Note 27): that Chinese mine owners equipped with a steam-boiler and a 6" gravel pump, "could not be sure of covering expenses with metal below £250 per ton" (See Note 28). The then Chairman of the F.M.S. Chamber of Mines, Sir E.W.Birch, who was also Chairman of 15 mining and other companies, stated in May 1928, that "Many of their (Chinese) mines are approaching the end of their richer ground, while many of them are only able to carry on by the aid of money lenders and persuading the coolies temporarily to accept little or no wages beyond actual food...These money lenders are gambling on a possible rise in the price of the metal, and if within the next few months a rise does not materialise, it was difficult to see how many of the Chinese mines could weather the storm."

Contrary to these predictions, the number of gravel pump mines, which were mainly owned by Chinese, instead of declining, rose to 428 at the end of 1929, and the number of

<u>Note 27</u>. Tin (AOMC) July 1928. <u>Note 28</u>. ibid. August 1928.

small mines, employing fewer than 50 coolies with no machinery rose to 707. Indeed, the number of dulang washers did decline from a 1928 peak of 10,400 to 9,000 in 1929, and further to 7,800 in 1930, with a corresponding reduction in the tonnage of ore won by this method, but the monthly output of tin from Chinese sources was maintained at the level of 2,000 tons or above, until the middle of 1930, after which it declined only slightly up to the advent of the official restriction scheme. There were indeed two months when the Chinese output fell to 1,500 and 1,300 tons; but this was due to factors other than price: the latter occasion being a Chinese New Year when the Chinese seized the opportunity to stop activities, only to resume at the normal level afterwards. During the two years before the official restriction of production, however, the Chinese share declined from 51% to 37%, and this was largely caused by the great increase in "European" output in 1929, and its relatively small decline in 1930 when the dredges and other machinery ordered during the boom were completed and became fully operative.

Table VI.2.

Monthly tin output of Chinese Mines in F.M.S. 1929-1930
(excluding sub-lease output)

| | | Average Price £ per ton. | Output ('000 tons) (monthly or monthly average). |
|---|---|---|---|
| Year 1926 | | 291 | 2.2 |
| Year 1927 | | 289 | 2.6 |
| Year 1928 | | 227 | 2.7 |
| 1929 Month | I | 223 | 2.4 |
| | II | 223 | 2.1 |
| | III | 221 | 2.1 |
| | IV | 207 | 2.1 |
| | V | 198 | 2.0 |
| | VI | 200 | 2.2 |
| | VII | 209 | 2.3 |
| | VIII | 210 | 2.2 |
| | IX | 205 | 1.5 |
| | X | 191 | 2.3 |
| | XI | 181 | 2.3 |
| | XII | 179 | 2.0 |
| 1930 Month | I | 175 | 2.6 |
| | II | 174 | 1.3 |
| | III | 165 | 2.1 |
| | IV | 163 | 1.8 |
| | V | 145 | 2.1 |
| | VI | 136 | 1.9 |
| | VII | 135 | 1.9 |
| | VIII | 135 | 1.8 |
| | IX | 133 | 1.8 |
| | X | 118 | 1.8 |
| | XI | 114 | 1.7 |
| | XII | 112 | 2.0 |
| Year 1931 | | 118 | 1.6 |

Under compulsory restriction, the share of the Chinese tin output in the Federated Malay States fell still further to 34%, at which level it remained for several years. (See Table VI.1, para.19). During the revival in 1937, and after 1939, the percentage became still lower: this was due to the fact that mechanised European mines with large idle capacity of machinery and property were able to respond more quickly to sudden increases in the quotas. In absolute tonnages, the decrease was from 25,500 tons in 1929 to 8,100 tons in 1933, or about 1/4 of the 1928 Chinese output. In 1937, working all but freely, Chinese mines produced 24,400 tons of metal, which was just above their output before the mid-1920's boom.

21. There are many reasons underlying the tough resistance shown by the Malayan Chinese tin miners against low prices in the 1928-1931 period:

(a) Their business organisation: The Chinese worked on a profit-sharing basis. The entrepreneur or "Towkay" usually recruited his coolies from his relatives or relatives of relatives various degrees removed, or those people who bore the same name, or came from the same village. The Towkay advanced a small sum of money to the coolies as pocket money each month, and provided food and lodging. At the end of the Chinese year, the profit, if any, was shared out as bonus to the workers. In this way, the cost items in a Chinese mine were very flexible, and the really inescapable costs consisted of rents, royalties, machine repairs and maintenance, and a small part of what would be called wages or salary in European business terminology. The pocket money was reduced in some cases to 15-20 cents a day (or less than sixpence), or even less. Since trade in general was bad, and total employed coolies in the mines were reduced in 1929 by about 4,500 (despite increase in output), and still further by nearly

4,500

24,000 in 1930, the drastic reduction in wages was readily acceptable to the coolies.

(b) In many cases, the capital was advanced by Chinese shopkeepers or other Chinese who had made money from Government contracts, rubber or mines, in the past. The miners were forced to carry on by the terms upon which they borrowed from these people, or the banks, or smelters, since any stoppage would involve the latter in the forfeiture of the whole of their interests. Thus the advancers of credit were willing sometimes to risk a few thousand dollars more in their venture. This reason, which applied to the early period of the depression, would, however, have proved to be insufficient to sustain Chinese output for very long, but for the other reasons, especially (c).

(c) The years 1928, 1929 and 1930 were the period during which the Anglo-Oriental Group staged world wide propaganda activity for output restriction. Although such propaganda declared that the Chinese miners were likely to close down their mines as price fell below £200, yet the "Group" professed a sanguine belief in the not-so-distant recovery of price on the one hand, and on the other strongly urged producers to come together into restriction agreements. Such propaganda had the effect of colouring the expectations of Chinese miners and created a general wishful hope for recovery. At the same time, it paid Chinese miners to maintain their output at the risk of "pocketing big losses" temporarily, because in this way they could expect to keep their share of the restricted permissible production, should the quota allotments be based on past performances, which was what actually took place.

(d) The introduction of the Diesel type of crude oil engines to drive their gravel pumps had the effect of considerably reducing the cost of running the mines, as compared to electrical power or wood fuel. An 8" gravel pump and a 6" nozzle pump could be run by a 200 H.P. oil engine for a fuel cost of about $800 (or just over £90) per month for a 16-hour day. (See Note 29). An average monthly yield of 75 piculs of ore or 3.1 tons of metallic tin, would bring a gross value, at £150 per ton, of more than £450. Even at price £110 per ton, the gross revenue would leave nearly £250 over the fuel cost. With reduced wages and other economies, this still left a reasonable net depression profit for the miner.

(e) It is also conceivable that, owing to strong income effect, the supply curve of certain individual Chinese miners and coolies might have assumed a perverse direction over a certain range: in other words, the elasticity of their demand for income in terms of effort might have been less than unity at the relevant points (see Note 30), so that they would produce

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Note 29. Mining Journal (London) Annual Review Number 1931: 24th January 1931, p.35.

Note 30. J.R.Hicks: op.cit. Ch.II: L.C.Robbins: "Elasticity of Demand for Income in terms of Effort" Economica 1930, p.123.

and sell more tin as the price fell, in order to maintain a level of aggregate income. This might be true especially of the dulang washers who worked independently with hardly any cost at all except their own efforts and the panning fees. It is doubtful, however, whether this motive could be assigned to many of the Towkay or entrepreneur types; since, if their cost expenditure were higher than their present revenue, and in the absence of expectation of recovery, they would have done better to cease activities in tin mining and turn to other business, or alternatively, if their labour were specific, to accept the Government's offer to repatriate them to China.

In sum, we may say that the small Chinese miners in the F.M.S. during the depression years of 1929/31 were able to hold out, partly because their costs had considerably decreased through mechanisation or wages cuts, partly because they were given reasons to expect recovery in the near future, and partly because of their form of business organisation which enabled their cost structure to be sufficiently flexible to carry on. This last reason has a general application to similar circumstances in the future. For as long as the organisation remains unchanged, their minimum cost cannot be determined a priori. With the advent of a Western Trade Union Movement, for instance, and the emergence of minimum wage legislation and collective bargaining, the situation will be changed. In the circumstances which prevailed in Malaya, and some other tin producing countries before the second World War, the cost factors of a large proportion of producers remained an unknown in the general equilibrium equation. Only vague statements can be made in this respect : such as : "If price falls to £80, a large proportion of Chinese mines will continue to produce". (See Note 31).

(d) Cost and Output of Small and Big Mines.

22. The above study of the working of Chinese mines in the F.M.S. reveals, in addition, the following points which are applicable to small labour-intensive mining units in all fields :

(a) Small "primitive" mines in normal times tend to work at somewhat higher running costs than dredging companies, because they have not the advantage of large scale economies. In general, the ground used in labour-intensive methods of mining has to contain a high metal content for the enterprise to be profitable, whereas dredging is workable on materials with tin content as low as ½ lb. to a cubic yard. This is, however, true only as far as prime costs are concerned. The long-run fixed inescapable charges in dredging companies, such as interest on capital, machinery maintenance and depreciation, administrative expenses, are items weighing against them in the comparison of costs. Not all European companies are dredging companies ; and amongst those non-dredging companies working in Malaya there were a few which,

Note 31. Mining Journal : Annual Review Number : 24th January, 1931, p.(35).

mainly on account of the richness of their leased area, could produce at notably low costs. (See Note 32). As the richest portions of a tin field are worked out, the small miners find it more and more difficult to maintain their production by old methods. This explains the long-term declining trend of Chinese output in Malaya and their increasing adoption of more mechanised methods. The fact that in normal times the production cost of labour-intensive methods is higher than mechanised methods is perfectly compatible with the greater degree of cost flexibility in small native mines, which enables them tenaciously to withstand depression for as long as two or three years.

(b) Normally, the small mines exhibit considerable flexibility of output. With the same degree of accuracy in price expectations, it is easier to increase output from small mines after the full capacity has been reached: it takes less time to bring more labour and simple machinery into production than to commission a new dredge which, moreover, cannot be supplied locally. In countries like Malaya where the local native population is not suitable or willing to work in the mines, or when there is "full" employment, extra labour supply, even with a substantial increase in wages, has to be drawn from overseas, which means in this case almost entirely from China.

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Note 32. One of the best known was the Gopeng Consolidated whose "full cost" per ton of metal during the 20 years ending September 1940 only reached £80 once, and that was in the 1940 working year. Their lowest full cost record of all time was a little over £50 in 1924.

This actually happened in the boom of 1926/27. Even so, the movement and training of labour was easier and more rapid than the construction and movement of dredges and other heavy machinery. By the early months of 1927, the Chinese mines in F.M.S. had already expanded 20%, whilst the European output for 1927 was only 5% above that in 1926. On the other hand, long after price had declined, in 1929 and 1930, the number of dredges completed and commissioned was still increasing, and European output in 1929 was more than double that of 1926, whilst the Chinese output had already subsided to the level of the previous three years.

During the next tin boom, in 1937, the situation had fundamentally changed: both the European and Chinese mines were working in the early 1930's at low capacity. When the international quota was increased from 85% in the second quarter of 1936 to 110% in the last three quarters of 1937, both categories of producers were able to increase their output promptly. The increase in European production in the second quarter of 1937, compared with the same quarter of the previous year was about 2,600 tons, or 30%; that in the Chinese output was about 1,275 tons, or 26%.

(c) Under the output restriction schemes, quotas for permissible exports were announced by the International Tin Committee for each quarter, normally in advance; and the export quotas for each participating country were divided among the producers in the country, generally in accordance with past performance. In this way, each producer knew in advance how much he was allowed to produce during the period of the next three months, and within these limits he could distribute production and sales through time as he wished. Table VI.3 reveals interesting patterns of time - spread of output in European and Chinese mines in the F.M.S.

Table VI.3.

Time-spread of European and Chinese Outputs Within Each Quarter in 1933, when the International Quota was 33.3% of Standard Tonnage.

| Month | European Output(tons). | Chinese Output(tons). |
|---|---|---|
| I | 1,497 | 885 |
| II | 1,355 | 536 |
| III | 712 | 550 |
| IV | 1,751 | 803 |
| V | 1,113 | 595 |
| VI | 434 | 482 |
| VII | 1,621 | 721 |
| VIII | 1,153 | 594 |
| IX | 449 | 578 |
| X | 1,710 | 704 |
| XI | 1,074 | 616 |
| XII | 500 | 610 |

There was a tendency in both European and Chinese mines to concentrate the output in the first month of the quarter and either ease off or stop work altogether in the next two months. This was due to the attempt to work at full capacity as far as possible, thus benefiting from the economies of large scale production. This tendency, however, was much more pronounced in European mines than in Chinese mines: European output during the first month of a quarter was usually about half of that permissible for the whole quarter, and by comparison became insignificant in the last month. The Chinese output-spread over the quarter, while following the same pattern, was less unequally distributed. (See Note 33). This difference, albeit in degree only in the system of work between the Chinese mines and European mines illustrates an important point. At any moment of time, there is a more or less fixed tonnage of output, which represents, for a European mechanised mine, a "full capacity" corresponding to the equipment in existence. For a small Chinese mine, on the contrary, the full capacity tonnage is a constantly moving one, depending largely on the number of labourers under contract. This amounts to nothing more than saying that for the primitive labour-intensive mines, the short-run cost curve is approximate to the horizontal shape (constant cost) over a wide range, and for the European mines, the cost curve conforms to the U-shape pattern.

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Note 33. This system of working was not widely adopted until the last quarter of 1932, nearly two years after the beginning of the restriction. This was due partly to the fact that producers took some time to adapt their production plan to the new situation, and partly to the fact that up till then restriction was not really drastic. From the middle of 1932 to the end of 1933, the international quota of permissible exports was kept at 33.3% of the standard tonnages. (In Malaya, where the actual capacity was considerably higher than the standard tonnage, the domestic quota was then about 25% throughout the period). This pattern of output distribution through time was maintained by mining companies right through to 1937, when the higher quotas released made it unnecessary, and it was adopted again in the 1938 recession.

## (C) THE COST RANGE OF TIN MINING DURING THE INTER-WAR PERIOD.

### (a) Analysis of the cost differentials.

23. We turn now to the examination of the cost range in the tin mining industry. The differences in production costs for tin arise out of the following factors, starting from the general to the specific:

(a) Currency policy: since the London Metal Exchange was, during the period under study at any rate, the principal tin market, and transactions quoted in £, the relevant cost figures are those in sterling, whether the tin was produced in Bolivia, Netherlands Indies, Siam or China. It is customary to speak of Malaya and Banka-Billiton as the low-cost producers and Bolivia as high cost, yet during a period of fluctuating exchange rates, Banka costs, for instance, which are normally lower than the majority of Malayan costs, may appear as higher figures in terms of £: this actually happened in the period 1931 to 1936 while the £ was depreciated and the gulden remained on the gold standard. Similarly, Bolivian costs, reputed to be generally among the highest, became lower than some in other fields in 1931/32 when the value of the boliviano was made to fluctuate with the price of tin. For Siam, the question does not arise, since the baht was fixed in terms of the £ throughout the period.

(b) Several items included in the cost arise out of governmental levies, and are variable according to the fiscal and budgetary policy of the governments concerned. For instance royalties can be regarded as the cost of raw materials (wasting assets of the country), or as export duties, and their rates are changeable according to the areas. As we have seen in Ch.V, the most notorious case where tin producers had to bear a heavy burden of taxation was that of Bolivia, with more than 25 separate laws dealing with export duties on minerals. In the period 1939/40, approximately theequivalent of 20% of the c.i.f. value of exports of tin was taken by the Government in the form of taxes, in addition to various internal imposts on tin mines and concentrating plants, and to the loss on the transaction offoreign currency through exchange control. The Bolivian export taxes alone were between twice and four times the equivalent in other producing countries, and they amounted to more than the full production cost of some of the lowest-cost companies in the East.

(c) Some items of cost could be classified as subsidiary: they are inland and sea freights, return charges, etc. Smelting charges vary from time to time: the general trend is a downward one: but they affect all the tin producers equally. For lower grade ores, however, the charge is higher per unit of metal. The reason lies partly in the fact that existing smelters are technically erected for the treatment of higher grade ores. This is in fact an element of external diseconomy from the point of view of producers of low grade ores. Most Bolivian producers again suffer under this head. Transport costs are also external factors. Here, not only

Bolivian mines, but most Nigerian, Congo, Siamese and Chinese (in China) mines suffered a disadvantage in cost comparison. The general tendency, however, was a general reduction in the differential, owing to the improvement in road and rail transport in more backward countries.

(d) With regard to mining cost proper, lode mining is on the whole more costly than alluvial mining, and among alluvial methods, the prime cost in dredging is as a rule the lowest, calculated per unit of throughput. This point has been referred to earlier in the chapter with regard to the Far Eastern fields. Table VI.4 shows that it is also true of Nigeria. Hydraulicking, ground sluicing, gravel pumping and electric dragline, are other cheaper mining methods. Costs in each method, of course, vary widely according to the richness of the material in the property. Some dredging companies in Malaya, for instance, produced at higher costs than the Pahang lode mines, or even the Patino lode mines in Bolivia. Lode mining and other methods using expensive machinery such as dredges and draglines have to carry large overhead costs. With complex deposits and the consequential larger areas required to be leased at a time, such as in Nigeria, overhead costs are also increased.

Table VI.4.

Average Mining Cost by Different Alluvial Methods in Nigeria, 1943 - 1946.

(d. per cubic yard)

(Source: Annual Report of the Mines Department.)

| | 1943 | 1944 | 1945 | 1946 |
|---|---|---|---|---|
| Hydraulicking | 6.8 | 5.8 | 8.1 | 10.1 |
| Ground Sluicing | 7.9 | 6.2 | 8.6 | 8.5 |
| Tributing | 6.2 | 8.2 | 8.8 | 8.2 |
| Handwork | 11.0 | 9.8 | 10.0 | 12.4 |
| Dragline (electric) | 4.2 | 3.5 | 8.3 | 3.9 |
| Dragline (Diesel) | 8.7 | 13.3 | 15.2 | 13.5 |
| Dragline (steam) | 14.2 | - | - | - |
| Shovels (electric) | 2.3 | 2.8 | - | 10.2 |
| Shovels (Diesel) | 9.4 | 8.4 | 16.0 | 11.9 |
| Shovels (steam) | 21.0 | 22.0 | 21.9 | 12.4 |
| Dredges | 5.8 | 6.8 | 4.3 | 4.2 |
| Gravel Pumps (electric) | 11.1 | 10.9 | 10.8 | 13.1 |
| Gravel Pumps (Diesel) | 7.1 | 12.4 | 11.0 | 11.8 |
| Gravel Pumps (steam) | - | 5.7 | - | 7.9 |
| Gravel Pumps (water turbine) | - | - | 2.7 | 3.4 |
| Loto (Pillar and Stall) | 27.5 | 34.1 | 30.3 | 51.0 |

(e) The official, compulsory restriction of output affected costs in either or both of the following ways:

Firstly, the overhead cost per ton of output was increased, and the more mechanised the method of mining, the larger was the increase. (See Note 34.) . Secondly, if a mine was to produce at fuller capacity, and thus escape the increase in overheads, quota rights could be bought from another mine which stopped work altogether. In Malaya, there was a ready market of production certificates during the years of restriction. The price of these certificates fluctuated with the intensity of restriction. For instance, in 1935, the quota right was bought and sold at £84 per ton of ore; in 1937, when the quota was as high as 110%, this subsided to just over £11, to be raised again to £78 in 1938 when restriction was more drastic owing to the recession. Buffer pool quota certificates in the same year bore a price about half of the ordinary quota certificates, partly owing to the "deferred" payment received for tin in the pool. In this way, a number of companies which stopped work during the periods of severe restriction were able to make some profit and pay a dividend, by selling their quota certificates, merely because they had produced some tin in 1929. There was also an extra incentive for several smaller companies to combine together or merge with a big company, in order to pool their quotas, as well as their overhead costs, and concentrate production at full capacity on particular plants.

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Note 34. See Note (c) to Figure VI.4 above, also para.22(c) in this chapter.

(b) "Full Cost" Range.

24. It can thus be seen that some of the factors constituting the cost differentials are national or geographical in character, in the sense that they affect equally all the mines operating in the same country or the same region. These include the exchange rate, the rate of taxation and royalties, freight rates, and to some extent wage rates, etc. Other factors in the cost differentials are geological, affecting the same type of deposits, and therefore the broad types of production methods - lode compared to alluvial mining. Lastly there is the differential which affects individual producers in the richness of individual properties, the efficiency of management, organisation, investment and price forecasts. These three groups of cost differentials need not work in the same direction for all mines, although the first two tend to do so. The third group sometimes reinforces and sometimes offsets the effects of national, area, and geological differentials.

Full data regarding the production costs of individual mining units, even for all the "European mines", are of course not available. Among those available, there are many whose cost figures are compiled and represented from the accounting viewpoint, and some estimation has to be made in order to convert them into our concept of "full cost". (See Note 35, next page). This task has been attempted in the course of this study for 25 concerns working during the inter-war period in Malaya (13 companies), Indonesia (2 big concerns), Siam (3 companies), Burma (1), Bolivia (2 big concerns), Nigeria (3 companies) and Cornwall (1 company). These concerns include mines working by most alluvial and lode methods and the selection of number and size of concerns in each country is carefully made in such a way as to make their "weights" agree with their respective output. For instance, two mining units each are chosen from Indonesia and Bolivia, as against 13 in Malaya and 3 each in Siam and Nigeria, because the units in the former countries are much larger than in the latter. The result of this study naturally cannot be claimed as comprehensive or conclusive; but it provides the first approximation of the cost structure of the industry. It is subject to the same error as any sampling method; and if anything, the present investigation is biased by the fact that

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Note 35. See para.4 of this chapter. It was pointed out there that the cost figures published by the various companies in their reports are not satisfactory for the purpose of comparison among themselves or with the price of tin, since they usually represent the working cost per ton of concentrate of various percentages tin content, or "all-in" costs severally defined. Nevertheless, they have been used in quite a "raw" state by students of the subject, such as: The Economist, e.g. 5th May, 1934, p.981; K.E.Knorr, op.cit., p.215-218; P.Lamartine Yates: Commodity Control, (Jonathan Cape 1943) p.143. The last named realises that "costs per ton are not strictly comparable, since the percentage of fine tin in the concentrates produced varies from mine to mine, this variation is reflected in the "realized price" (which is given) and the reader can make the necessary adjustments." The inclusion of realised price for comparison purpose is an improvement, although the comparison is not simple. Even so, the figures are still misleading, since a host of items, notably depreciation, amortisation, taxes, transport costs, are still either left out of the picture or remain unsegregated.

several units under study are big organisations (the bigger the organisation, on the whole, the more complete and satisfactory are the published data). The most serious gap in this estimation consists of the absence of data regarding small mines. This involves arbitrary estimates, supported by the empirical observation which has been made earlier in this chapter.

25. The result is as follows: Expressed in terms of the world output of a normal year in the period 1921-1940, with output about 150,000 tons of tin in metal, we find that approximately 65% of it came from producers whose costs varied between £150 per ton and £200 per ton. This range can be called, with reference to the period under study, medium-cost producers. Below this big group, there were about 15% producing at £70 to £150 full cost, with some exceptional cases as low as £50 per ton. Those producing at the costs exceeding £200 comprised about 20%; of these very few had costs exceeding £250. The frequency distribution of producers according to their full costs is illustrated in Figure VI.5; the diagram is drawn in broken line to indicate some elements of arbitrariness in the estimates.

The low cost group comprised such producers as a majority of the Indonesian mines, especially in Banka, and a few Malayan companies, e.g. the Gopeng Consolidated, the Malayan Tin Dredging, the Southern Kinta Consolidated, etc. The high cost group included most mines in Cornwall and

(p.277).

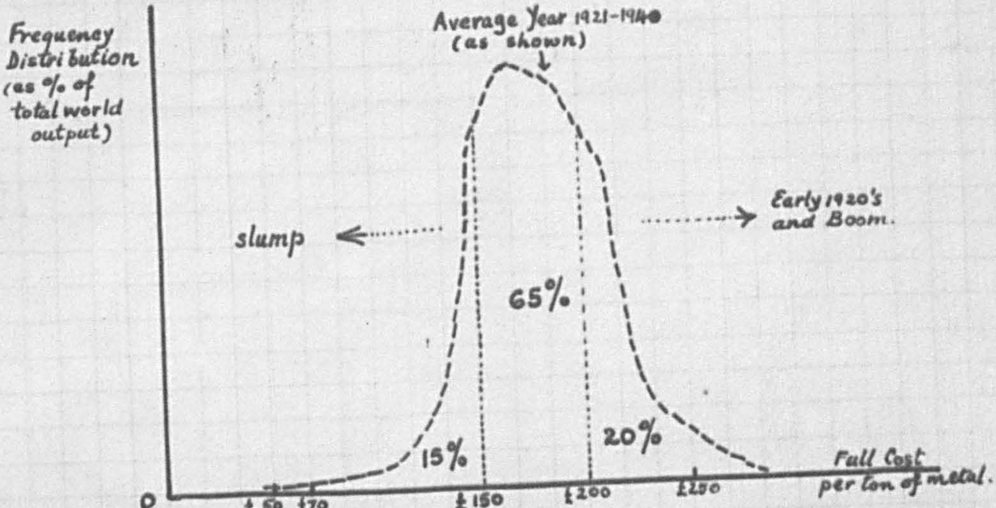


FIG. VI.5. : Frequency Distribution of Tin Production according to Costs.

Australia, about half of the Bolivian output, as well as a few in Malaya, Siam, Nigeria and some lode mines in Indonesia. Mines in all producing countries are represented in the largest, medium-cost group, including Chinese mines in S.E. Asia and small mines elsewhere. The "mode" of our frequency distribution is round about £160 - £170, which comprises about 20% of the world total.

As we have observed earlier, costs during the 1920's had a definitely declining trend. The position in the early 1920's can be represented by shifting the frequency curve to the right, so as to show that the bulk of the producers were then producing at the full cost of £180 - £230. The position as presented in Figure VI.5 was reached after the benefit of improvements in technique and of inland transport. This, however, as should be clear from earlier sections of this chapter, is not a fixed position for the whole period, since cyclical oscillations also affected costs. During the boom, the whole curve moved somewhat to the right, and depression caused it to move further to the left. In these movements, the skewness of the curve was affected. In the depression, since the bulk of small (Chinese etc.) mines were capable of cutting down their costs more drastically, the portion containing low cost producers became inflated from 15% to about 45% or 50%.

26. One point is clear from the cost study outlined above. That is the pitfall in talking of costs in terms of national average. In popular discussions and in some financial and other periodicals, it is the habit of the unwary to take it for granted that Malaya and Indonesia are low-cost producers, Bolivia high cost, and other countries medium cost. (See Note 36). Statisticians in the Mines Departments of various countries are prone to calculate the average cost of tin mining year after year, not realising that such figures have little meaning and still less use. The U.S.House of Representatives Tin Investigation Committee of 1934/35 was not

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Note 36. From these premisses, it is often argued that if price were to fall below £200 for some time, Bolivia as a country would be ruined altogether.

above this. Although realising that "because of the great variety of conditions under which tin is produced, "average" production costs for any given period are inapplicable to any one property, and are in many aspects meaningless", the Committee went on to state that: "over the period 1930-33 the average production cost of tin ore concentrates of 20 of the representative Malayan Companies was approximately $340 per long ton of metallic content. Costs range from $183 to $534 per long ton of metallic content." The average figure given for Nigeria was $370 and for Bolivia $400.(See Note 37).

Much more dangerous is the general tendency to treat the cost range in the past as being immutable, without further inquiries into the elements of the cost differentials. Bolivian producers, for instance, are assumed to continue being high cost producers and always to be so. Such generalisations are contradicted by facts. Even under the general framework of fiscal conditions as existed in the 1920's and 1930's, several of the Bolivian producers were able to produce at full costs lower than £150, but the important point is that the chief factors which inflated Bolivian costs were, as we have seen,

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Note 37. op.cit.pp.18-20. The context was the demonstration that the average full cost of production for the world was about $400 per long ton, while price was $649 on average; and that this gave the profit margin of $249.

(1) the heavy and complicated taxation affecting both imports of machinery and exports of tin, (2) costly inland transport, and (3) the absence of smelting plants built specifically for low-grade ores. With a thorough reform of Bolivian taxation, from export and other indirect taxes to personal income tax, the costs would be lowered by about 10%; and with the disappearance of other external diseconomies, e.g. by an improved transport system, the differentials would be much reduced in most cases, and disappear in a few. For one thing, the tin content of Bolivian deposits, notably in the Patino properties, has been found to be higher than in lode mines elsewhere, and a fortiori higher than in alluvial mines.

(c) The spread of Prime Costs and Full Costs.

27. In the short period, it is the prime cost (less the closing-down expenditure), not the full cost, which is relevant in the determination of the rate of supply of tin.

In his assessment of the long-run full cost range of the industry, the economist need not follow the business man's cost accounting method: he can, and should, use the latter's figures and recalculate them in order to make the cost figures conform to his theoretical concept. To take a concrete example, it is legitimate to work out a "straight line" method of depreciation and amortisation allowance for all the companies, irrespective of the fact that some of them employed the "fixed percentage", "annuity" or "revaluation" methods. This is what we have done in this study, but the prime cost is a different case. The rate of supply of tin is governed by considerations relative to the price and what the business man <u>thinks</u> is his prime cost, or "working cost" (+ subsidiary expenses: smelting charges, duties, etc.). If this diverges from the theoretical concept, the latter must be left out. (See Note 38). This method is followed in our estimate of the prime cost range. We confine ourselves therefore to accepting the "working" or "operating" cost figures in the various company reports; converting them when necessary for comparison purposes to £ per unit of fine metal; and adding subsidiary costs which cannot be escaped. The result is, in all other respects, subject to the same degree of arbitrariness of estimates as in the assessment of the full-cost range.

The difference between prime costs and full costs is a variable quantity; it varies (a) positively with the degree of capitalisation and mechanisation of mining methods, and (b) inversely with the output. For the Patino mines, for instance, this difference ranged between £15 per ton with large output, and £50 per ton of tin when output restriction became more drastic. At the other end of the scale, the difference was always negligible for small labour-intensive mines. Between the two extremes lay the majority of the mines.

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<u>Note 38</u>. See footnote 8 in paragraph 4 above.

The frequency distribution of output according to prime costs shows a similar pattern to that in Figure VI.5. For an average year of the period under study: the spread was as follows:

| Prime Cost per ton of tin. | Proportion of World Output. |
|---|---|
| £40 - £120 | 25% |
| £120 - £160 | 60% |
| £160 - £200 | 15% |
| over £200 | very few. |

The frequency curve moved to the right during the boom, and to the left during the depression. The difference either way was between £10 and £20 per ton. The reasons are the flexibility of wages and the concessions and graduation of taxation and other charges, as well as the change in the property values treated. The skewness of the curve was also changed somewhat as the curve moved: but it was negligible.

28. The comparison between the full-cost and prime cost spreads adds another difficulty in the adjustment of the supply schedule to consumption through price. Take the case of a mine A whose full cost in normal times is £200 per ton of tin, and whose prime cost is £180; and another mine B will full cost £150. With the price of tin at £200 per ton or above, both mines will be producing. As the price falls to £190, both will still be in operation, since mine A can still cover its prime cost. A will stop producing as price

falls below £180, assuming that expectation does not interfere with the decision. Thus, with a fall in demand, the price of tin can be in equilibrium somewhere between £150 and £180 per ton, without causing losses to B. (See Note 39).

Now, if the prime cost of A is as low as £150, and the full cost of B is £160, the situation becomes more difficult. The equilibrium price cannot be maintained over £150, since both categories of mines will still be producing, and from the short-run view point, it would pay A to produce as near full capacity as possible in order to spread their overhead expenses, and thus minimise net losses. The same degree of demand decline will in this case cause a more protracted depression, and price will have to fall lower than £150 before A goes out of production. In the meantime, medium-cost, and sometimes low-cost, producers will suffer a larger or smaller net short-run loss. (See Note 40).

In the tin mining industry in the period under study, the prime cost of many high full-cost mines was lower than the full cost of a good number of lower full-cost mines.

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Note 39. Compared to mine B, A is in a state of "economic obsolescence" and the situation is described by J.W.F.Rowe as the "second order of magnitude of difficulties". (W.Y.Elliott (ed.): International Control of Non-Ferrous Metals (1937) p.62-65)

Note 40. In this case, A is only "technically obsolete" compared with B, and the difficulties are of the "first order of magnitude", ibid.

The former were the highly capitalised mines with large areas, but whose working costs were low because of the machinery used. Moreover, big organisations with heavy investments have large liquid assets behind them, which enable them to hold on and sustain temporary losses for a considerable time. This explains why the equilibrating process of price movements was protracted and injurious to many other producers whose cost conditions were compatible with long-term equilibrium. It explains, too, why some low-cost producers were willing to join hands with their high cost rivals in the world-wide output restriction schemes.

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## Appendix to Section (B)

### Schut's Equations of Supply.

The analysis and historical description of the working of tin mines in F.M.S., set out in Section (B) of this chapter, serves to show how difficult and full of pitfalls it is to try to predict the behaviour of a group of producers reacting against a change in data, say, a fall in the price of their produce. A large number of considerations, sociological, psychological, political, technical, apart from economic, have to be taken into account. Without thorough knowledge of the relevant facts, which can only be acquired by long empirical observations aided by theoretical reasoning, one is apt to make wrong presumptions and arrive at wrong conclusions.

The fact that even objective experts in the tin industry gave erroneous pronouncements in the past should be sufficient to caution, for instance, econometricians trying to put forward equations which purport to describe the behaviour of human beings.

Dr.M.J.Schut, in his work "Tin restrictie en Tinprijs" already referred to in Chapter III, made an attempt to calculate "the price elasticity of production" by means of regression equations from data in 1929 and 1930, for Malaya, the Netherlands Indies and Bolivia. (See Note 41). The regression equations obtained are as follows:

$$X'_b = 37.1P + 27,000 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.1)$$

$$X'_r = 27.4P + 54,800 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.2)$$

$$X'_d = 146.3P + 20,000 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.3)$$

where P represents the price of tin in £, $X'_b$ is the calculated output from dredges in long tons, $X'_r$ = calculated output from manual labour methods, $X'_d$ = calculated output from deep (lode) mines.

Since these three countries produced together about 78% of the world's output of the time, the equation for the world supply ($X'_w$) is derived therefrom:

$$X'_w = \frac{100}{78}(X'_b + X'_r + X'_d)$$

$$X'_w = 270.2P + 130,500 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4.5)$$

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Note 41. op.cit., Ch.IV, pp.66-72).

The equations of supply from lode ($X'_p$) and from alluvial deposits ($X'_a$) are also calculated:

$$X'_p = 132.6P + 28,500 \quad \ldots\ldots\ldots\ldots\ldots\ldots(4.8)$$

$$X'_a = 892.8P - 12,200 \quad \ldots\ldots\ldots\ldots\ldots\ldots(4.9)$$

which would give an alternative equation for total world supply:

$$X'_w = X'_p + X'_a = 1025.4P + 16,300 \quad \ldots\ldots(4.10)$$

As a piece of retrospective statistical analysis, this is quite unassailable.The relative supply elasticity coefficients : 27.4, 37.1 and 146.3 for "manual", dredging and lode mining methods respectively fall in line with the common sense and historical approach, reflecting the reverse of the degrees of tenacity with which the various categories of mining could resist falling prices during the depression. The author, moreover, appears to limit the applicability of his findings to a moderate scope by qualifying them with the important clause: "Supposing that the ratio between the percentage decline in production and the percentage fall in price from 1929 to 1930 is representative of the elasticity of total production in respect to price...." (See Note 42), then the regression equations would be applicable. However, in the concluding Chapter VII, Schut uses these equations, together with some others, calculated for stocks and price,

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Note 42. ibid. p.114, also pp.66 and 94 n.1. in the text.

to repudiate the argument of J.K.Eastham (in the cited article in the Review of Economic Studies), and works out "from these hypothetical production figures, the stocks that would have existed under free competition and the prices that would have resulted"for the period 1930-1934. From there, another plunge was made to arrive at the position that "the price would have been on a level that would not have permitted the majority of producers to cover their cost. The conclusion which can be drawn therefrom is, that the restrictive measures taken must be regarded as having been necessary." (See Note 43).

But the applicability of the production functions obtained by Dr.Schut is obviously limited. The data in the calculation are too few, and the period covered by the study was too short to make the result anything like representative. Historical, psychological, institutional, political as well as economic factors were neglected. This is the real weakness of the correlation method as applied to economics. The results are no more than the production functions of three chief producing countries, generalised for the whole world. Old decaying tinfields such as Cornwall, Australia, China, and new growing areas such as Siam, Nigeria, Belgian Congo, and Burma are not taken into account. A more serious shortcoming is that the period of two years, on which calculations were made, and generalised in the final conclusion, is

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Note 43. ibid. p.115: pp.95-105 in the text.

conspicuously inadequate. Moreover, these two years 1929 and 1930 witnessed the most extensive and loudest propaganda in the history of the tin industry for the formation of a producers' co-operation. As stated earlier, the propaganda had the effect of bolstering producers' hopes and kindling the upward price expectations among them such as to keep them in operation. The equations, in addition, do not take account of the fact that the aftermath of the 1926/27 tin boom was still incomplete, at least so far as dredge construction was concerned. Nor were the change in technique, and the cost factors, allowed for. Another event overlooked by the analysis was the "voluntary restriction scheme" which was in force, albeit ineffectively, in most major producing countries for many months in 1930. A large number of other relevant factors, such as the fiscal policy, and the exchange policy of producing countries must obviously be by-passed in this statistical method. To be sure, some of these points might have been used to support Schut's final conclusion; but most of them would tend to pull the other way. One thing is certain: the regression equations are not representative, and cannot be used to prove anything.

# CHAPTER VII.

## PRICE-SUPPORTING MEASURES BEFORE 1931.

1. From 1914 to the present day, there have been three periods in which special measures were taken to maintain the price of tin:

(a) Certain measures taken during and after the first World War which culminated in the Bandoeng Pool 1921-1924;

(b) The voluntary restriction schemes prompted by the British Producers' Association in 1930;

(c) The inter-governmental restriction agreements 1931-1946 in which Governments and producers co-operated.

The first two periods are considered in this chapter.

## (A) THE EXPERIMENTS BETWEEN 1914 AND 1924.

### I The 1914 Price-Support.

2. At the outbreak of the War in 1914, marketing and shipping difficulties, coupled with the general belief that tin was not a war material caused a sudden stoppage in the demand for tin. The price of tin in Malaya fell from (S.S.) $95 per picul in February to $57 in October, with the average for the year about 25% below 1913. The number of workers in the mines (excluding dulang washers) fell from 225,400 in 1913 to just under 171,700 in 1914. The Government decided to assist the mining community in the form of purchase of tin. The money was advanced by the Straits Settlements Government. The crisis was short; the miners' confidence was soon restored; the price of tin rose steadily and the Government derived a

"considerable profit from the sale of tin purchased and the proceeds were used for the payment of the cost of repatriation of the Chinese who were thrown out of work". (See Note 1).

## II The 1919 Price Support.

3. Things went smoothly all through the war. At Singapore, tin price climbed up to $150 in 1918, with costs rising paripassu. In the last year of the war, partly owing to the smaller smelter output of the United Kingdom, and partly because of wartime control, dealings in the London Tin Market came practically to an end. Business was diverted to Singapore, However, all competitive dealing in the East was soon suspended. In August, when the price of tin was around the peak of $182 per picul (£380 per ton in London), the U.K. Government issued instructions to the Colony that all dealings were to be conducted by a single house. Price was then forced downward. From November, when war suddenly came to an end, the fall in price became more rapid, largely owing to the import ban imposed by the U.S.A. on Eastern tin. The U.S.Tin Control then held about 10,000 tons of tin and decided to sell at the purchase price of 72 cents per lb. before any more tin could be permitted to enter the country. The British Government also stopped buying towards the end of the year. There was no local market for tin in Malaya, and the London and

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Note 1. F.M.S.: The Chief Secretary's Report for the year 1914. (Cd.8155) pp.30/31.

American tin markets had practically ceased to transact business right up to the end of the first quarter in 1919. In January the F.M.S.Government stepped in, and appointed the Straits Trading Co. and the Eastern Smelting Co. as their agents to buy tin at $118 a picul, at which level price was maintained for a month until after the Chinese New Year, when the purchasing price was lowered to $100. The F.M.S.Government buying was carried on until the end of April. The total holding amounted to about 6,000 tons of metal. It was reported that on this occasion the Netherlands East Indies authorities were consulted and agreed to an informal co-operation, and that a considerable stock was accumulated in Banka.

About the end of May, the local market in Singapore reopened and price advanced considerably. The F.M.S.Government began selling their holding of tin at the price of $119, and their stock was duly liquidated a few months later. The operation brought in a profit of about $1 million.

III The 1920/21 Price Support.

4. It soon became clear that the price advances in 1919/20 were extremely precarious. Much of the buying in the second half of 1919 was speculative. Industrial demand remained low, especially in the United States. After February 1920 a reaction set in.

At the beginning of December 1920, the Singapore price stood at $90 per picul, which was less than half of that in February. On the 6th, partly encouraged by previous profitable successes, and partly "in order to save a number of mines from closing down and to prevent the consequent dislocation of labour", the F.M.S. Government stepped in to support the tin market for the third time. The purchase price was fixed at $110 per picul at first, and then raised to $115 a fortnight later. After the Chinese New Year, in the middle of February 1921, it was reduced to $100, and at the end of the month, Government purchasing was discontinued. It was subsequently disclosed that the total Government holdings amounted to about 10,000 tons. In addition, it was disclosed by Government communiques that the Dutch authorities in Banka had pledged co-operation in the action by not forcing supplies upon the weak market. The Straits Trading Co. also participated in the accumulation of stocks of refined tin to the extent of about 2,500 tons.

By the middle of February, 1921, it became evident that the current crisis, unlike the two previous ones, was going to last for some time. Europe's demand for tin remained very small owing to the devastation of her industrial capacity, and the British industry was crippled by the post war slump. The U.S.A. emerged as the most important outlet for tin, but American imports were even smaller than during the 1919 crisis. The accumulation of stocks in the East was a double-edged weapon: on the one hand it momentarily relieved the market of some of its supplies, and, on the other, the increase in total stocks was a constant threat to any hope of price revival, should the several stock-holding bodies suddenly reverse their policy. An attempt was therefore made to bind the various parties by a more formal agreement which would regulate their action in this respect. The result was the Bandoeng Agreement of 1921.

## IV. The Bandoeng Agreement 1921-24.

5. The Anglo-Dutch Agreement of 28th February 1921 was the outcome of a conference held at Bandoeng in Java. The initiative came from the then managing director of the Straits Trading Co., with support from the F.M.S.Government. The representatives of the Straits Trading Co., and of the Eastern Smelting Co., acted for the F.M.S. and Johore Governments; on the Dutch side, there were the Netherlands East Indies Government and the Billiton and Singkep Companies. The Straits Trading Co. was, while the Eastern Smelting Co. was not, a party to the agreement.

The main provisions were as follows:

(a) The combined accumulated stocks of refined tin should be held off the market for a minimum period of three months (to the end of May 1921).

(b) If the price of three-month standard tin in London reached the figure of £240 per ton during the minimum (see Note 2) period, or a private offer were received by any of the contracting parties at the equivalent of that figure, the further continuance of the agreement was to be reconsidered.

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Note 2 The average price for three-month tin in London for February 1921 was about £170 per ton.

(c) If the market price remained below £240 during the minimum period, provision was made for the further extension of the period.

The accumulated stocks at the time of the Bandoeng Agreement totalled just under 19,500 tons.

6. The Bandoeng Agreement was in effect a negative measure: it was merely an agreement preventing, for the time being, the parties from selling the stocks of tin that had been acquired. It did not provide for further acquisition of stocks in order to support price at least in the short run. (See Note 3.) With the worsened state of consumption in America and Europe, price declined still further to $72 per picul in Singapore. London price for three-month tin fluctuated during the rest of the year between £157 and £179. At the end of May, the agreement was duly renewed, and it was renewed again several times before the final liquidation in 1924.

Meanwhile, some additional stocks were held speculatively by traders. In particular, the Straits Trading Co., a party to the Bandoeng Agreement, had acquired a stock outside

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Note 3. This point needs to be emphasised. Some writers, overlooking it, seem to ascribe too much importance to the Bandoeng Agreement: K.E.Knorr, for instance, (op.cit.p.74, also 77-79). If the Bandoeng Agreement were, as Knorr says, a valorisation scheme, it was a very timid and negative one, and the success or failure of it could not be taken as a precedent, "likely to influence future developments in this direction". P.Lamartine Yates, likewise, is misleading when he states that the "Pool activity undoubtedly hastened the recovery in tin prices in and after 1922" (Commodity Control, p.145). It did nothing of the sort: on the contrary, price still declined in the early months of 1922, in spite of the progressive recovery in consumption, and the annual average price in S.S. $ was still lower in 1922 than in 1921.

the Pool, amounting to some 1,350 tons. The financial position became difficult for the company, and after the resignation of the managing director towards the end of 1921, the stock outside the pool was sold at a loss. The two Dutch companies which participated in the agreement were allowed to liquidate their stocks of about 3,000 tons in April 1922. The two contracting Governments were financially strong enough to continue carrying the stock, the N.E.I. Government having raised a loan in the Federated Malay States for the purpose.

From the last quarter of 1921, American and European imports of tin began to revive. After March, 1922, price began to rise, advancing more rapidly. The quotation in London rose to a peak of £188 in November.

The decision for the liquidation of the main stock of the Bandoeng tin was not arrived at until April 1923. At that time, the total tonnage in the Pool was returned at 17,600 tons (including about 270 tons in ores). Under the liquidation scheme, each party to the agreement could release monthly 5% of its total holdings in the Pool. The contracting parties availed themselves of their rights to dispose of their stocks at various intervals. At the beginning of 1924, the tonnage in the Pool was declared at 7,680 tons, which was entirely sold during the year.

7. The immediate financial result of the Bandoeng Pool, unlike the previous F.M.S.Government operations in the tin

market, was unprofitable. Data are not available for Banka; but much of the stocks of the Straits Trading Co. and of the Billiton and Singkep companies were disposed of during the ebb of the market. The Chief Secretary of the F.M.S.Government reported that "the cost to the Government of its assistance to the tin industry", was about $2,600,000 (See Note 4) or about £300,000.

## V. The Lessons of the Bandoeng Pool Agreement.

8. The recovery of tin price since 1922 could not have taken place without the expansion of consumption, especially in the United States. This follows from the negative character of the Bandoeng Agreement, and from the smallness of the size of the stocks held. The history of the Pool raises the question whether it is wise to allow individual companies, however strong financially, to take part in a valorisation scheme. The transactions involve large sums of money being locked up for a period of several years. This creates a heavy strain on the capital of the companies. The Straits Trading Co. and the Billiton Co. were the cases in point. Even if it were financially possible given certain sets of price expectation, actions guided purely by profit motives might upset the market and exaggerate price fluctuations

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Note 4. F.M.S.: Annual Report of the Chief Secretary for 1924 (Colonial Reports No.1256) p.15.

In a rising market, the companies may decide to delay the liquidation of stocks in anticipation of an even higher price, and this would drive price up further than it would otherwise have gone, and conversely. If, for instance, the Bandoeng authorities in 1923/24 had agreed to hold their stocks for another year or so, they would have made good profits instead of losses, because then they would have enjoyed the full recovery of demand.

9. The advocates of the Bandoeng Pool, particularly the tin producers in Malaya, claimed for the agreement two merits: (a) that the Government buying of tin in 1920/21 was beneficial because it alleviated the unnecessary suffering of producers; and (b) that the release of tin from the pool was done gradually, without undue disturbances to the rising market.

These claims could easily be exaggerated, especially since the actual purchases by the F.M.S. Government took place between December 1920 and February 1921, after which period the official stocks were merely maintained without additional tin being acquired. The subsidiary tin accumulations by private individuals and companies did not appear to be large by comparison, and in any case much of the private holdings was soon liquidated after it became apparent that the depression would last for some time. All through the year 1921, and right up to the end of February 1922, price was on a downward course, and the most the Pool did for the producers was to abstain from pressing it further by a premature liquidation of the stocks. It is true that the Pool liquidation when it took place was wisely carried out in a gradual manner; but the smallness of the stocks - amounting to only about half of the difference between U.S. imports in 1921 and 1923 - was evidently not sufficient to prevent a spectacular rise in price. In other words, the Pool was merely a temporary relief measure, for the benefit of the producer, without attempting to regulate the market in the interests of the consumer.

10. Critics of the Bandoeng Scheme, on the other hand, tend to overstate their case. J.K.Eastham, for instance, asserts that the "Bandoeng Pool was responsible for the tin famine" (See Note 5) in 1925-1927, arguing that earlier on, "price did not fall sufficiently to cause any drastic reduction of output, and the surplus was absorbed slowly. Consequently new investment was not attractive although consumption was steadily increasing." (See Note 6). It is not clear how, if output capacity had previously been reduced, the subsequent tin famine could have been avoided in the absence of a sufficiently large stock. Eastham's argument would be valid only on two assumptions, both of which must obtain:

(a) the new investment in response to the early rise

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<u>Note 5</u>. loc.cit., p.28. <u>Note 6</u>. ibid. p.18.

in price (due to the rise in consumption) will bring forth far greater output than that lost by the elimination of high-cost producers during the slump.

This was unlikely, since, in Eastham's own words :"the concessions obtained by the companies floated towards the end of the period (1925-1929) were in general poorer than those of older companies". (See Note 7).

(b) The time-lag between investment and production is sufficiently short.

This, as we have shown in previous chapters, does not obtain in tin mining, particularly in the dredging sector of the industry. There is no guarantee that had output been drastically reduced in 1920/21, the tin shortage which actually took place in 1926/27 would not have been felt three years earlier, in 1923/24, when consumption, and especially U.S.imports suddenly increased. (See Note 8.).

11. It is a widespread belief among students of the tin industry that the gradual release of the metal from the Bandoeng Pool blinded the market to the fact that consumption was running ahead of the existing capacity to produce, and thus was responsible for the excessively high price in 1926-1927. It is argued that if these stocks had not been added to the

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Note 7. ibid., p.20.

Note 8. cp. The Economist, 19th January 1924, p.95.

current production, the price of tin would have risen much more rapidly, and this would have given a clear signal that additional productive capacity was required. (See Note 9).

The validity of these contentions depends on the following assumptions: (a) that during 1923-24, price was kept sufficiently low, in contrast to the period 1926-27, by the liquidation of the Bandoeng stock; (b) that tin producers, or would-be producers, in 1923-24 did not realise that the stock was being liquidated nor the extent to which liquidation was being made; (c) that if there had been no pool, price in 1923 and 1924 would have risen sufficiently to attract new enterprise and expand old mines. The last point implies, in turn, that the tin miners' investment decision depended solely on the current price of tin. None of these three assumptions is entirely true.

12 (a) The first point is a factual one. The average tin price was £202 in 1923, £249 in 1924: it became £261, £291 and £289 respectively in the next three "free" years. However, when one looks more closely into the figures, instead of finding that price shot up after the exhaustion of the pool, one sees (See Note 10) that the peak level of £298, reached

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Note 9. See J.W.F.Rowe: Markets and Men (Cambridge University Press, 1936) pp.158-9. P.Lamartine Yates, op.cit., p.145. K.E.Knorr, op.cit., p.79 also p.87. G.W.Stocking and M.W.Watkins: Cartels or Competition (20th Century Fund, N.Y., 1948) p.163.

Note 10. See Figure I.1.

in March 1924 (during the stock liquidation) was not attained again until March 1926, and that the monthly average of £278 in March 1924 was not equalled until November 1925. It can be conceded that the existence and liquidation, however gradual, of the Bandoeng stock had the effect of preventing price from rising. When we compare the periods during and after the stock liquidation, however, we see that much bigger forces were at work than the additional supply of 880 tons per month freed from the pool. Table VII.1 clearly shows that both world consumption and deliveries of tin for the average of 1925-27 period were about 15% higher than the 1923-24 averages. On the other hand, the biggest increase in world tin production during the period occurred in 1924 when output was about 12% higher than that of 1923. In addition, a serious slump occurred in 1924 in the U.S.A., not only in tin, but in the consumption of most metals. That cannot be attributed to the release of the Bandoeng tin stocks. Throughout the years 1923/24, tin price fluctuated with the deliveries of tin in the U.S.A.; and the sales from the Pool, at least as far as the F.M.S.Government holdings were concerned, were made during the period of high price. In other words, the sales from the Pool followed the lead of the deliveries, and not the other way round.

Table VII.1.

Production, Consumption, Stocks and Price of Tin 1921-1927.

| | London Price £ per ton | (1) World Production. | (2) World Consumption. | (3) Total Visible Stocks. |
|---|---|---|---|---|
| | | (in thousands of long tons) | | |
| Bandoeng Stock | | | | |
| (a)Holding (1921 | 165 | 115.7 | 80.0 | ? |
| (1922 | 160 | 122.6 | 129.0 | 45.4 |
| (b)Release (1923 | 202 | 125.5 | 134.0 | 36.2 |
| (1924 | 249 | 141.6 | 133.0 | 32.1 |
| (1925 | 261 | 146.1 | 151.0 | 22.3 |
| "Free"Years (1926 | 291 | 143.4 | 148.0 | 18.6 |
| (1927 | 289 | 158.9 | 154.0 | 21.0 |

Sources: (1) I.T.R.D.C.
(2) Metallgesellschaft (converted from metric tons)
(3) L.C.E.S. (end of year figures).

The most important reason for the slump in tin price towards the end of 1924 is not difficult to single out, and the contribution of the stock liquidation, if any, could not have been as large as it is alleged to be.

13. (b) The second point is also a point of fact, and the fact contradicts the contention that the Pool release blinded the miners to the growing consumption. For one thing, the terms of stock release were made fully public, and communiques were issued from time to time regarding the balance of stocks remaining in the Pool. In addition, the F.M.S.Government announced the details regarding the sales of tin thus released.

The prevailing contemporary opinion was that once the pool was exhausted the price of tin would rise substantially, provided demand conditions were not worsened. (See Note 11). The miners themselves were well aware of the situation. The liquidation of the Pool did not prevent tin shares from rising, sharply at times, during the period. (See Note 12). In all the reports of tin mining companies at their annual meetings during the period, without exception, the Chairman's speeches took full account of the situation, and in several cases, direct reference was made to the prospect of further price rise after the Pool had been liquidated. The following statement was representative: "Personally, I am optimistic enough to think tin will hold its price of £200 or go better, especially when the artificial position caused by the "Eastern Pool" is got rid of". (See Note 13). The evidence can be multiplied.

14. (c) The third point - that in the absence of the pool sales, the price of tin would have risen to a much higher level

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Note 11. The Mining Journal and the Economist can be cited as examples. See the Mining Journal's leading articles on 8th September, 1923, 26th January, 1924 and 15th March, 1925; The Economist: 11th August 1923, p.214/5, 10th November 1923, p.831/2, 24th November, 1923, p.918, 19th January 1924, p.95, 14th June 1924, p.1195, 6th September 1924, p.380.

Note 12. See e.g., The Economist 8th Sept. 1923, p.363, 10th November 1923, p.831.

Note 13. Tekka Ltd., Chairman's speech on 12th October, 1923, reported in the Mining Journal of 20th October 1923, p.800.

in 1924 and 1925 resulting in a prompt larger output of tin,- has been partly disproved.in (a). This increase in world tin output in 1923 and 1924 was checked by the "most violent slump witnessed on the London Metal Exchange for many years", (See Note 14) in the second quarter of 1924, when the price of tin fell from £298 in March to £200 in May, with backwardation persisting throughout the first half of the year. The general situation with regard to tin was recognised as precarious. For the whole year of 1924, despite the sharp revival in the second half, both deliveries and consumption remained below the 1923 level. This recession was sufficient to revive the tin miners' memory of the past crises of 1914, 1919 and 1920/21: hence their guarded optimism during this period.

It might be argued that without the Bandoeng Pool liquidation, the recession in the spring of 1924 would not have been as bad as it was, and in general tin price level would have been higher. Even if this conjecture is granted, it does not follow that the current price level is a sufficient factor to determine the production plan of the miner. As we have seen in a previous chapter, producers may take advantage of the momentary high price in order (i) to work the poorer portion

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Note 14. The Economist of 14th June, 1924, p.1195.

of his property, or (ii) to develop the mine at the expense of production. When general confidence is not backed by a long period of high price - as it was not in 1922-24 - the former course is likely to be taken. It was in a later stage, when it became clear beyond doubt that higher price lay ahead, that additional investment and development started. Probably for this reason, there was a slight decline in world output in 1926, as compared with 1925: but at the end of 1926 it was reported that, in the F.M.S., 21 dredges were under construction and 40 more proposed to be constructed.(See Note 15). The production plan took a long time to mature, and the rate of output increase became accelerated only after 1927. By 1928, the rate of increase in consumption had already slowed down. In the period 1922 to 1924, the same atmosphere of unqualified optimism did not obtain. It seems more reasonable, therefore, to argue that even without the monthly release of 880 tons from the Pool, and even if price had consequently shot up to, say, £300, a ton in 1923, the investment boom would not have taken place on such a large scale. The turning point of the metal slump in the middle of 1924 was indeed the clear signal of an impending boom. Backwardation turned into a contango, and tin price pursued a steady rising course. The Bandoeng Pool had in fact very little significance in the face of changes of such a magnitude in the intrinsic conditions of business.

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Note 15. F.M.S.: Annual Report of the Chief Secretary for 1926 p.21.

(B) PRIVATE STOCK-HOLDINGS.

15. From 1925 to 1929, tin consumption rose further from 151,000 tons to a record of 183,600 tons. World output increased at a greater rate from 146,100 tons to 192,600 tons, overtaking consumption in 1927. Average visible stocks (calculated from stocks at the ends of the months) amounted to 18,600 tons in 1925, reached the lowest figure of 14,900 tons in 1926 and progressively increased to 25,000 tons in 1929. At the end of this year, they stood at 32,000 tons, while "invisible" stocks were generally believed to exist to a substantial extent. The price of tin took an upward course from £201 per ton in May 1924 to peaks around £320 at the end of 1926 and the beginning of 1927: afterwards it fell to £206 in July 1928 and after a short recovery fell further to £173 towards the end of 1929. Backwardation at times exceeding £10, appeared, with short intervals, from the end of 1925 to the end of 1928.

Heavy investments in tin mining during the period had the two-fold effect of increasing output and reducing costs. The fall of price in 1928 and 1929 was therefore not unexpected by the market. Good profits were made and high-level dividends paid in 1928 in most cases, and even in 1929 a good number of companies were able to pay high dividends, in spite of the level of price under £180 per ton. The period 1925 to 1929 was a prosperous one for the tin mining industry as a whole.

16. Not only were the years 1925 to 1929 the period of

heaviest investment in the history of tin mining, they were, as related in Chapter V, the period of amalgamation culminating in the establishment of Consolidated Tin Smelters Ltd., in 1929. In particular, the Anglo-Oriental group expanded its holdings in Malaya, Nigeria, Burma, Siam and Japan, and its control covered power supplies and smelting as well as mining companies. Most of the investments were made in the period 1924-1927. With the price of tin falling towards £250, as early as October 1927, a proposal was outlined in the "Financial Times" for "stabilising the price at £300". From time to time there were rumours of the formation of a tin syndicate and the price of £300 was often mentioned as an objective. In June, 1928, appeared the first issue of "Tin", the organ of the A.O.M.C. Propaganda was made with greater vigour regarding the desirability of preserving world tin resources, whose exhaustion was declared to be imminent. Tin producers were urged to co-operate for mutual protection against the bearish speculation and against the manipulation by consumers in America. (See Note 16). Tin price improved somewhat in the last two months of 1928, especially towards the end of November, when it reached £240. This improvement was not unconnected with the circulation of reports as to a widely-supported agreement among producers in Malaya to restrict production. The immediate causes of the

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Note 16. e.g. "Tin" June 1928 quoting the speech of the Chairman of the F.M.S.Chamber of Mines at the annual general meeting in May.

price rise were the increased deliveries in America consequent upon the inauguration of the National Metal Exchange, Inc. in New York, and the bullish activities believed to be launched by the A.O.M.C.group in November. On December 3rd, the day of the opening of the National Metal Exchange, price reached a maximum of £242; after that it resumed its declining course and in April 1929 it went below £200 for the first time since 1923.

17. Little is known about the bullish activities in this period, since, unlike the previous price supporting actions carried out by governments, very little was disclosed. Heavy speculative buying of forward metal was reported as far back as in 1927, One report stated that, towards the end of 1928, a block of 4,000 to 8,000 tons of tin was acquired and withheld by a financial group in London, "which has been purchasing tin consistently for some months past with the object of keeping it off the market and so stabilising the price...The group is in a position to command a considerable amount of capital." (See Note 17). Another report said that between 5,000 and 8,000 tons were accumulated. (See Note 18). That these speculative activities took place, there was no doubt, and all contemporary reports concurred that the "Group" - i.e. the A.O.M.C.- was

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Note 17. F.M.S.Report on the Administration of the Mines Department for 1928, pp.34-5.

Note 18. Mineral Industry, 1928, p.587.

responsible for them. The "Metal Bulletin" of the 6th July, 1929, under the heading of "Tampering with Tin Figures" stated that "During last year several parcels of tin were withdrawn from official warehouses in U.K. which make returns of their holdings and transferred to warehouses which do not issue returns. The tin thus withdrawn....was at the time of such transferences treated in the monthly statistics issued by the trade authorities as delivered, in such a manner that the figures for U.K. apparent consumption were exaggerated." The speculation probably resulted in a loss, since the metal must have been bought at an average price of £230 per ton, a level which was not reached during the next five years.

That the A.O.M.C. did engage in speculative tin holdings was well known, and confirmed by the establishment in June 1929 of the British American Tin Corporation whose declared business was to deal in metallic tin as well as in tin shares, and afterwards, from 1932 to the end of 1933, of the Tin Holding Co., whose specific purpose was described by its name. It is highly probable, judging from the balance sheet of these companies and from the course of tin price, that speculative holding of tin metal must have been the least successful side of the business of the "Group" in this early period. The British American Tin Corporation in fact incurred a small loss in 1929, despite the fact that most tin mining companies associated with it were then able to pay dividends.

With the optimistic outlook in the first stage, (See Note 19), the group then started to accumulate tin, expecting price to recover. This, however, proved to be wrong and they probably incurred a heavy loss on their speculative hoardings of tin. This is an instance showing that speculation can have the effect of increasing fluctuations of price and cannot be relied upon to achieve stability. The activities of the A.O.M.C. group in speculative holding of tin continued into the middle of the thirties.

(C) <u>VOLUNTARY OUTPUT RESTRICTION 1930.</u>

18. In 1928 and 1929, it became clear not only that output had increased faster than absorption, but consumption itself had slowed down in its rate of increase. The year 1928 saw the British-American agreement in the marketing of tinplate exports and the restriction in tinplate production in South Wales. The A.O.M.C. group intensified their efforts towards "rationalisation" of the tin industry, and the first step in bringing British tin producers together on a formal basis was achieved when the Tin Producers' Association (TPA) was publicly proposed at a meeting in July, 1929, and

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<u>Note 19.</u> Witness an article in "Tin" of September 1928 entitled "The Over-production Bogey" : "Output is still barely keeping pace with consumption....nor is there any sign of demand slackening....It is therefore impossible to find in the present low level of tin price any reason for anxiety" It is of course difficult to distinguish pure propaganda from genuine optimism.

incorporated in September. By the formation of the Consolidated Tin Smelters Ltd., towards the end of the year, the Patino and Dutch interests became closely linked to the A.O.M.C.

I. The Formation of the Tin Producers' Association.

19. The formation of a comprehensive association was a prerequisite to any international concerted action on the part of producers. The tin mining industry in Malaya, even in the European sector only had remained highly competitive. Dutch interests had from the start intimated that a combined front must be shown by British producers before it was any use inviting the co-operation of foreign concerns. (See Note 20). The overture was made in the form of a letter to the Times, published on June 6th, 1929, bearing twelve signatures associated principally with the A.O.M.C. The signatories were claimed to represent "important tin mining interests in Malaya, Siam, Nigeria and Burma", and collectively to stand for "an output exceeding 40,000 tons of tin oxide per year. This was equivalent to about 15% of world output, or 30% of the total output of the countries named, in 1929. The argument put forward in the letter was the familiar one of the danger of the exhaustion of world tin resources, and the price-inelasticity of demand for tin. Attention was called to the

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Note 20. See Mining Journal of 8th June 1929, p.458.

critical condition of the tin mining industry and producers were urged to co-operate. There followed a meeting in July at a London Hotel. The motion proposing the formation of the association was carried and a Council of 21 was appointed. Efforts were made to include all influential British producers in the Council, and the Redruth, London, Ipoh and other groups as well as the A.O. group were represented therein. The chairmanship of the Council went to Sir Philip Cunliffe-Lister (See Note 21), and the vice-chairmanship to Sir William Berkeley Peat (chartered accountant, director of iron and steel companies). The latter was also the Chairman of the Executive Committee of nine members.

II. <u>The Proposal for Week-end and Monthly Holidays</u>.

20. After September 1929, the price of tin suffered a sharp fall, beginning with the Stock Exchange crash in the U.S.A. Discussions became more serious on the ways and means of limiting the flow of tin supplies. After unsuccessful attempts at securing active co-operation from the smelters other than the C.T.S., it was decided to restrict the production at the mines. This entailed the co-operation of foreign producing interests. The majority of British producers were anxious that the scheme should be as comprehensive as possible.

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Note 21. Sir Philip Cunliffe Lister (Viscount Swinton), was the Vice-Chairman of Consolidated Tin Smelters, Ltd., subsequently Secretary of State for the Colonies.

Bolivian and Dutch producers were approached, and in December, it was announced that they had agreed to participate.

In an announcement issued in December 1929, the TPA Council issued a recommendation urging all members to restrict their output. For the Eastern concerns, where continuous operation was the practice, the restriction was to take the form of (a) a stoppage of 32 hours during the week-end each week throughout the year, plus (b) a complete shut down for seven days in each month during the first three months of the year 1930. "A similar ratio of curtailment is recommended in the case of Nigeria and other tin producing countries upon a basis more exactly suited to the particular conditions obtaining in those fields." In the case of Nigeria, it was feared that a formal closing down might result in labour leaving the mines.

The recommendations were not accepted by all the tin mines, not even among all the members of the T.P.A., and where they were accepted, it was not without hesitation and delay. On Sunday, 19th January, it was reported that only 59 out of the 105 tin dredges were idle in the Malay States. The majority of the Chinese miners in Malaya rejected the proposal as impracticable. F.M.S.Chinese output was actually higher in January 1930 than that for any month in 1929, and after a seasonal (Chinese New Year) decline in February, it rose again in March to about the average of 1929. The week-per-month stoppage for three-months was later postponed to start from February to April. Late in January, Nigerian mines were reported to have agreed to the curtailment of output by 20% for the first quarter and 15% for the rest of the year - which was less than the proposed Malayan restriction. In Malaya itself, the week-end stoppage was by no means genuine in all cases. Many companies took the opportunity of the "holidays" to make repairs, overhauls, or changes in the machinery. "The usual dredge practice had been a stoppage for cleaning once every 24 hours, the total inactivity being equivalent to one or two days' stoppage a week. The Sunday cessation of activity meant the daily overhauling was cut to a minimum and a more thorough going overhauling undertaken on Sunday. The gravel pumps in Chinese mines were also stopped, but coolies continued to cut earth and the extra accumulation was disposed of by added activity of the pumps within the next few days. Only monitor mines failed to compensate for this loss of time". (See Note 22). Early in March, the TPA declared that of the 141 member companies, 37 had not curtailed output.

The weekend closing had been the normal practice among Bolivian producers. Here, some medium-size organisations were reported to have favoured the restriction scheme, and the

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Note 22. J.W.F.Rowe, quoted by E.May: op.cit.pp.318/19, note 72.

Aramayo mines decided to concentrate upon silver production instead of tin. The biggest producer, Sr.Patino, did not announce his intention of restricting the output of the mines under his control until after the middle of February. (See Note 23). He then accepted the invitation to become the President of the T.P.A. and to nominate two members to the Council. In the Netherlands East Indies, requests were made to the Government by a committee of the People's Council to introduce "free Sundays" in the tin industry, but on February 15th, the Director of Public Works gave a non-committal reply, stating that although the curtailment of production was imperative, the Government did not wish to take the lead because it was not the N.E.I. Government which was responsible for over-production, but the foreign producers who had considerably increased production. The Board of the Billiton Co., repeating the argument, stated towards the end of the month that the company was disposed to fix its production for the next working year on the basis of the mean production in the last three years. On March 8th, the N.E.I. Government issued a statement, declaring its decision "not to increase the production in Banka island, where the maximum for 1930 is fixed for 22,000 tons". These "undertakings", in the view of the British miners, "could not be regarded in any light other than negative". (See Note 24).

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Note 23. This had the immediate effect of raising the price of tin by over £4 per ton.
Note 24. F.E.Mair at the Gopeng Co. Meeting on 19th March, 1930, see Mining Journal of 22nd March 1930, p.237.

III The Proposal for a 20% Cut.

21. Growing dissatisfaction was manifested with regard to the anomaly in the varieties of restriction rates in practice. In March, the Chairman of the Gopeng group declared that his group of companies had decided to restrict output to 80% of the 1929 figures, reserving the right to reconsider the policy "if the present TPA restriction scheme falls through in whole or part." (See Note 25). In the same month, the TPA Council decided to recommend a revision of the restriction scheme in favour of uniformity. All the tin mines of members of the TPA were to reduce their shipments of ore for the whole year by 17.4% of their 1929 rate. This was modified in April by another recommendation that the ore output for 1930 was to be reduced to 80% of that for 1929. Those mines that began production after January 1st 1929 were to produce 80% of their estimated 1930 output, being allowed two clear months of unrestricted operation after bringing their plants to full production.

IV. Stephens' two-month holiday plan.

22. Meanwhile the price fell further from £170 in March to just over £130 in June. Whilst deliveries during the first half of 1930, compared with those for the same period in 1929, fell by 15%, the aggregate output of all important countries

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Note 25. Mining Journal of 22nd March, 1930, p.237.

declined by less than 3% (See Note 26), and that of Malaya, Siam and Burma actually increased.

In June the International Committee of the TPA met in Paris and recommended that the members of the Association should close down for a period of two out of the three months July to September, while curtailing 20% on the 1929 output for the remaining four months. Bolivian producers and the Billiton Co. were to curtail from June 1st 1930 by 20% of their 1929 output.

This recommendation, proposed by Mr.C.V.Stephens of the Malayan Tin Dredging Group, was not received with enthusiasm. In July, it was reported that only 30 companies in the F.M.S. had either adopted, or notified their intention to adopt, the stoppage plan. Banka and the F.M.S.Chinese producers generally ignored it. Bolivian producers and Billiton announced their curtailment policy of 25% and 20% respectively. However, the "holiday" was observed by a sufficient number of producers - 63 mines in the F.M.S. declared so in August - for a sharp reduction of tin ore output to be reported for a while. The decline in price was halted or slowed down in July and August. Later, it became apparent that in many cases, production had only been temporarily postponed. Bolivian shipments increased again

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Note 26. In April, the TPA estimated a decrease of 19% for the whole year.

in September and October, and in the latter month those from the F.M.S. followed suit. Price again fell, nearly reaching £100 at the end of the year.

V. The Result of "Voluntary Restriction".

23. The situation in 1930, as compared with 1929 was as follows:

Table VII.2

Tin Position 1929 and 1930.

| | 1929 | 1930 | + or - % of 1929 |
|---|---|---|---|
| World Production('000 tons) | 192.6 | 176.0 | - 8½ |
| Malaya Total .. .. .. | 69.4 | 64.0 | - 8 |
| FMS European .. .. | 41.6 | 39.1 | - 6 |
| FMS Chinese . .. .. | 25.5 | 23.0 | -10 |
| Nigeria .. .. .. .. | 10.7 | 8.6 | -20 |
| Bolivia .. .. .. .. | 46.3 | 38.1 | -18 |
| N.E.I. .. .. .. .. | 35.9 | 34.9 | - 3 |
| Banka .. .. .. .. | 21.3 | 21.6 | + 1 |
| Billiton .. .. .. | 13.2 | 12.0 | - 9 |
| Siam .. .. .. .. | 9.9 | 11.1 | +12 |
| Stocks ('000 long tons) .. | ? | ? | + >51 |
| Visible Supply(year end). | 27.9 | 42.1 | +51 |
| Speculative and Invisible | ? | ? | + ? |
| Price London (average £ per ton).. .. .. .. | 204 | 142 | -30 |

It is impossible to say how far the situation would have differed without the intervention of the T.P.A. and its voluntary restriction scheme. The price would have fallen much lower and stocks would have grown much larger. On the other hand, without the hope of earlier recovery engendered by the T.P.A.'s action, several high-cost producers would have gone out of production. The decline in production was largest in Nigeria and Bolivia, where probably high-cost producers had stopped work, and in the Eastern fields the decrease was least, and in some cases there were even increases. It is possible that with the co-operation of low-cost producers in the restriction scheme, the T.P.A. had prevented the price and stocks situations from being worse than they were in fact. One thing is clear, the T.P.A. had failed substantially to restrict output. With two months' holiday and 20% curtailment in 10 months, the aggregate output of their members should have been reduced by one third; and assuming that outside the T.P.A. all other producers produced as much as in 1929, the world output would have been reduced by at least 10%. As it was, with a net reduction in outsiders' output, world tin production only declined by 8½%. Evidently, some higher authority than that of the T.P.A. was needed.

24. Up till the middle of 1930, the Tin Producers' Association had represented a united front. Although the T.P.A. did not embrace all the tin mining interests - in fact not even all British interests - important groups of producers had been united and agreed on the broad policy. There was no open opposition to the Council's recommendation, though compliance was by no means universal. The two months' holiday proposal caused dissension in the organisation. Several important producers, chiefly spokesmen of low-cost mines, refused to accept restriction; they emphasised that

comprehensive statutory restriction on the basis of equality was the only alternative to unrestricted production.

## CHAPTER VIII

## THE COMPULSORY RESTRICTION OF OUTPUT 1931-1941 (I)

### (A) THE ESTABLISHMENT OF COMPULSORY RESTRICTION.

1. Towards the end of 1930, the T.P.A. and its Committees and Council continued to discuss the situation which deteriorated every day, and to plan its policy for the next year. At a Council meeting held in October, the Dutch representative made a proposal that the Governments of the various producing countries should themselves be asked to enforce and administer the control. Suggestions were made that if the Malayan and Nigerian Governments agreed to the scheme no difficulty would occur in securing the agreement of the Dutch and Bolivian Governments. This proposal was accepted and approaches were made to the British, Dutch and Bolivian Governments.

The consent of the latter two Governments was, as anticipated, obtained with little difficulty. As early as December 16th,1930, the Bolivian Government dictated a decree approving the project. Legislation in the case of the N.E.I. was considered unnecessary, as control of production and export was possible by Executive Orders. (See Note 1). For the British Colonial territories, the U.K.Government adopted the policy that they had to be satisfied regarding the opinion

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Note 1. See the text of the Agreements in I.L.O.: Inter-governmental Commodity Agreements (Montreal 1943) p.75: 1st. Tin Agreement 1931 Clause 20; also 2nd Agreement, 1933, Clause 16.

of the majority of producers before assenting to legislation.

I. Discussion in Malaya.

2. Much discussion took place in Malaya. The miners were asked to say whether they would accept statutory restriction. No detail of the scheme was, however, available, and the general feeling of the miners was that the discussion was conducted in a high-handed manner by the Senior Warden of Mines who was reported as saying "The miners' word was not final; the final word rested with H.M.'s Government." (See Note 2).

In general, established mines and low-cost mines in Malaya, opposed the scheme. The quota system, they said, would discriminate against them; production costs rose in a much more rapid ratio than did increasing restriction; and as quotas were said to be based on the 1929 exports, in the case of Malaya, allowance would have to be made for new mines starting in 1930, this would make older mines in Malaya suffer more drastic restrictions than elsewhere. (See Note 3). On the other hand, Chinese opinion was reported to be on the whole in favour of the scheme. Among European producers, with the subsequent intimation of the Cornish-Malayan Group that they would support the scheme, should the government

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Note 2. The Times of Malaya, January 7th 1931.

Note 3. See, e.g. Letter of Mr.F.E.Mair to the Financial Times of 6th January 1931; Chairman's speech at the Rambutan Ltd. annual meeting on the 20th January, 1931; also Gopeng Consolidated Ltd. annual meeting on 17th March, 1931, reported in the Mining Journal.

wish to give it a trial for twelve months and provided that a later date than January 1st be taken for making the scheme operative, the majority of opinion for the scheme appeared to be obtained. Late in January, the Chief Secretary of the F.M.S.Government declared in the Federal Council that the Government was satisfied that the bulk of local producers favoured the principle of tin restriction.

Shortly afterwards, the details of the scheme were announced, and were greeted with criticism by many miners outside the A.O. Group and its associates. The scheme as revealed provided for a cut of about 22% on the 1929 output, bringing down the Malayan permissible production to about 53,850, compared with 69,400 in 1929. The figures contained in the scheme appeared to have been agreed as early as in November 1930 at an international meeting held in London on official level. They were not made public for several months. Opposition was chiefly to the adoption of 1929 as the basis year without allowing for new production, which was much larger in Malaya than in other countries. In order not to exceed the quota allowed, it was estimated that the actual curtailment in Malaya would have to be about 32%.

The result of the vote taken in January was declared in March. 65% of the producers were returned as in favour of the scheme, with 12% against and 20% abstaining. The voting was said to be weighted on the individual outputs in 1929. In the opinion of some, restriction had been, in any case, a fait accompli since November 1930 when the F.M.S. High Commissioner took part in the meeting in London. The date of the introduction of the necessary legislation in the Federal Council was fixed for April. The Tin and Tin Ore Restriction Bill was duly passed by the Federal Council, with some unofficial members protesting and abstaining, mainly on the ground that the detail of the International Scheme was only communicated to them on the morning of the debate. (See Note 4.)

II Discussion in Nigeria.

3. The enactment for the restriction was easier in Nigeria. As in Malaya, the Legislative Council had an official majority. At the end of 1930, the small mines were informed that the Government were committed to the idea of restriction and that they must choose representatives to sit on a conference to recommend to the Lieutenant-Governor of the Northern Provinces the details of the scheme. The Conference included six representatives of the Mines and met several times in January and February. As the cost conditions in Nigeria were such that, without the scheme, and with current prices, the

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Note 4. Criticism in Malaya and Great Britain continued afterwards, but the only company which really challenged the authority of the Government was the Pahang Consolidated Ltd. Soon after the Tin and Tin Ore Restriction Act was passed, the company filed a suit against the State of Pahang on the ground that the enactment was a violation of their concession obtained from the Sultan in 1888, before the British occupation. The claim was that the company should not be subject to the provisions of the F.M.S. ordinance, or that if it came under th scheme, it should be indemnified by the Pahang State. The Court decision was against the company at all stages up to the Privy Council. The case was in the courts for well over a year.

exports would not have been much in excess of the allowed quota in any case, the principle of the scheme was more or less readily accepted. Local opinion was more preoccupied with the technical side of the restriction. As wet and dry seasons are clear-cut there, it was the practice of miners to strip the overburden in the wet season and pick up the wash in the dry season - this operation involved a whole year, and it was felt that export allowances fixed for periods shorter than a year would seriously interfere with the work of the mines. As an element of elasticity was introduced into the Ordinance regarding quarterly production, the main obstacle disappeared. The Tin (Production and Export Restriction) Ordinance, 1931, was enacted on April 1st, and as in the case of Malaya, was made retroactive from March 1st.

III Sales in anticipation of Restriction.

4. During these months of discussion and negotiation, uncertainty prevailed in the tin market. Several times rumours circulated that the international negotiations were broken down. On several occasions the TPA had to issue denials. Meanwhile, producers, in anticipation of restriction, took the opportunity to increase their output while they could: particularly after it was announced in February that restriction would start in March, instead of January as previously intended. In Malaya, the output in February showed a big increase over the same month in 1930, reversing the normal

seasonal decline. The increase was most conspicuous among the Chinese mines, but all European methods of production, except dredging, shared in the rise. In addition all hoarded stocks of ores were shipped from the country. (See Note 5). Shipments of ores from Banka and Billiton to the Straits Settlements rose about 30% over the January figures. Tin shipments from Nigeria also increased, chiefly from the London Tin Organisation. While visible stocks at Singapore and Penang declined a little from 15,500 tons to 14,700 tons, in U.K., U.S.A. and Europe, they rose by more than 2,500 tons. This increase in "visible supply" counteracted the effect of confident rumours regarding the impending compulsory restriction, and prevented a big rise in price. Average price in February was £118 per ton, compared with £116 in January. It rose again in March to £122 before resuming its downward course after the advent of the scheme was announced.

IV <u>The Establishment of the I.T.C.</u>

5. On the international level, the negotiations culminated in the meeting held at the Colonial Office in London at the end of February 1931, presided over by Sir John Campbell. (See Note 6). The final draft of the scheme

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<u>Note 5.</u> Monthly Bulletin relating to the FMS Mining Industry, February 1931.

<u>Note 6.</u> Sir John Campbell was economic and financial adviser to the U.K.Colonial Office from 1930 to 1942. He became the Chairman of the ITC during the whole period of its existence from 1931 to 1946. He also played a prominent part in the international control of rubber, sugar and tea. At this meeting the TPA was represented by Sir.P.Cunliffe Lister, John Howeson and two other members of its council, in the capacity of advisers.

was agreed and subsequently ratified by the contracting Governments. In April, the International Tin Committee held its first formal meeting in London. The Agreement had effect from March 1st and would remain in force for two years, subject to any subsequent disagreements regarding proposals for altering the quotas. Subsequently in August, the life of the agreement was extended unconditionally for two years, and provisionally extended up to August 1934.

The declared objective was to reduce world production of tin to 145,000 tons for 1931, representing a reduction of about 22% from the 1929 level, and thus reducing the size of the visible stocks. The assumption was that non-contracting producers would also reduce their output by 22%, but among the participating countries, the restriction from the "agreed 1929 output" was by no means uniform. The Dutch interests argued that their mines did not expand as much as the others, and therefore were entitled to preferential terms. In order to induce them to accept the agreement, it was agreed that Bolivia and Nigeria would impose heavier restriction on their 1929 figures. On this basis, the initial degrees of restriction were as follows:

| | % Restriction on 1929 "agreed" output. |
|---|---|
| Malaya | 22.23 |
| N.E.I. | 16.31 |
| Bolivia | 26.07 |
| Nigeria | 25.55 |

Almost immediately the scheme was announced it was realised that the 22% cut in total output was not sufficient to reduce the stocks and raise price. A further 'cut of not less than 20,000 tons a year' was agreed to at the next meeting of the I.T.C. at The Hague on May 16th, and the international quota was consequently reduced from 77.77% to 65.4% for the second half of the year.

On the basis of 1929 figures, the four participating countries had a combined output of about 84% of the world. In the circular issued after the 1st meeting of the I.T.C. on April 1st, it was mentioned that "The Committee are asking the Governments of Siam, Burma and certain other countries, the tin production of which is important, to adhere to the scheme". In May, the I.T.C. was able to announce that the Siamese Government had decided to join the scheme from September 1st, on the condition that their production should not exceed the output of 1929, or about 10,000 tons. This brought the total membership control of tin production to about 90% of the 1929 world output.

V. Successive Tin Control Agreements.

6. The control agreement was renewed several times. The successive quota agreements were as follows:

| Quota Agreement. | Duration. | Members | Notes |
|---|---|---|---|
| First | 2 years 1/3/31 to 1/3/33. extended to 31/8/34, actually ended 31/12/33. | (a)Bolivia (b)Malaya (c)N.E.I. (d)Nigeria. (e)Siam | Siam participated. |
| Second | 3 years 1/1/34 to 31/12/36. | (a) to (e) (f)F.Indo-China (g)B.Congo. (h)Portugal (i)Cornwall. | (f) to (i) joined in July 1934, retrospective from 1/1/34. (i) for 3 important producers only. |
| Third | 5 years 1/1/37 to 31/12/41. | (a) to (g) | - |
| Fourth | 5 years minimum 1/1/42 to 31/12/46. | (a) to (d) and (g). | - |

The text of all the four agreements can be found in the International Labour Organisation's publication entitled "Intergovernmental Commodity Agreements" (Montreal, 1943), pp.73-103. The official title of the first three agreements was "Agreement on the International Tin Control Scheme"; that of the last: "Agreement for the International Control of Production and Export of Tin". Reflecting the early stage of the experiment in control, the first agreement was rather in the form of a declaration of policy. It was imperfect as a control document. Clause 24 left to a sub-committee of three (British, Dutch and Bolivian) to determine various matters of procedure and machinery for the control. Subsequent agreements improved on the previous ones, and they incorporated several provisions which were found useful from experience. The fourth agreement was influenced by wartime considerations, and although it was the most comprehensive as an international treaty and control document, it contained several clauses which would not have been introduced in peace-time. There were supplementary agreements to the Second and Third Control Agreements, signed on the same dates, dealing with temporary or minor departures from the provision of the main agreements.

There was also an "Agreement on a Tin Research Scheme" signed on January 25th, 1938, for the purpose of scientific research with a view to increase tin consumption. The membership of this research agreement included all the countries participating in the Third Agreement. Previously, scientific research in tin uses was carried out by a Council of Research and Development, financed by the four Governments which were original members of the First Agreement from a special cess raised on tin exports (1st.Agt.Clause 23; 2nd Agt. Cl.22). The Council came into existence on January 1st, 1932, replacing a Tin Research and Industrial Applications Committee, which was formed by the T.P.A. and financed by voluntary contribution from the tin mining companies.

More important adjuncts to the Quota Agreements were the International Agreements for the Tin Pool schemes. (a) The First Tin Pool existed from August 1931 to the early months of 1934. (b) The agreement for the Second Pool was signed at The Hague on July 10th 1934, and was due to remain in force until the end of 1935, but in fact operated for a much shorter period. (c) Thirdly, the "Tin Buffer Stock Scheme Agreement" was concluded in London in June 1938 and the accounts were liquidated at the end of 1942. All the three Pools worked under the instructions of the I.T.C. The First Pool was, however, owned by the Anglo-Oriental Group and the Dutch Government. The members of the Second Pool were the four original restricting Governments. All participants in the Third Quota Agreement took part in the Third Pool.

(B) THE TIN QUOTA AGREEMENTS

I. General Principles of the Quota Agreements.

7. Although the successive tin quota agreements differed somewhat in detail, their general principles were the same:

(a) Each of the signatories (except those members on flat rate) was allotted a standard tonnage which would represent the maximum quantity of tin in ore which the country was allowed to export during a year if the quota allowed were 100%.

(b) The export quota (See Note 7) was fixed, common to all signatories in (a), for a period - usually every quarter - by the International Tin Committee (I.T.C.)

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Note 7. See next page.

(c) The I.T.C. was composed of the Delegations of member Governments, and was responsible for the administration of the scheme.

(d) International Restriction was done by reducing the quota percentages. Thus the degree of restriction varied inversely with the percentage of the quota. With the standard tonnages unchanged, which was normally the case within the life-time of an agreement, the ratio of permissible exports amongst the quota countries was kept constant, while the degree of restriction varied.

(e) Some member countries received special concessions in the form of a flat rate - i.e. a maximum tonnage of annual export. Sometimes a modified flat rate was in force; in such cases, the maximum tonnage applied when the quotas were below a certain percentage (say 65%); over and above this, the permissible exports for such privileged countries increased pari passu.

(f) Each member Government was responsible for allotting its quota among its individual producers, and for controlling production and export which were to be distributed as uniformly as possible throughout the year.

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Note 7. The term "quota" was used in the Rubber Agreement in a different sense. The basic quota in the Rubber Agreement corresponded to the standard tonnage in the Tin Agreement; and the exportable percentage in the former corresponded to the quota or quota release in the latter.

(g) There were provisions for the correction of excess or deficit of exports over or under the permissible quantities. In the first two agreements, there was no provision for minehead stocks, but production was to correspond as closely as possible throughout the year to export quota. In the last two agreements, minehead stocks were allowed up to 25% of the Standard Tonnage.

## II. The Standard Tonnages in Operation.

8. From the above principles, it follows that the total quantity of tin coming forward depended on the quota fixed by the International Tin Committee, whilst the relative shares of the individual producing countries depended on their standard tonnages (or flat-rate tonnages). Consequently, in the negotiations prior to a new agreement, the crucial point of contention was usually the figures of the standard.

The standard tonnages and flat rates in force throughout the period were as follows:

Table VIII.1.

(A) First Agreement 1931-1933.

| | Standard Tonnages | Relative Shares (Total of the Standard tonnages of the four original countries = 100). |
|---|---|---|
| Bolivia | 46,338 | 28.6 |
| Malaya | 69,366 | 42.8 |
| N.E.I. | 35,730 | 22.1 |
| Nigeria | 10,412 | 6.4 |
| | Flat Rate. | |
| Siam | 10,000 | (absolute maximum). |

(B) Second Agreement 1934-1936.

| | Standard Tonnages | Relative shares |
|---|---|---|
| Bolivia | 46,490 | 28.0 |
| Malaya | 71,940 | 43.4 |
| N.E.I. | 36,330 | 21.9 |
| Nigeria | 10,890 | 6.6 |

Flat Rates

| | | |
|---|---|---|
| Siam | 9,800 | ) maxima when quota $\leq 65\%$; |
| Cornwall | 1,700 | ) proportionately increased |
| | | ) when quota $> 65\%$ |
| Portugal | 650 | -do- except $81\frac{1}{4}\%$ instead of 65%. |
| Belgian Congo | (1934 = 4,500)<br>(1935 = 6,000)<br>(1936 = 7,000) | maxima when quoted $\leq 65\%$; above 65%, maxima raised by 25 tons for each 1% over 65%. |
| F.I.C. | (1934 = 1,700)<br>(1935 = 2,500)<br>(1936 = 3,000) | absolute maxima. |

(C) Third Agreement 1937-1941

| | Standard Tonnages | | | Relative shares |
|---|---|---|---|---|
| | 1937 | 1938+ | 1939-41 | |
| Bolivia | 45,951 | 41,843 | 46,027 | 26.6 |
| Malaya | 71,940 | 79,583 | 77,335 | 44.6 |
| N.E.I. | 36,330 | 40,189 | 39,055 | 22.5 |
| Nigeria | 10,890 | 11,639 | 10,890 | 6.3 |
| Siam * | 18,731 | 18,602 | 18,528 | |
| F.I.C.* | 3,000 | 2,835 | 3,000 | |
| B.Congo | 11,008 | 12,042 | (1939 = 13,035<br>(1940 = 14,035<br>(1941 = 15,035 | |

\+ Averages for 1938: Tonnages in force during the first half of 1938 were different from those in the second owing to variations in assay value.

* Siam had a minimum quota of 11,100 tons calculated at 72% assay.
F.I.C. had a minimum quota of 1,800 tons calculated on a true assay.

(D) Fourth Agreement 1942-1946.

| | Standard Tonnages | Relative Shares |
|---|---|---|
| Bolivia | 46,178 | 21.7 |
| Malaya | 95,474 | 45.0 |
| N.E.I. | 55,113 | 25.9 |
| Nigeria | 15,367 | 7.2 |
| B.Congo | 20,178 | |

III The Relative Shares among the Signatory Countries.

(a) The Original Four.

9. The four original countries as a whole had to make generous concessions in order to induce the new members to join the scheme. The most striking case is shown by comparing the figures for Nigeria and the Belgian Congo, in the second and fourth agreements. The 1933 output of the Belgian Congo was in fact only 2,225 tons. On the assumption that the international quota was 100% throughout the period, Siam's maximum exports were permitted to rise by 50% between the first and second agreements, and another 35% in the third. These two countries, however, together with Portugal, were subject to a certain degree of restriction in terms of productive capacity, since they had shown a tendency to "over-export" during the period of the agreements. On the other hand, there was absolutely no restriction in the cases of Cornwall and French Indo-China. The output of the latter has never reached the 1,800 tons guaranteed minimum in the third agreement.

10. The relative positions of the four original member countries are shown in the last columns of the table. Except in the case of Bolivia, the absolute standard tonnages were

slightly increased in successive agreements, but unequally. Without considering the Fourth Agreement, which was purely formal, the relative shares of the N.E.I. and Nigeria remained practically constant; that of Malaya was increased, almost entirely at the expense of Bolivia. This, however, does not mean that Bolivia suffered a greater degree of restriction than others, since the original basis of agreement for standard tonnages was arbitrarily chosen as the 1929 output, and 1929 was Bolivia's best year. On the other hand, the Malayan producers justifiably complained that the 70,000 tons figure assigned to them was grossly unfair, since Malayan productive capacity had greatly expanded after 1929. At each renewal of the scheme, there were protests from them and several times there were rumours that Malaya, though not the British Colonial Office, was seriously considering the termination of the agreement if better terms were not secured. It was not until 1938 that the Malayan standard tonnage was increased by any noticeable amount; and it was only during the War that it was raised to a level approaching the true capacity. Table VIII.2 shows the divergence between the standard tonnage and the capacity of Malaya.

Table VIII.2.

Divergence between the Standard Tonnages and Domestic Assessments of Malaya.

| | Quota Releases (annual averages.) | | "Standard Tonnages" | Domestic Assessments* (exc.Dulang ores) at the beginning of periods. | |
|---|---|---|---|---|---|
| | International | F.M.S. Domestic. | | active | dormant. |
| 1931 (9 months) | 69.50 | 63.33ϕ | 69,366 | 89,649 | n.p. |
| 1932 | 44.44 | 32.77 | " | n.p. | n.p. |
| 1933 | 33.33 | 24.33 | " | n.p. | n.p. |
| 1934 | 47.33 | 32.83 | 71,940 | n.p. | n.p. |
| 1935 | 58.75 | 42.35 | " | 96,900 | n.p. |
| 1936 | 92.50 | 67.00 | " | 97,763 | n.p. |
| 1937 | 107.50 | 77.75 | " | 98,489 | 3,041 |
| 1938 | 58.14 | 41.22 | 79,583 | 99,828 | 4,897 |
| 1939 | 76.25 | 53.00 | 77,335 | 101,430 | 3,447 |
| 1940 | 115.00 | 88.75 | " | 103,279 | 2,551 |
| 1941 | 130.00 | 100.00 | " | ? | ? |

Sources: Malayan Union Mines Dept.: Bulletin of Statistics relating to the Mining Industry, Vol.IV, 1946. and F.M.S.Mines Dept. Bulletin of Statistics (pre-war)

n.p. = not published.

ϕ = Domestic release in 1931 proved to be too high: result = over-exports.

* = It appears that the domestic assessment was somewhat over-estimated. In 1941, with no restriction, Malayan output was only about 83,000 tons. Even after allowing for some war-time difficulty and the time-lag necessary to produce at full capacity, the true capacity in 1941 at the ruling price was probably about 95,000 tons. This, however, does not invalidate the complaints of Malayan producers - See also Sir Lewis L.Fermor, op.cit. pp.133/4.

11. A minor discrepancy between the actual tonnage of metallic tin exported and the exportable tonnage could arise in certain cases, owing to the difference between the assumed assay value of the ores exported and the true assay value. From the Second Agreement onwards, assay value was taken at the true assay value (II:11(b); III:4: IV:2(g)) (See Note 8) In the cases of Malaya and Nigeria in the First Agreement, the tin contents of ores were taken as 72% and 70% respectively; and in the case of Siam throughout the period, 72% was the assumed assay value. Since the ores exported from all these countries usually had higher tin content than the assumed values, this amounted to a small allowance for extra exports.

12. Discussions and negotiations regarding the agreements were, of course, carried out in secret. Little is known of the hard bargaining, persuasion, and probably even pressure in some cases, which was necessary to secure adherence to the schemes.

Among the four original members, there were from the outset difficulties regarding the relative shares of each country in the world output. The complaints of the Malayan producers led to an assurance that the Malayan share in world

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Note 8: 2nd.Agreement, Clause 11(b); 3rd Agreement, Clause 14; 4th Agreement, Article 2(g). References to the text of the agreements will be expressed in this manner.

output would be maintained at about 37%, representing the status quo 1929 (I.10). Then the Dutch stood for preferential terms and concessions on quota were made to them by Bolivia and Nigeria. (See Note 9). Two years later, the Bolivian delegation requested that such concessions should be abolished in the Second Agreement. A compromise was reached by providing in a Supplementary Agreement (Clause 1) that for the year 1934, the concession would be continued but that it would be stopped afterwards. At the same time, the excesses of exports over the permissible amounts at the end of 1933, which were the largest in the case of Bolivia, were to be eliminated in 1934. To facilitate this adjustment, a special fixed quota of 6,626 tons was allotted to the four countries in equal monthly quantities (Cl.2 and 3.).

13. The 1937 boom gave rise to another strong demand for the readjustment of standard tonnages. During the year, the international quota averaged 107½%, which meant no restriction; but for Malaya, the domestic release was only about 78%. Most countries in the Agreement failed to export their full quotas: Bolivia's deficit amounted to over 24,000 tons, nearly half of her total permissible exports. Malaya and the N.E.I., on the other hand, exported in excess of their quotas. At an I.T.C. meeting in December, 1937, Bolivia, the

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Note 9. See paragraph 5 above.

Belgian Congo and F.I.C. agreed to surrender their arrears to the extent of 11,500 tons in favour of the N.E.I., Malaya and Nigeria in proportion to their standard tonnages. With trade recession in 1938 and the consequent sharp cut in quotas, this arrangement meant that the Malayan producers were no better off than before. Confronted with heavy unemployment, the F.M.S.Government decided, in March, to form a Pool of 2,900 tons in order to alleviate the hardship of quota reductions. It was understood that the Dutch Delegate on the I.T.C. objected to this measure on the grounds that it violated the agreement regarding minehead stocks, and that it would have an unfavourable effect on the market. Probably this led to a compromise by which the standard tonnages of both Malaya and the N.E.I. were increased by 7½% from the second half of 1938. (See Note 10). At the same time, Bolivia raised the question of the arrears from 1937 which, she argued, should be returned to the countries which had previously surrendered them. Another compromise was reached, by which 37½% of the respective tonnages surrendered by the Belgian Congo, Bolivia and F.I.C. were returned to them as permissible exports for the second half of 1938.

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Note 10. The Financial News of 25th June 1938 reported that Siam was being obstructive in the I.T.C.meeting - "and unnecessarily so too - by quibbling over the 7½% standard increase granted to Malaya and the N.E.I.". It added: "If this report is true, it is a pity that Siam, the spoilt child of the agreement, cannot be treated as such."

14. The usual long drawn-out negotiations were also understood to have taken place in 1941, at the end of which year a new agreement was due. The spread of the War made any tin control agreement unrealistic; nevertheless, it was thought advisable to keep a skeleton scheme in existence, and the Fourth Agreement was signed on September 9th 1942, with "retrospective enforcement" from the beginning of the year. The new standard tonnages reflected more closely the relative capacities of Malaya and the N.E.I. Figures of output during the war years suggest that Bolivia, Nigeria and the Belgian Congo were over-assessed by about 3,000 tons in each case.

(b) <u>The New Members.</u>

15. The original signatory countries were aware, from the start, of the danger of outside production being increased by the very fact that their own output was restricted. For the year 1929, outside production was estimated at about 24,700 tons, or 13% of the world figure. The First Agreement aimed at maintaining the ratio between the four signatories and the outsiders at 87:13 (I: 10 and 11), assuming, without stating why, that the latter would restrict their output proportionately. It was stated that the Governments of Siam and Burma would be invited to join the scheme. Burma did not accept the invitation on the grounds that, in her case, tin was produced jointly with wolfram and therefore export control was difficult. As has been related, Siam accepted the invitation and joined the

scheme from September 1931. Meanwhile, the I.T.C. took care to leave the door open to newcomers who would be admitted to the scheme "on such terms as the Committee may deem equitable". (II:4; III:23; IV:3(i))

At the World Monetary and Economic Conference organised by the League of Nations in London during June and July, 1933, the I.T.C. addressed a memorandum to the Conference which appointed a Sub-Committee to consider the tin control scheme. The Sub-Committee reporting that "the existing scheme of control is framed upon sound lines", urged other tin producing countries to join the agreement "on the basis of a flat rate quota; .... in determining the initial flat rate the basis of negotiations should normally be the level of production during the year 1932...." (See Note 11).Specially recommended were negotiations with the governments of South Africa, Australia, Belgium, U.K., China, France, India (for Burma), Japan, Mexico and Portugal. The Report was approved by the Conference; but South Africa and Australia almost immediately declined to join the scheme. The Belgian Congo was at first reported as unwilling to join; six months later, it transpired that all the producers in the Congo - except the largest tin company - were willing to come into the scheme provided their requirements of 17,000 tons of concentrates for 1934 and 1935 be conceded. In October, when the

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Note 11. L. of N.: Monetary and Economic Conference: Reports approved by the Conference on July 27th, 1933. (L.o.N.II.Econ. and Fin. 1933.II Spec.4) pp.28/29.

Second Agreement was announced, there were unofficial reports that Cornwall, F.I.C. and Portugal were likely to join the scheme; but when the new agreement came into force on January 1st,1934, negotiations were far from being concluded regarding the terms for any new members. It was not until July that the adherence of the Belgian Congo, F.I.C., Cornwall and Portugal were officially made known. All the terms proved to involve no restriction, and subsequent events indicated that only the Belgian Congo became a producer of importence. China, the only dangerous outsider, consistently turned down the invitation to accede.

16. Generous though the terms were for the new-comers, their participation had the effect of saving the international agreement for disintegration. It was provided in the Second Agreement (Clause 20) that if the estimated production of all countries outside the scheme had, for six consecutive months, exceeded 25% of the estimated world production, or 15,000 tons of metallic tin, whichever were the lesser amount, any member country was free to withdraw from the scheme at six months's notice. (See Note 12). The restriction of output imposed by the I.T.C. was so successful that, with increased consumption, price was raised from about £100 in March 1931 to about £230 towards the end of 1933. By this

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Note 12. This clause reappeared in subsequent agreements, with modified percentages and tonnages. III:22 - 15% or 12,500 tons. IV: 16(a) - 20% or 18,000 tons.

time, outside production was so much encouraged that its share in the world output rose to about 25%. In the last month of 1933, it stood at a half-year rate of 10,500 tons or 25.5% of the world output, and for the six months ending March 1st 1934, the percentage was about 24%. By the accession of new members, the possibility of the enforcement of Clause 20 was avoided.

It was, however, not quite certain that the parties to the Agreement would readily avail themselves of their right to withdraw from the scheme. In the beginning of 1938, when a recession occurred and quotas were drastically reduced, outside production became sufficiently large to justify a withdrawal; but no one, publicly at any rate, showed any inclination to use this right. It was possible that each member country found itself too weak to withdraw from the scheme during the recession. It was also possible that the members were attracted by the success of the scheme. However, it is interesting to note that during this period some readjustments in the standard tonnages took place, to pacify the discontents of the Malayan producers in particular.

17. A great difficulty was encountered in 1936 when negotiations took place for the Third Agreement. The Second Agreement was due to expire at the end of the year, unless an extension was "considered at least twelve months before the date" of expiry (II:2). Negotiations must have begun

in 1935 and have been proceeding for some time before it was made known that the I.T.C. held informal discussions in March 1936. These proceeded until May, when it was officially announced for the first time that the main stumbling block was the question of the Siamese standard tonnage. The I.T.C. apparently decided to end the flat rate privilege and to convert it into a standard tonnage. In June, a British and a Dutch representative were sent by the I.T.C. to Siam, with full powers to negotiate with the Siamese Government. It was understood that earlier Siam had been offered a quota of 15,000 tons, an offer which was turned down on the grounds that the Siamese production capacity was estimated at over 18,000 tons. The two I.T.C. delegates arrived in Bangkok in July with a "final" offer of a standard tonnage of 18,000 tons and a guaranteed minimum of 10,500 tons. After the Siamese counter-proposal for a standard tonnage of 20,000 tons and a minimum of 14,000 tons, negotiations broke down. Rumour after rumour of the cessation of the scheme, or of its renewal without Siamese participation, had the effect of depressing the market. Price fell from nearly £210 in May to £175 in July. Subsequently, however, negotiations were resumed in London; and on November 5th, the I.T.C. announced, without giving the details, that an agreement had been arrived at with Siam. The announcement took the tin market by surprise; price jumped on that day £10 to £225, and later to nearly £245. "(Tin) shares were being bid for almost indiscriminately and prices went ahead practically all round". (See Note 13). The agreement was finally signed at Brussels in January. Face was saved on both sides by specifying in the main agreement the Siamese standard tonnage and minimum export, as in the I.T.C.'s "final" offer, and by increasing them to 18,500 tons and 11,100 tons respectively, at 72% assay value, in a supplementary agreement signed on the same day. The concessions made to Siam were borne by Bolivia and the Belgian Congo. The I.T.C. was finally able to rid itself of the flat rate system; but minimum exports were still conceded to Siam and French Indo China.

IV The Outside Producers.

18. The relative expansion since 1929 in the tin production of the principal countries, both outside and inside the agreement, is shown in Table VIII.3. The years selected for comparison are:

| | | |
|---|---|---|
| 1933: | severest restriction | : quota 33.3% |
| 1937: | boom | : quota 107.5% |
| 1938: | recession | : quota 41.2% |
| 1941: | no restriction | : quota 130.0% |

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Note 13. Financial News: 6th November 1936.

Table VIII.3.

The Expansion of Tin Production in Privileged-Member and Non-Member Countries.

(Tonnages: '000 long tons)

| | 1929 | | 1933 | | 1937 | | 1938 | | 1941 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Q | I | Q | I | Q | I | Q | I | Q | I |
| Original Signatories | | | | | | | | | | |
| Bolivia | 46.3 | 100 | 14.7 | 32 | 25.0 | 54 | 25.4 | 55 | 42.1 | 90 |
| Malaya | 69.4 | 100 | 24.9 | 36 | 77.5 | 112 | 43.2 | 62 | 79.4 | 114 |
| N.E.I. | 35.9 | 100 | 14.4 | 40 | 39.8 | 111 | 21.0 | 59 | 51.0 | 142 |
| Nigeria | 10.7 | 100 | 3.8 | 35 | 10.5 | 98 | 7.3 | 68 | 12.0 | 112 |
| Total<br>% of World | 162.4<br>84 | 100<br>- | 57.8<br>64 | 36<br>- | 152.8<br>74 | 94<br>- | 96.9<br>66 | 60<br>- | 184.5<br>77 | 114<br>- |
| Privileged Signatories and Outsiders. | | | | | | | | | | |
| Siam | 9.9 | 100 | 10.3 | 104 | 16.5 | 167 | 13.5 | 136 | 15.2 | 154 |
| B.Congo | 1.0 | 100 | 2.2 | 220 | 8.9 | 890 | 7.3 | 730 | 16.2 | 1,620 |
| F.I.C. | 0.8 | 100 | 1.0 | 125 | 1.5 | 187 | 1.6 | 200 | 1.3 | 162 |
| Portugal | 0.4 | 100 | 0.4 | 100 | 1.2 | 300 | 0.8 | 200 | 1.5 | 375 |
| Cornwall | 3.3 | 100 | 1.5 | 45 | 2.0 | 61 | 2.0 | 61 | 1.5 | 45 |
| China | 6.8 | 100 | 8.1 | 119 | 10.5 | 154 | 11.2 | 165 | e 5.0 | 74 |
| Burma | 2.4 | 100 | 2.4 | 100 | 4.0 | 167 | 4.0 | 167 | e 5.0 | 208 |
| Australia | 2.2 | 100 | 2.8 | 127 | 3.6 | 164 | 3.6 | 164 | 3.5 | 159 |
| Argentine | (2tons) | (1) | (50tons) | (25) | 1.3 | (650) | 1.7 | (850) | 1.1 | (550) |
| Total (inc.others)<br>% of world | 30.3<br>16 | 100<br>- | 33.2<br>36 | 110<br>- | 55.4<br>26 | 183<br>- | 51.5<br>34 | 170<br>- | 54.5<br>23 | 180<br>- |

Sources: ITRDC and ITSG
Q = Quantity I = % of 1929 e = estimated.

The Table is on the whole self-explanatory. The following points are noteworthy :-

(1) The absence in the agreement of a clause by which the deficits of a member country's exports compared with the quotas could be automatically transferred to other signatories tended to keep down the aggregate output and share of the four original signatories. In 1937, Bolivia had a big deficit, but the producers in Malaya and N.E.I., who were working under some degree of restriction, were not allowed to produce Bolivia's arrears.

(2) The severity of the restriction on the four original countries is shown by the fact that as restriction was relaxed in 1937 and 1941, their aggregate share in the world output rose, and tended towards the 1929 percentage, which, however, was not reached.

(3) The inability of Cornwall to take advantage of favourable conditions contrasted with the new developing countries like the Belgian Congo, or even with Australia.

(4) The development of China's tin output was erratic, mainly due to political conditions.

V. <u>The I.T.C.</u>

19. The question of the standard tonnages was mainly a question of who would contribute what percentage of the cake. The size of the cake depended on the quota which was fixed from time to time. From another point of view, the question of the standard tonnages was principally the business of the

producers themselves; (See note 14); the question of the quotas was the issue between producers and consumers.

The responsibility of quota fixing was entrusted to the International Tin Committee (I.T.C.) composed of delegations representing the member governments. Each delegation consisted of not more than three members voting as a unit. Each territory could associate with its delegation not more than two advisers. (I:3,4 and 5; II:3,5 and 6; III: 4 and 5; IV: 10.

Officially, the delegates to the I.T.C. were all representatives of the contracting governments, but the Dutch and Bolivian delegates were, as the Mining Journal pointed out, "great personalities in the tin world, thoroughly conversant with the business in its various aspects." (See Note 15). Representatives of the British Government, on behalf of Malaya and Nigeria, were government officials; but it was a well known fact that the I.T.C. worked in close co-operation with the T.P.A. Besides, the "technical" advisers to the British Delegations, in the persons of Mr.John Howeson, and later of Mr.E.J.Byrne, were also "great personalities in the tin world".

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Note 14. From the point of view of the consumer, the standard tonnages have also some significance. When some producing countries are under-assessed while others are over-assessed, and the difference between the permissible and actual exports is not transferrable from one country to another, restriction is more severe than otherwise it would be.

Note 15. Mining Journal of April 16th 1932, p.255.

The representatives of Siam were truly Government officials: but it was well known that they referred all matters back to the Government (vide the negotiations in 1936).

The Committee had a Chairman and a Vice-Chairman appointed for such a period as it might think fit. (II:7; III:7; IV:11). (See Note 16). The Chairman was to convene the meetings at intervals not longer than three calendar months, and under certain circumstances decisions could be taken, without a meeting of the Committee by correspondence between the Chairman and all delegations entitled to vote. (III: 8(c); IV: 12(b)).

There was no provision for voting in the I.T.C. in the First Agreement. Presumably, decisions had to be unanimous. By the Second Agreement, unanimity among the four original countries was required for any changes in quotas (II:10(f)). In the Third Agreement, the unanimity principle was retained only for the provision regarding withdrawals from the scheme; in matters affecting quotas or any other question a majority system was used. The voting powers were distributed as follows:

| | |
|---|---|
| Malaya | 5 |
| Bolivia | 4 |
| N.E.I. | 4 |
| Nigeria | 2 |
| Siam | 2 |
| B.Congo | 2 |
| F.I.C. | 1 |
| Total | 20 |

Note 16. The Second Agreement specified that the Chairman and Vice-Chairman should not be chosen from the same Delegation but this provision was absent in subsequent agreements. By the 4th Agreement, the Chairman did not need to be a member of a delegation and could be paid.

Only those delegations representing territories whose export would be affected by the decision were entitled to vote for the fixation of the quota. In any case, a total of 11 votes in favour was necessary to carry a proposal (III:13). This meant that Malaya and Nigeria , plus the N.E.I. or Bolivia could always have the majority required. In the Fourth Agreement, all the members were given the same number of votes as in the Third; but with the absence of Siam and F.I.C., the aggregate was reduced to 17. A total of 10 votes was necessary for a decision, bar some exceptional cases. (IV:14).

20. In the earlier agreements, the decisions taken at the I.T.C. meetings were regarded as "recommendations" to the member governments, whose consent had to be obtained (e.g.; II :10(e)) This involved some delay and hampered the I.T.C. in taking quick decisive action. In practice, this delay proved to be unnecessary, since the signatory governments always accepted the decisions of the I.T.C. Subsequent agreements therefore treated the I.T.C. decisions as final and binding on the Governments. (See Note 17).

Quotas were to be changed as seldom as possible, at any rate not more often than every three months. The quota periods came to be taken as the calendar quarter-years. (I: 12 and 16; II: 10(d); III:2; IV:2(c)).

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Note 17. T.P.A. op.cit., p.10n.

The I.T.C. was assisted in its taks of controlling the working of the scheme, and of estimating world production and stocks by the obligations of member governments to telegraph the monthly figures of production and exports of their territory, and to furnish the average true tin assay of the concentrates exported, as well as other statistics (II :17; III :19; IV :7; also I :17). Further assistance was given by the Government of the Straits Settlement, who, through the Tin and Tin Ore (Disclosure of Smelters Stocks) Act of 1934, made it compulsory for the smelters to furnish "all the necessary information" regarding their stocks.

VI. Consumers' Representation on the I.T.C.

21. It was clear from the outset that the Scheme was exclusively a producers' arrangement, and that the I.T.C. represented purely producers' interests. This fact was not altered by the presence of British Government representatives on the I.T.C., although the U.K. was the second largest consuming country.

The Second Agreement provided in Clause 6 that the I.T.C. "may invite such other persons as it may think fit to attend its meetings in an advisory capacity". After the price of tin was successfully raised to above £200 per ton in 1933, demands for consumers' representation grew more insistent. At the World Monetary and Economic Conference in July 1933, the I.T.C.Chairman emphasised that his committee had been "consistently mindful of the interests of the consuming countries". (See Note 18). Mr.Cordell Hull, on behalf of the U.S.A.Government, expressing a "natural concern that any agreement should be equitable to the consuming countries", stressed that "international commodity agreements should contain provisions for the protection of the consuming countries". When the price soared to the £240 level in April, 1934, "there was certainly a widespread feeling among consumers everywhere, notably in the U.S. that the markets, and therefore at any rate the small consumers, were being starved with a view to forcing up prices to a higher level." (See Note 19). The U.S.House of Representatives Committee on Foreign Affairs appointed a sub-committee to investigate the means of making the U.S.A. as far as possible independent of the Tin Control. Although a proposal from financial quarters that the U.S.A. should acquire big stocks of tin "as war reserves" was negatived, the McReynolds Tin Bill was introduced in April 1935 to foster domestic mining and smelting industry under heavy protective duties.

22. The I.T.C., in the face of adverse criticisms, decided that a panel representing the chief consuming countries,

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Note 18. L.O.N.; op.cit., (1933. II. Spec.4) p.28.

Note 19. Mineral Industry 1934, p.561; also the "Economist" 18/8/34, p.30.

but without voting powers, should be invited to attend the Committee meetings and discuss "subjects directly concerning the interests of consumers". After a meeting of the I.T.C. in October 1934, it was made known that the U.S.A. and Great Britain would be represented as consuming countries in a consultative capacity.

The crucial points appeared to be (a) the selection of the consumers' representatives and (b) the interpretation of what questions affected consuming interests. Both issues depended entirely on the I.T.C. The Third Agreement provided for consumers' representation from "each of the two largest tin consuming countries....to tender advice to the Committee regarding world stocks and consumption (III:6; italics added). The Fourth Agreement specified that there were to be three consumers' representatives: one appointed by the U.S.A.Government, one "appointed as the direct representative "of U.S. tin consumers, and the other appointed to represent other tin consumers. (IV: 13)

In fact, the consumers' representatives invited to the I.T.C. under the Third Agreement were essentially the representatives of the Tin Plate Industry, whose concern was, as Knorr pointed out, rather for the stability of price than the cheapness of tin. The tinplate industry, confronted with high tin (and steel) price and low demand had just concluded an international cartel agreement in 1934 in order to raise the price of its own products. (See Note 20 on the next page).

The final consumers of tin were so diffused that no concerted action or representation was possible, except perhaps through the Government of such a purely consuming country as the U.S.A. In any case, the advices sought from the consumers' representatives were those regarding "stocks and consumption". The consumers' panel had no voting powers; and decisions of the I.T.C.could be taken without a meeting by correspondence between the Chairman and all delegations entitled to vote. Knorr interpreted this clause as a measure calculated to discuss the producers' policies without the presence of the consumers' representatives. (See Note 21).

VII The Policy of the I.T.C.

23. From its first formal meeting in April 1931, till the end of 1941 when de-facto control of exports stopped, the I.T.C.held about 80 meetings: an average of one every six weeks. The composition of the I.T.C.varied from time to time. Its main tasks concerned the fixation of quotas, the renewal of agreements and determination of the standard tonnages and the Buffer Pool. Except during the war years, when it was confined to London, the meeting place of the I.T.C. rotated among the four European capitals : London, The Hague, Brussels and Paris.

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Note 20. It is interesting to note that the Tinplate Cartel and the T.P.A., at some time or other, used the same address in London. This could not be mere coincidence.

Note 21. op.cit., p.153.

The only terms of reference for the I.T.C. policy, as far as published documents were concerned, were contained in the first clause or reamble of each agreement. The First Agreement declared that "the Scheme is intended to secure a fair and reasonable equilibrium between production and consumption with the view of preventing rapid and severe oscillations of price". In the Second Agreement, the phrase "and to ensure the absorption of surplus stock" was added; but curiously enough, the word "equilibrium" was replaced by "relation". "Equilibrium" is a vague enough concept: "relation" is much more so. The wording was recast in the Third Agreement, and the aim was stated as: "adjusting production to consumption, preventing rapid and severe oscillations of price and maintaining reasonable stocks". The preamble of the Fourth Agreement set out the object in these words: "keeping world stocks at a normal figure, adjusting in an orderly manner supply to demand, while at the same time making available all the tin that may be required and preventing rapid and severe oscillations of price."

The drafters of these documents, using the terms which they did in these declarations, would be severely taken to task, were they to submit an Economics thesis for a Ph.D. examination. "Adjusting production to consumption", or "supply to demand", and "making available all the tin that may be required", all beg the important question: at what price?

The nearest answer to this is the phrase "fair and reasonable equilibrium", which in its turn begs the questions of what is fair and reasonable? and in whose view? what criterion? If "severe and rapid price oscillations" were to be prevented, it is pertinent to ask whether the price was to be stablised around the top, mean, or minimum level of the price waves which would obtain under "free" conditions. Again, the assertions that "surplus stocks" were to be "absorbed", that stocks were to be kept at a "reasonable" or "normal" figure raise the issue of what is reasonable or normal. The normal stocks in the I.T.C.'s view transpired, in 1933/34 during the discussion of the buffer pool scheme, to be between 15,000 and 18,000 tons. Even the latter quantity only amounts to little more than two months consumption in the most depressed year 1932, or about five weeks' consumption at the 1929 rate. This was far below what is regarded as normal in the trade, i.e. between 2½ and 3 months absorption. A large stock is usually associated with low price: when stocks are said to be in "surplus", it implies that the price is too low in the eye of the speaker, and a reasonable stock corresponds to a reasonable price. The crux of the matter, therefore, involves the determination of price.

24. In the early stages of the control, the I.T.C. gave an impression that its function was to regulate the stock position, and that it was not concerned with prices. At the

World Economic and Monetary Conference in 1933, the Chairman of the I.T.C. asserted that:

> "It was no part of the Tin Committee's policy or the policy of the Governments they represent to force up the price unduly. The scheme does not attempt to regulate or control prices, except indirectly by adjusting production to demand, and by making a reasonable provision for the reduction of admittedly excessive stocks". (See Note 22).

Again in 1935, in an official telegram to the American Tin Trade Association, Sir John Campbell reiterated that "none of the governments represented (in the tin control plan) desired any undue price rise". This led a writer to ask what the word "undue" meant, and whether £230 at the beginning of 1935 was not considered high enough, since quotas were then cut and the stocks of the Tin Pool withheld from the market. (See Note 23).

Some light can be shed on the price policy of the I.T.C. by observing its actions and those of the International Tin Pools. In 1931, it was stated that the Pool would start sales of 5% per month of its holding, at the monthly average price of £150, which was subsequently raised

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Note 22. L.O.N. (1933 : II : Spec. 4) p.28.

Note 23. E.Baliol Scot in Mineral Industry 1935.

to £165 after sterling left gold. That was in the depth of the depression when price was around £115 per ton. This declaration seemed to suggest that the minimum level which could be regarded as "reasonable" was £165; but such a unilateral declaration was not binding, and in September 1932 when the average price rose to £153, the Pool Committee revised its pronouncement and promised not to release tin until the quotas reached 40%. Moreover, the presence of a subsidiary invisible pool (See Note 24) suggested that £165 as a minimum fair price was not seriously contemplated. In May 1932, suggestions were put forward to make the base level £200 per ton. It is known that the Tin Pool begun in 1931 was first liquidated in the last months of 1933, whilst the international quota stood at only 33 1/3%; but the average price was then around £225. From these facts, the rumours within the trade that the I.T.C. aimed at a price between £225 and £230 were justified. They were confirmed in August 1934 when, as the price showed a falling trend towards £225, the I.T.C. decided to cancel the increase, previously made, in production quotas as from the third quarter of the year. A little earlier, a new Pool agreement had been signed, whose activities, since it could not come into operation until April 1935, were carried on in the meantime by a private pool run by "members of the advisory Committee to the I.T.C. or companies of which some

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Note 24. See paragraph 33 in Ch.IX below.

of them were directors or shareholders." (See Note 25). The reason officially given for the setting up of this pool was "the urgent importance of preventing wide fluctuations in tin prices". (See Note 26). However, the average range of price fluctuations in the three months ending June 30th, before the pool was established, was only about £7 - a low index of fluctuations for tin, compared with £8 in the same period of 1935, and £15 (at times : buyers only, no sellers) in July 1935, while the Pool was functioning. The truth appears to be, rather, that the I.T.C. was trying hard to maintain price around £220-230, at any rate above £200.

It was in the summer and autumn of 1936 only that price was allowed to remain below £200. With 10% heavier deliveries than in 1935, the quota was allowed to remain at a percentage much higher than the 1935 average. There was no pool activity, owing to the criticisms of the last Pool and the adverse effect of the "Pepper Scandal" in 1935, but the main cause of the fall in price appeared to be the anticipation of a breakdown of the International Control, due to the difficulties over the negotiations with Siam. However, from the middle of November 1936 to October 1937, price was allowed to rise to an average of £230, with a peak over £300 in March. Quotas were lowered from 105% to 100% in the

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Note 25. Answer given in the House of Commons by Sir Philip Cunliffe-Lister, the Colonial Secretary, in February 1935.

Note 26. ibid. - also T.P.A. : op.cit., p.13.

first quarter of 1937, thereafter they were maintained at 110%. There was no reason why, in the interest of price stabilisation, they could not have been raised still further. In the first quarter of 1938, when deliveries showed a small decline, and price started to fall below £200, the quota was reduced sharply to 70%, and further to 45% (including 10% frozen in the Buffer Stock) in the second half of the year. In June, after price had fallen to nearly £150, a new tin buffer stock scheme, under negotiation for several months, was concluded and opened for signature.

The Tin Buffer Stock scheme of 1938 stated in clear terms for the first time the price policy of the I.T.C. Clause 19 provided that "the present objective of the scheme.... is to maintain a price per ton ranging between £200 and £230 sterling. This price range may be varied by a resolution of the I.T.C....." The objective was realised from October 1938 onwards, and price successfully maintained between the bounds, until the outbreak of war in Europe altered the whole situation.

The conclusion is irresistible that, from 1933 at any rate, the policy of the I.T.C. had consistently been to maintain price level at a level above £200 - possibly around £225; although it may be true that in 1931 and 1932 the I.T.C. had a purely defensive policy of preventing price falling below £150. Contrary to the published objectives, price stabilisation, normality of stocks and other considerations appear to have been subsidiary to this policy.

Table VIII.4.

Quotas, Price, Visible Stocks and Deliveries.

| I Quota-Period. | | II Quota % (excl. Buffer Stocks etc. Quotas. | III Date of Decision | IV Monthly Average Price £ | V* Total Visible Stocks '000 tons. | VI Monthly Deliveries (Av. of 3 previous months) '000 tons | VII Vis. Stocks i/t of months of deliveries. |
|---|---|---|---|---|---|---|---|
| | | | | at date III. | | | |
| **First Agreement** | | | | | | | |
| 1931 | Mar.-May | 77.7 | Feb. 1931 | 118 | 53.0 | 10.0 | 5.3 |
| | June-Dec. | 65.4 | May 1931 | 104 | 58.1 | 10.0 | 5.8 |
| 1932 | Jan.-May | 56.2 | Nov. 1931 | 133 | 59.2 | 8.4 | 7.0 |
| | June | 43.8 | Apr. 1932 | 109 | 60.8 | 6.7 | 9.0 |
| | July-Dec. | 33.3 | June 1932 | 115 | 58.2 | 6.7 | 8.5 |
| 1933 | Jan.-June | 33.3 | June 1932 | 115 | 58.2 | 6.9 | 8.5 |
| | July-Dec. | 33.3 | Apr. 1933 | 158 | 50.2 | 7.1 | 7.1 |
| **Second Agreement** | | | | | | | |
| 1934 | I | 40 | Oct. 1933 | 224 | 34.1 | 9.7 | 3.5 |
| | IIa | 40 | Apr. 1934 | 240 | 22.9 | 7.6 | 3.0 |
| | II | 50 | May 1934 | 234 | 21.6 | 8.0 | 2.7 |
| | III | 50 | May 1934 | 234 | 21.6 | 8.0 | 2.7 |
| | IV | 40 | Aug. 1934 | 228 | 19.7 | 7.2 | 2.7 |
| 1935 | I | 40 | Nov. 1934 | 229 | 19.2 | 7.0 | 2.7 |
| | II | 45 | Mar. 1935 | 216 | 22.9 | 7.6 | 3.0 |
| | IIIa | 50 | June 1935 | 228 | 17.5 | 8.1 | 2.2 |
| | IIIb | 65 | Aug. 1935 | 223 | 17.9 | 8.3 | 2.1 |
| | IVa | 65 | Sept. 1935 | 224 | 16.2 | 8.8 | 1.9 |
| | III | 70 | Oct. 1935 | 227 | 17.4 | 9.2 | 1.9 |
| | IV | 80 | Oct. 1935 | 227 | 17.4 | 9.2 | 1.9 |
| 1936 | I | 90 | Dec. 1935 | 220 | 17.3 | 9.4 | 1.8 |
| | II | 85 | Feb. 1936 | 207 | 19.3 | 9.5 | 2.0 |
| | III | 90 | June 1936 | 183 | 18.6 | 10.5 | 1.7 |
| | IVa | 90 | Sept. 1936 | 195 | 18.4 | 9.6 | 1.9 |
| | IV | 105 | Nov. 1936 | 231 | 25.3 | 8.8 | 2.8 |

For Third Agreement see next page.

Table VIII.4 contd.

| I Quota-Period | | II Quota % (excl. Buffer Stock etc. Quotas. | III Date of Decision. | IV Monthly Average Price £ at date III. | V* Total Visible Stocks '000 tons. at date III. | VI Monthly Deliveries. (Av.of 3 previous months) '000 tons | VII Vis. Stocks i/t of months of deliveries. |
|---|---|---|---|---|---|---|---|
| Third Agreement | | | | | | | |
| 1937 | I | 100 | Jan. 1937 | 229 | 29.1 | 10.2 | 2.8 |
| | II | 110 | Mar. 1937 | 283 | 27.5 | 12.0 | 2.3 |
| | III | 110 | June 1937 | 250 | 27.1 | 11.0 | 2.4 |
| | IV | 110 | Sept.1937 | 259 | 26.1 | 11.5 | 2.2 |
| 1938 | I | 70 | Dec. 1937 | 190 | 29.4 | 10.7 | 2.8 |
| | II | 55 | Feb. 1938 | 183 | 29.0 | 9.2 | 3.2 |
| | III | 35 | June 1938 | 178 | 35.8 | 8.3 | 4.3 |
| | IV | 35 | Sept.1938 | 194 | 40.5 | 6.8 | 6.0 |
| 1939 | I | 35 | Nov. 1938 | 214 | 37.1 | 7.8 | 4.7 |
| | II | 40 | Mar. 1939 | 216 | 37.8 | 7.4 | 5.1 |
| | IIIa | 45 | June 1939 | 228 | 30.0 | 9.4 | 3.2 |
| | IIIb | 60 | 3/9/1939 | 229 | 31.2 | 9.1 | 3.4 |
| | IIIc | 80 | 12/9/1939 | 229 | 31.2 | 9.1 | 3.4 |
| | IIId | 100 | )late Sept. | 229 | 31.2 | 9.1 | 3.4 |
| | IVa | 60 | )1939. | 229 | 31.2 | 9.1 | 3.4 |
| | III | 120 | Oct. 1939 | 230 | 38.2 | 9.6 | 4.0 |
| | IV | 100 | Nov. 1939 | 230 | 38.0 | 10.4 | 3.6 |
| 1940 | Ia | 60 | Nov. 1939 | 230 | 38.0 | 10.4 | 3.6 |
| | I | 120 | Dec. 1939 | 249 | 38.3 | 13.0 | 2.9 |
| | II | 80 | Feb. 1940 | 243 | 33.1 | 15.8 | 2.1 |
| | IIIa | 100 | May 1940 | 264 | 30.6 | 14.3 | 2.1 |
| | III+IV | 130 | July 1940 | 266 | | | |
| 1941 | I+II | 130 | July 1940 | 266 | | | |
| | III+IV | 130 | Mar. 1941 | 270 | | | |

Sources: V : American Metal Market : Metal Statistics (N.Y.)
VI: W.H.Gurtsen (London)

Note The Roman figures in Column I denote calendar quarter-years. For some quarters, the quotas were fixed several times. Earlier fixations of quotas are marked by letters a, b, c,.... after the quarter. The final fixations are indicated by the absence of such letters.

* Total visible stocks include stocks in the Tin Pools. For composition of the visible stocks, see.Ch.II, para.17.

VIII <u>Quota Fixing</u>.

25. The method by which the I.T.C. fixed the quotas has not been revealed to the public. An examination of Table VIII.4, however, suggests some broad principles which appear to have been adopted by the Committee. The data on which the calculation was based appeared to be the following: (a) price, (b) deliveries, (c) stocks, (d) outside production, (e) members' actual output, (f) consumers' reaction, (g) general conditions, (h) producers' reaction.

(a) <u>Price</u>: The current price was considered against the background of the trend. If it was too low, quotas were cut, and conversely. Compare Columns II and IV. In the earlier stages of restriction, small cuts were made tentatively; but after January 1934, whenever the monthly average price showed a tendency to drop below £200, the quota was cut sharply. This was particularly true of 1938.

(b) <u>Deliveries</u>: In general, quota changes followed the changes in deliveries. (Column VI) As deliveries slackened, quotas were cut. Large divergences between deliveries and consumption were probably taken into account, and consumption estimated from the activity of tinplate mills in the U.S.A., and South Wales, the extent of tinplate orders, automobile production, building activity, etc.

(c) <u>Stocks</u> : Stocks influenced quotas in an inverse manner. A low level of stocks was a signal for the quotas to be raised. Whether the I.T.C. had access to the statistics of invisible stocks is not known. Judged from the visible stock figures (Column V), the I.T.C. appeared in the early stages to set itself the task of reducing them from 60,000 tons to a figure below 30,000 tons. If, however, the average monthly deliveries were below 10,000 tons, quotas were kept below 50%, even though visible stocks were low enough, in absolute terms, and even though price was above £200. This was most conspicuous in 1934 and the first half of 1935. From 1934 onwards, the total visible stocks were deliberately maintained below the rate of three months' deliveries (Column VII) and at times even below two months' rate.

(d) Outside production: Having estimated the figure of consumption (or deliveries) and the desired changes in the stocks according to the price criterion, the tonnage of total current production required to meet these conditions was obtained. This figure, less the estimated outside production, gave the total release for the participating countries. Outside production was a fairly predictable quantity, though it was not a fixed one - generally it followed a rising trend - since errors of estimates tended to cancel each other out. The biggest item which probably worried the I.T.C. was the shipments from China which showed an erratic course varying between the annual rates of 6,000 tons and 11,000 tons.

(e) Members' actual output: The total desired release for the participating countries arrived at in (d) was then converted into a percentage of the standard tonnages - expressed in monthly or quarterly rates. Some complications arose out of the flat-rate privilege enjoyed by some members, whose current exports, however, could be estimated from the statistics they were obliged to supply to the I.T.C. In the Second Agreement, when many of the flat-rates were made equivalent to 65% of the standard tonnages, an increase in quotas above 65% entailed a bigger increase in the permissible exports. This probably influenced the action of the I.T.C. Notice the attempts to fix quotas at 65% and no more for the third and fourth quarters of 1935, which subsequently had to be given up. Another source of complications in the calculation of quotas was the discrepancy between actual exports and permissible exports, since arrears and excesses were carried over and adjusted in the next quota period. Bolivia, for instance, presented some difficulties on this point, especially during the Chaco War when the adjustments required assumed very large magnitudes.

(f) Consumers' reaction : Although consumers' representation on the I.T.C. was ineffective, not to speak of its absence in the earlier stages, the reactions of industrial consumers, especially in America, had some influence upon the quota determination. This consideration probably led the I.T.C. to maintain quotas above 85% in 1936, in spite of price falling to nearly £175.

(g) General Conditions: The normal decisions of the I.T.C. were somewhat modified by the general course of events. At the outbreak of the war in Europe, quotas were swiftly and repeatedly raised at short intervals, and visible stocks were allowed to rise to amounts equivalent to about 4 months' intake. Again, from July 1940, the contract of bulk purchase between the U.S.Government and the I.T.C. was responsible for the maintenance of a 130% quota, but as stocks grew, the I.T.C. did not hesitate to reduce quotas drastically, even in wartime. Note the considerable lowering of the quota for period IVa in 1939, and the second quarter of 1940.

(h) Producers' Reaction: Not least among the considerations influencing the I.T.C.'s action was the producers' reaction to drastic cuts in quotas. These were decidedly unpopular , since cost of production was raised as output was restricted. An absolute restriction by two thirds of the standard tonnages (about $\frac{3}{4}$ in the case of Malaya) was possible in 1932 and 1933 when price was at a record low level and stocks similarly high. In the recession of 1938, the quota released to the market was 35%, but producers were allowed to ship an extra 10% for the Buffer Stock. The I.T.C. had probably learned the psychological fact that successive and frequent cuts in quotas were unpopular: consequently there was a tendency to make swift cuts and to maintain low quotas while this was possible, in order to be able to grant small, yet welcome, increases later. Large increases in quotas were seldom made, except in wartime. The quota for the third quarter of 1935 was revised twice. That for the second quarter of 1937 was increased within a week. That for the third quarter of 1939, at the outbreak of war, was revised four times. These facts could be cited in favour of the I.T.C. on the grounds that their decisions were not rigidly clung to, when events had clearly proved that the release was not sufficient, but on the other hand, they showed the I.T.C.'s reluctance to raise quotas. For the third quarters of 1935 and 1939, the final revisions of quotas were made retrospective, after the periods had elasped. Such increases in permissible exports were therefore too late to be effective, as was shown by the large under-exports.

IX Drastic Action during the Slump.

26. Of special interest was the attempt made by the I.T.C. to raise the price of tin from £102 in April 1932 to £230 towards the end of 1933. Despite the successive quota cuts from the original 77.7% to 43.8%, the visible stocks accumulated to 60,900 tons at the end of January 1932 - an increase of 8,500 tons within 10 months. In June 1932 they stood at 58,200 tons, equivalent to 8½ months' deliveries. The International Tin Pool reached the maximum holding of 21,000 tons only five months after it was begun. This was exclusive of subsidiary pools and other private holdings. There seemed, at the time, to be no end to the depression which had then lasted for more than two years.

27. Opinions of some sections of Bolivian interests had been from the outset that the initial restriction was not sufficiently drastic, and that at least a cut of 50% in world output was called for. Low cost producers in Malaya were against excessive cuts. As late as in November 1931, the Chief Secretary informed the F.M.S.Federal Council that the Government "was definitely opposed to any international cut if it involved a local cut of more than the present 60%" That this view was not shared by the Colonial Office in London was demonstrated by the subsequent lowerings of quotas. Nevertheless, compromises were sought and the changes in quotas were gradual. In the Spring of 1932, the view of many Malayan producers became more reconciled to drastic actions. The Mining Journal of April 30th (p.291) observed that "Today there are many who say that...to give results which are worth while there should be a complete shut-down, say for three months, in all the countries comprising the restriction body." In the beginning of May, the Council of the T.P.A. in London discussed a proposal made by Mr.E.J.Byrne (See Note 27) to the effect that all signatories were to cease production during June and July and that the quota for the next ten months was to be 40%; an alternative was offered by which production

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Note 27. E.J.Byrne : Chairman of the Kamunting Tin Dredging Ltd., executive committee of the T.P.A.; replaced Mr.Howeson in 1935 as adviser to the British Delegation on the I.T.C.

could proceed in the three months June-August at $13^{1}/3$%, and the liquidation of the Tin Pool was made conditional on the price reaching £200 for a month. The total stoppage of mining met with stiff opposition, particularly among Chinese mines. In May, the Malayan Chamber of Mines (in London) recommended a modified version of the Byrne proposal. Instead of a stoppage of production, there was to be a stoppage of export for two months and for the next ten months export quota was to be at the rate of 40%; thus production could be continuously carried on at $33^{1}/3$% for the whole year. This was endorsed by the Nigerian Chamber of Mines. After an I.T.C. meeting at the Hague later in the month, it was made known that "the practicability of this scheme is now under consideration by the participating Governments; and subject thereto the Committee are unanimously of opinion that it should be accepted and introduced at the earliest possible date." The main difficulty seemed to be with Malaya - since the International $33^{1}/3$% production quota meant a 25% domestic quota. A Chinese spokesman asserted that 25% production would kill the gravel pump mines. The F.M.S.Warden of Mines, however, urging them to accept the scheme, said that "it is feared that people holding large quantities of tin will go bankrupt and be forced to sell", that the miners were in fact between "the devil of 25% quota and the deep sea of price down to anything around £50 a ton". He added that "the I.T.C. would not tolerate" any production in excess of the quota. Earlier in

May, the F.M.S.Government had declared that they would buy up and hold quantities of Chinese mines' output until the price reached £200. Final decision in any case rested with the Governments. Late in June, the I.T.C.announced the acceptance of the modified Byrne scheme, with the export embargo starting on July 1st for two months. In September, the International Pool authority pledged itself not to release any tin until the quotas were raised to 40%. Siam did not participate in the Byrne scheme, nor in the Tin Pool, although her tin export in 1932 was about one quarter lower than in the previous year.

28. The effect of the embargo was to increase the stock of tin concentrates in producing countries in July and August. Total visible stocks rose from 58,200 tons at the end of June only to 60,400 tons at the end of July, and started to decline to 57,400 in August. The increase in July was mainly accounted for by the increase in the Straits Settlements carry-over. Elsewhere the visible stocks started to decline, gradually at first, but more rapidly in August, and especially after the end of the year. World deliveries reached the lowest level of 4,820 tons in July, compared with 9,382 tons a year earlier. After the New Year, and particularly after March 1933, they rose by leaps and bounds, because of the revival of the industrial demand in the U.S.A. At the end of the Byrne Scheme, they reached 9,400 tons and

were still increasing. In April 1933, when the I.T.C. met to decide upon the quota for the next period, visible stocks amounted to about 50,000 tons, and monthly deliveries were at the rate of 8,000 tons. Price rose about 50% to £158. The I.T.C. decided to continue the 33.3% quota for the next six months. Meanwhile, as a result of the drastic restriction in export, consumers continued to draw upon their invisible stocks to meet the increase in consumption. The combined effect was to keep deliveries at a lower level than actual consumption. Visible stocks, however, steadily declined and were below 30,000 tons in December 1933 for the first time since 1929. Price was thus pushed up past £200 in May,1933, and in November it reached £230.

29. Various opinions have been advanced regarding the justice and fairness of the measures taken by the I.T.C. in 1932 and 1933. Advocates of the scheme justified the I.T.C.'s action by the argument that, since the metal was not wanted by the consumers - witness low price and high stocks - it was only right that exports be stopped and then severely restricted. Those against it argued that the £200 aimed at was more than twice the costsof a big proportion of producers, and that without the control, production would have been concentrated on the low-cost mines. To this argument, the low cost producers would subscribe and their complaints were that they had to suffer severe restrictions whilst others

outside the scheme benefitted without being subject to any control. Whatever we think of the initial justification of the Byrne Scheme, its special justification disappeared in 1934 when price had reached a high level and stocks became "normal" in the sense of the trade. The continuance of the Control Scheme in 1934 at a low quota of 45% could not be justified in the face of the revival in the industrial demand.

# CHAPTER IX

## THE COMPULSORY RESTRICTION OF OUTPUT 1931-1941.(II)

## (C) THE TIN POOLS

30. The general tendency of the promoters of the Tin Quota Scheme to hold stocks for speculative purposes, together with the encouraging examples of the Bandoeng Pool and other price support measures of the past, made it natural for the I.T.C. and its advisers to consider the withholding from the market of tin already produced as an important adjunct to the scheme for preventing the metal being produced. Not only did this promise higher price and profit, but it proved to be a useful means of avoiding too drastic quota cuts during a trade recession, without releasing much tin to the market.

### I. The Terms of the Pool Agreements.

31. The terms of the Pool Agreements (See Note 1) were as follows:

(a) Membership: The First Pool was formed by British and Dutch groups with the knowledge and approval of the four governments which were signatories to the Quota Greement. The Second Pool operated in two parts: (i) Between June 1934 and February 1935, it was formed by British and Dutch interests, (ii) the second part which operated actually according to the Agreement of July 10th, 1934, came into operation in April 1935

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Note 1. References to the text of the Agreements will be abbreviated in this manner : PII: 12 and 13 for Second Pool Agreement Clauses 12 and 13. The First Agreement took the form of a communique of the ITC dated 21/9/31.

and existed for five months: it comprised the four Governments which were original members of the Quota Scheme. (PII :1) The Third Pool membership comprised, in addition, the Governments of the Belgian Congo, French Indo-China and Siam.

(b) Executive: All the three Pools worked in close co-operation with, and under the guidance of the ITC (PII :3 and 16; PIII : 15 and 17). The executive of the First Pool was not specified; but the Chairman of the I.T.C. was ex-officio the Pool Chairman. In the Second Pool, this clause was repeated; but the executive was a "Buffer Stock Committee" of four members, each nominated by a Delegation on the I.T.C., and working on the principle of unanimity (PII :2). In the Third Pool, the Executive Body included a manager and an assistant manager appointed by an I.T.C. sub-committee. Neither the manager nor the assistant manager might be persons "at present" connected with tin mining, marketing or distribution. The Executive Body carried out the I.T.C's instructions, communicated to it by the I.T.C.Chairman. (PIII: 13,14,16, also 19 and 20).

(c) Intake of the Pool. It was not specified how the tin was to be acquired by the First Pool. Contribution to the Second and Third Pools took the form of a special "buffer quota" allocated among the members in proportion to their Standard Tonnages. (PII: 6; PIII: 5). The Buffer quota was fixed at 5% in the Second Pool - making 8,282 tons of metal in all to be delivered not later than the end of 1934 (PII :7). For the

Third Pool, the initial amount was to be 10,000 tons, which the I.T.C.could increase, and did in fact increase, to a maximum of 15,000. Half of the initial tonnage was to be contributed not later than October 31st 1938 (four months' time), the balance within the next three months. For these purposes, the I.T.C. was empowered to fix quotas as they wished. Any difference between the permissible contribution and actual contribution of any member could be offered, pro rata, to other members. (PIII : 3,4,7 and 8).

Contribution could be in the form of (i) actual tin at local smelters or warehouses, or (ii) London Metal Exchange Warrants, or (iii) warrants on any warehouse or documents of title approved by the Executive. (PII : 8 to 10; PIII : 9 to 11).

(d) Sales from the Pool : Sales from the First Pool were governed by a schedule with a sliding scale according to price - which was subsequently revised. By the Second Pool Agreement, the Committee was empowered to sell and employ the proceeds for the purchase of tin; there was some specification regarding the disposal of the stocks on the expiry of the Scheme (PII; 11, 13 to 15). From the Third Pool, sales were authorised at the price of £230, or as the I.T.C. thought fit. Tin remaining in the Pool after the expiry of the Agreement was to be liquidated within 2 months at a price not below £200, or if that was not possible, within 12 months in equal monthly quantities (PIII : 19, 20 and 24(b).

(e) Secrecy: Although not specified in the First or Second Pool Agreements, secrecy was strictly observed. This was provided for in PIII : 18, according to which, even the communication of information to the I.T.C. was forbidden without the express sanction of the I.T.C.Chairman.

All contributions to the Pools, however, were included in the "Visible Supply".

(f) Objective: The object of the First Pool was avowedly to raise price. The subsequent Pools officially named "Buffer Stocks"had as their "definite objective the maintaining of the price of tin between certain limits" (See Note 2). These limits were defined in the Third Pool Agreement as between £200 and £230, which could be altered by the I.T.C.

II The First Pool 1931 - 1934.

32. In June 1931, the price of tin reached £100 per ton and total visible stocks rose to nearly 59,000 tons. After an I.T.C.meeting at The Hague in August, it was announced that an International Tin Pool had been formed earlier in the month. The tin to be acquired by the I.T.P. would be released only if and when the average price of spot tin on the London Metal Exchange during any completed calendar month exceeded £150 per ton, and the initial monthly release would be 5% of the Pool's holding.

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Note 2: T.P.A.: op.cit., p.13; also PIII :2)

In December 1931, the minimum selling price was increased to £165 for a monthly release of 5%, £176 for 10% etc., with rising percentage as price advanced. In September 1932 it became known that, owing to the more drastic restriction of output in the Byrne's scheme, the I.T.P.Committee had committed themselves not to release any tin until production quotas were raised to 40% of the standard tonnages.

33. It is not quite clear whether the "tin to be acquired by the I.T.P." was acquired from previous private or government stocks, and merely immobilised by the Pool, as in the Bandoeng Agreement, or whether the I.T.P.Committee bought tin in the open market. Originally it was suggested that it should be financed by the signatory governments; but most of the administrations at that time were too hampered by budget deficits to accept the suggestion. The working of the Pool was kept a secret; the membership of its Committee was not revealed. Compared with it, the Bandoeng arrangement was quite a well publicised affair. According to Knorr, the I.T.P. of 1931 "was essentially a private syndicate...it seems that it was financed by private subscription, and that the A.O. corporation and the Government of the N.E.I. were the most important members." (See Note 3). From September 1931 to July 1933, Pool communiques regularly revealed the total holdings of the Pool; but there was no intimation of how, when and

Note 3. op.cit., p.119. See also Mr.V.A.Lowinger's address to miners in Malaya in 1935 reported in Mining Journal of 17th August, 1935, p.611.

how much was subsequently sold. The size of the Pool, as published, was increased from 5,000 tons in September 1931 gradually to 21,000 tons in January 1932, at which level it remained, probably until sales began late in 1933. A contemporary writer reported that "the general impression appears to exist that the Pool consists in part of an accumulation of tin in Government hands, and in part of the former private pool holdings; but whether the Pool itself purchased metal on the market, which was added to the previous stock, the writer is in no position to judge." (See Note 4.).

There were reports that a second large Pool was formed late in June 1932, which started to enter and support the markets in August. The new pool was probably private speculative dealing, with strong financial backing, since as much as 1,000 tons was reported to have been bought within a day, and altogether something like 7,000 tons was thought to have been taken up by it at the end of August. Some observers commented that the objective of the "New Pool" was to alarm consumers into re-stocking in view of anticipated improvement of trade in the U.S.A., and the heavy restriction of production. Whatever the case, the effect of the "New Pool" activities was different from the "International Pool", since

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Note 4. Mineral Industry 1931, p.534. See also Eastham, loc.cit., p.22; Mining Journal 27/1/34, p.54; Wollnik, op.cit., p.184; Schut, op.cit., p.49 n.2.

the tin hoarded by the "New Pool" did not appear in the visible stocks. As the "International Pool" stocks were unchanged, while the "New Pool" accumulated, the visible stocks as published tended to be reduced.

The amount of tin frozen was thus much in excess of the 21,000 tons which the Pool communiques announced as being maintained intact throughout the year 1932.

III. The Second Pool 1934 - 1935.

34. In April 1933, while there were still large quantities of tin in the First Pool, a proposal for a new Pool to be shared by the Governments of Malaya, Bolivia and the N.E.I. was put forward by the Dutch representative at the meeting of tin producers in Singapore. Soon afterwards, a more ambitious scheme to take up practically the whole "visible supply" was suggested. These early proposals, however, were not adopted. Early in October of the same year, when the new Quota Agreement was signed, discussion of a Second Pool Agreement restarted. It was now proposed to effect a closer link between the Quota Agreement and the Pool Agreement by including all the restricting governments in the Pool. It was also proposed that the contribution to the Pool must come from the quota fixed by the I.T.C. In December, the discussions reached the stage of definite proposals, and a memorandum was circulated to the restricting parties. It claimed that without a surplus or "margin" pool, the tin market would be at the mercy of speculators who, by

purchasing or bidding up the current smelter output for a few days, could raise the price to an undesirable level, even if production and consumption were balanced. In such an event, the I.T.C. would be compelled to increase the quota at the risk of putting production out of balance with consumption. Moreover, the time-lag between the decision to increase the quota and the availability of the increased supplies would provoke oscillations in price. On the other hand, a surplus stock outside the I.T.C. would afford no means of preventing oscillations in price.

35. Soon after its publication, the memorandum encountered critical comments, not only from the usual opposition spokesmen of the Gopeng-Tronoh group, but from the smelting industry (The Straits Trading Co.), the Chinese miners in Malaya, a number of Nigerian miners, the London Metal Exchange and some of the Eastern merchant houses. Inside the T.P.A., the controversy led to the resignation of Sir George Maxwell (See Note 5) from the Chairmanship. The general feeling against the scheme was engendered by the realisation that the tin industry was now to be under permanent control, even at a time when the industry had taken a prosperous turn. The specific argument against the Buffer Stock scheme was that it was unnecessary since the alleged fear of speculative cornering could be easily prevented by giving the I.T.C. emergency powers to increase and lower the quota at short notice. On the whole,

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Note 5. Sir William George Maxwell was Chief Secretary to the F.M.S. Government 1920-26.

among British opinions, the support for the scheme came mostly from London, where the T.P.A.Executive Committee expressed great enthusiasm and the members unanimously voted in its favour after the resignation of the Chairman. The Malayan Chamber of Mines (in London) also approved the scheme by a bare majority in the absence of the Chairman and some other members of the Council. In the middle of February,1934, the Nigerian Chamber of Mines (also in London) followed suit by supporting the scheme on the understanding that its acceptance did not commit the industry to any further prolongation of the Restriction scheme. In Malaya, the F.M.S. Chamber of Mines in January rejected the proposal by nine votes to four, unanimously adding a rider that it was undesirable for the I.T.C. to be connected with Pool operations. Stronger criticisms were voiced at the Chamber's meeting in May. Among the Chinese miners in Malaya, those in the State of Perak unanimously opposed the Pool on the grounds that it was unnecessary, contrary to their interests and that it would destroy free marketing of tin. This unanimous protest was repeated in March, and again in April, accompanied by a request for a policy of de-control and an immediate increase in quota. The Federal Council was also critical of the scheme. In Nigeria, outside the L.T.C. group, criticism was reported to be unanimous.

36. In the face of all opposition, the British Colonial Office and the I.T.C. stood firm. At the I.T.C. meeting in

April 1934, it was made known that the Buffer Stock proposal was adopted "in the interest of consumers, and therefore in the long-term interest of producers." Price immediately rose from £236 to £244. There was some delay in the formal commencement of the Pool, reportedly owing to the hesitation of the Bolivian Delegate because of American pressure. The text of the Pool Agreement, however, was settled at the next I.T.C. meeting in June. The Executive Committee of the Pool was then nominated. Apart from the Chairman, the other three members were the leaders of the Three Big producing groups; I.T.C., Patino and Billiton. Commenting on the Pool, the Mining Journal (9/6/34, p.429) observed "The bulk of this supply (8,252 tons) will presumably be available as soon as the Pool is formally in existence, as the N.E.I., Bolivia, and Nigeria are believed to have tin, either in metal or in process, presently available." The agreement was finally signed on July 10th.

In order to encourage small miners to participate in the Buffer Pool, the Governments of Malaya and Nigeria were prepared to make advances of money to the contributors to the Pool; the money was treated as a loan and the miners thus financed had to pay interest on it.

37. Very little was known of the actual operation of the Pool. Reading contemporary reports, one is under the impression that the Pool agreement came into force in July 1934. (See Note 6)

Note 6. See even the I.L.O. publication in 1943: op.cit., p.80.

that the tin accumulated as at December 1934 fell short of the specified tonnage by about 1,000 tons, owing to Bolivian procrastination (See Note 7), that it reached 7,476 tons in February 1935 (See Note 8), and 8,400 tons in March (See Note 9) and that the Pool "was wound up at the end of 1935, with profit to the contributory countries" (See Note 10).

Evidently, there is much more to be learned about the operation of this 1934-35 Pool Agreement. It was well known in the trade that there was some private accumulation of tin, estimated at between 5,000 and 6,000 tons at the end of February 1935. The first public hint that the Pool did not function exactly according to the agreement came out in the House of Commons' debate on the "Pepper, Shellac and Tin Crisis" early in 1935. Sir P.Cunliffe Lister who was then Colonial Secretary, was asked whether the private Tin Pool comprised any members of the Advisory Committee of the I.T.C., or any companies of which they were directors or shareholders. The reply was in the affirmative (See Note 11). Further, the Colonial Secretary said that the Dutch Government were the major proprietors of the mines owning perhaps four-fifths of the shares (of the private Tin Pool). (See Note 12).

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Note 7. Mineral Industry, 1934, p.556.

Note 8. I.T.C.Communique in February 1935.

Note 9. The Colonial Secretary: in the Tin Debate in the House of Commons on March 7th, 1935.

Note 10. F.M.S.Mines Department: Report for 1935.

Note 11. House of Commons Debate on February 27th 1935.

Note 12. ibid. on March 7th 1935.

In the Annex II to the Report of the League of Nations Committee for the Study of the Problem of Raw Materials in 1937 (L.O.N. 1937: II.B.7., p.57, paragraph 6) it was stated that there was "one unofficial (Pool) which operated in 1934, and one official which covered about 8 months in 1935".

According to the T.P.A., in a pamphlet justifying the activities of the I.T.C. and Pool Authorities, published during the recent war, the official Pool set up by the Agreement signed in July 1934 did not come into existence until April 1935.

> "And meanwhile, in view of the urgent importance of preventing wide fluctuations in tin prices, a Producers' Stock was formed by British and Dutch interests on June 19th, 1934. This stock....continued in existence until the middle of February 1935."

Notice the date of commencement of the so-called "Producers' Stocks",which preceded by about twenty days the date of signature of the Agreement. Of the Official Buffer Stock, the T.P.A. pamphlet related that it

> "came into operation on April 12th, 1935; but in June 1935, Bolivia terminated the agreement as from December of that year. Owing to this decision no more purchases of tin were made after June 14th, by which time the total quantity of tin purchased by the Buffer Stock only amounted to 1,240 tons. After this date the Buffer Stock could have no great influence on the market. Its liquidation was completed on September 27th, 1935."

K.E.Knorr (op.cit., p.144) accepting the T.P.A.'s version, observed that the operation of the official Pool was delayed "apparently because of Bolivia's procrastination in ratifying the buffer agreement".

38. The point regarding Bolivia is quite plausible, considering that Bolivia was deeply involved at the time in the Chaco War, and that a revolution and a change of Government took place in 1934. Bolivian shipments in the second half of the year exceeded the ordinary (i.e. ex-Buffer Stock) permissible quantity by something like 670 tons; but this was entirely used to compensate the much larger arrears which had accumulated since the beginning of the year. At the end of the fourth quarter, the deficits still amounted to about 350 tons. In all probability, Bolivia did not contribute at all to whatever Pool there was in 1934. The 5% Buffer Stock quotas for Malaya, Nigeria and the N.E.I., if entirely fulfilled, would total 7,800 tons at the end of December 1934, which is a figure compatible with the 7,476 tons announced in the I.T.C. communique of February 1935.

This is, however, far from saying that the official Buffer Pool did not come into existence until April 1935. The producers in Malaya, Nigeria and the N.E.I. did produce 5% extra quota for the Buffer Stock according to the Agreement; and in the first two countries, small producers had to pay interests on the loan advanced by the Governments for their contribution. The understanding was that the tin thus contributed would be handled by the Committee created according to Clause 2 of the Pool Agreement. To change the status of the "official" buffer pool into a "producers' stock" called for an announcement, and perhaps an apology, from the I.T.C.

or the contracting governments. The T.P.A.'s version of events is further contradicted by the statement of the British Colonial Secretary in the House of Commons. The latter said on March 7th, 1935, that "the only Government pool was one of about 8,400 tons", but according to the T.P.A. pamphlet, March was the month just after the liquidation of the "producers' stock", and just before the operation of the official Buffer Pool. If the fact were as the T.P.A. alleged it to be, it would have been simpler for the Colonial Secretary to deny that there was any stock under the I.T.C. control at the time. It is true that 5% contribution to the Buffer Stock from April to June 1935 amounted to about 1,240 tons, as revealed by the T.P.A.; but it is by no means clear h how and when the "producers' stock" was liquidated.

It is highly probable that the Dutch and British interests had already accumulated some tin even before the acceptance of the Pool Agreement in the Summer of 1934. As the formal agreement came into being, the "producers' stock" existed side by side with the official Buffer Stock, which did not include Bolivia's contribution. Bolivia probably started contributing to the Buffer Stock in the second quarter of 1935, which gives some justification to the T.P.A. allegation that the official Pool began in April. It is also quite possible that the tin accumulated in 1934 changed hands sometime between February and April 1935. It was during this time that visible stocks rose by nearly 4,000 tons. It was also during this period that leading personalities in the tin industry and in the circle close to the I.T.C. were involved in an inquiry into the Shellac, Pepper and Tin scandal in the United Kingdom.

39. Whatever the facts regarding the operation of the Tin Pool or Pools, there is no doubt that the creation of the Pool in 1934 could not have been worse timed. Price was above £220 per ton; industrial activity was increasing; while the quota fixed by the I.T.C. was only between 40% and 50% of the Standard Tonnages. Visible stocks had fallen to little above 20,000 tons, or about 10 weeks' deliveries. In terms of real consumption, the stocks were much smaller: it was during this time that consumers drew heavily on their own stocks.

40. It is true that tin price was more stable in 1934 than in any year within memory (apart from the war period when it was under control). The T.P.A. pamphlet gave full credit to the "Buffer Stock" scheme for this. The average price of the year was, however, £230. Stability at this level was unpopular with the consumer who resorted to substitutes, as already related. Whether or not the stability was due to the Buffer Stock operation is another question. In 1935, in the course of which the Buffer Stocks were in being for several months, price fluctuations were very frequent and

violent. (See Note 13). The T.P.A. pamphlet exonerated the I.T.C. and Pool authority from these fluctuations, arguing that "no more purchases of tin were made after June 14th.... After this date the Buffer Stock could have no great influence on the market". After the purchases for the Buffer Stock had ceased, owing to the termination of the agreement, it would be fair to say that the Buffer Stock was not responsible for downward fluctuations of price, but the fluctuations in the Summer and Autumn of 1935 followed in fact an upward trend. It was revealed that the stocks were not completely exhausted until September 27th. In July, when the price rose to £245 per ton, buyers could find no sellers in the London Metal Exchange. Moreover a stock which did not exceed 8,500 tons at any time could not possibly smooth out fluctuations.

IV The 1938 Tin Pool.

41. The Pool activities in 1934/1935 were a complete failure. Addressing a meeting in Malaya towards the end of July 1935, Mr.V.A.Lowinger, head of the Malay States Agency in London, and one of the Delegates of Malaya on the I.T.C.,

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Note 13. See Ch.I, paragraph 21 and Table I.8. On p14 of the T.P.A. pamphlet cited, it was claimed that 1935 was a year of stable price. The argument rested on the smallness of the price ranges. This is misleading, as has been shown in Ch.1.

said: "I think I am on safe ground in saying that the difficulties of its (the Pool's) operation are such that there will be no general demand for its prolongation: it had proved in practice an undesirable complication of an otherwise elastic scheme." (See Note 14.). During the next year, the I.T.C. was rather on the defensive and was preoccupied with the question of renewing the quota agreement. When the new Agreement appeared it contained no reference to any pool activity.

From the beginning of 1937, with big increases in industrial demand, price rose; and although quotas were greatly raised, the slow increase in exports was sufficient to prevent neither a high level of price nor violent price oscillations. During the 21 market days ending March 15th, 1937, price rose £82 from £229 to £311; during the 38 market days from September 15th, price fell £83 from £264 to £181. At Geneva, the League of Nations Committee for the Study of the Problem of Raw Materials, meeting during the course of the year, "received a number of criticisms of regulation schemes", and invited two of its members "specially competent in this sphere" to prepare a memorandum for the improvement of existing schemes. The memorandum recommended

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Note 14. Reuter Report quoted in the Mining Journal of 3/8/35, p.576; also ibid. 17/8/35, p.611.

the setting up of a buffer stock in which consumers and producers would co-operate. (See Note 15).

42. Inside the tin industry, the idea that the I.T.C. should resume Buffer Stock measures came again from the Dutch. Early in June 1937, at the annual general meeting of the Billiton Co., the President of the Company urged the I.T.C. to build up stocks in order to stabilise price, because the changing of quotas worked too slowly. In the same month, Mr.J. van den Broek, also of Billiton Co., a member of the I.T.C. addressed the American Tin Trade Association and declared that the I.T.C. was not able to stabilise price by merely altering the quota, because it could not forecast future consumption sufficiently accurately. "Ample supplies", he added,"were necessary because with too small stocks speculative elements could manipulate the market." The matter was understood to have been discussed at the I.T.C. meetings,and a sub-committee on Price Oscillations was set up quite early in the year with the purpose of formulating a scheme. Towards the end of 1937, the final draft of a Buffer Stock Agreement was before the I.T.C., despite strong opposition from some Delegates. The proposal was then accepted and submitted to the various governments, but not published until the following March.

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Note 15. L.O.N. II. 1937. II.B.7. pp.17-20 and 56-62.

43. Storms of protest began to break in Malaya. In February 1938, when Captain O.Lyttelton, Chairman of the London Tin Corporation,visited the colony, he had to deny reports that he was an envoy of the Buffer Pool proposers, adding that the L.T.C. would not participate in a private buffer pool in any circumstances. When the I.T.C. decided to cut the first quarter's quota to 70% and that of the second to 55%, Reuter reported that the feeling among the miners in Malaya was rising, because this meant the dismissal of 20,000 coolies. Late in March, when the outline of the Buffer Stock scheme was published (dated December 9th 1937) with the clause specifying that any country which did not produce its quota for the Buffer Stock would lose its rights to withdraw from the quota agreement under Article 22, "Malaya was torn by differences of opinion". (See Note 16). Objection was based particularly on this clause; but discussions led to a more general protest against the iniquity of the Malayan standard tonnage. Demands for Malaya's withdrawal from the quota agreement were voiced by smelting as well as mining interests. The Chairman of the Selangor Miners Association, a Chinese, who led the request for a revision of standard tonnages supported by all important groups including the A.O.M.C., stated that in this claim, Malaya had a

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Note 16. Sir Lewis L.Fermor: op.cit., p.130.

precedent in the action of the N.E.I. Government two years earlier for a revision of their Basic Quota for rubber to meet their native problem. In April, the request was officially made through the High Commissioner to the Colonial Office.

Two months later some concessions were obtained for Malaya. The clause regarding the surrender of the rights to withdraw from the scheme was deleted from the draft agreement. The standard tonnage of Malaya (as well as that of the N.E.I.) was raised by 7½%. A referendum took place among tin producers regarding the Buffer Stock agreement. Voting was according to the assessment of each producer's output. Sir Lewis Leigh Fermor wrote of this referendum "The Europeans in favour of the scheme were mainly those connected with groups that had substantial tin interests outside Malaya, whilst the Europeans who were opposed to the scheme were those whose tin interests were mainly in Malaya. The Chinese community who were at first uncertain, eventually voted heavily in favour of the Buffer Stock scheme, and this, added to the vote of those Europeans who favoured the scheme, was sufficient to give a substantial majority in favour, with the result that Malaya agreed to the scheme." (See Note 17). Those Chinese who

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<u>Note 17</u>. op.cit., p.130; see also the Times of 1/6/38; Mining Journal 16/7/38, p.685.

voted in favour of the scheme did so on the understanding that production for the buffer stock would constitute an additional quota of production over and above the 55% then operative. When the I.T.C. decided in June to reduce the quota for the third quarter to 35% + 10% buffer stock quota, there was an outcry of protest. In any case, the British Colonial Office had earlier made known its support for the scheme. (See Note 18). In June, the Government refused a request made in the House of Commons for an inquiry into the question of tin pools. The controversy regarding this 1938 Buffer Stock Scheme caused the resignation of Mr.A.G.G.Glenister, one of the Malayan Delegates, from the I.T.C. owing to his dissatisfaction with Malaya's treatment in the negotiations and disregard of his advice.

44. Outside Malaya, opposition to the Buffer Stock Scheme was not strong among tin producers. The Dutch were its initiators and Bolivian interests supported it. The Nigerian Chamber of Mines delcared itself generally in favour of its object. The new members of the I.T.C., Belgian Congo and French Indo-China, were satisfied with their liberal standard tonnages. Siam alone presented some domestic constitutional difficulties. At the I.T.C.meeting

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Note 18. In an article published on March 26th,1938,entitled "Won't you walk into my parlour?", theMining Journal observed that the Buffer Stock Scheme was a fait accompli, and that the secrecy in which its preparation had been evolved, militated against any independent examination of the position.

in London on June 20th, 1938, when the agreement was opened for signature, the Siamese delegates were not present. However, Siam's signature was obtained towards the end of October, after a Committee set up in Bangkok to study the subject had reported in its favour. The signature was still subject to the ratification by the Siamese Government, which was not forthcoming until June next year. Meanwhile, the scheme entered into operation from the third quarter of 1938, and it was the first Pool scheme to include all the members of the Tin Quota Agreement.

45. The Executive of the Buffer Stock was appointed and took office in August 1938. The Pool in fact proved a useful measure for the producers: it avoided the necessity of a quota cut to 35% during the second half of 1938 and the first quarter of 1939. Mines were allowed an extra 10% quota for the Pool, which was withheld from the market. The original plan was for the Pool to accumulate up to 10,000 tons of tin; subsequently, at the end of 1938, the holding was increased to 15,000 tons, the maximum amount specified in the Agreement. It was to be all delivered by the end of April 1939. In fact, the total tonnage was a little more than 15,500 tons, and the delivery was not completed until the beginning of July 1939.

46. The internal arrangement in Malaya for the contribution to the Pool was that special buffer stock certificates of production were issued to holders of ordinary quota

certificates in proportion to their assessments. (See Note 19). These buffer stock production certificates were made transferrable only among those producers who were registered as producing for the Buffer Stock. Producers were divided into three classes:

(a) Those who contributed 25 piculs of tin or more per month and who did not want financial help were to pay customs duties on the ruling price, and other fees and cess as in ordinary export.

(b) Those who contributed 25 piculs of tin or more, but who wanted financial help, were given an advance through the smelters of a sum of $50 per picul, less customs duties and other charges. The advance carried an interest of 4½%.

(c) Smaller producers' contribution was purchased outright by the Government through smelting companies at the Singapore price ruling, but not more than $100 per picul.

The rent of storage in the Straits amounted to about 2 Straits cents per ton of tin per day.

47. The Report and Accounts of the Buffer Stock Executive (See Note 20) revealed that the total purchases and sales

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Note 19. See paragraph 57 below.

Note 20. See the Summary in T.P.A. : op.cit. pp.32-34.

carried out amounted to slightly over 66,400 tons - about 4 times the "maximum tonnage holding". When it took office, the Executive had no cash with which to operate in the Market. It was considered advisable to convert the Straits tin in the stock into Standard Tin by means of daily sales of small quantities in the East against similar purchases of standard in London. A result of this was that "the Executive's control over the London Market began to take increasing effect". In the Spring of 1939, in order to "conserve the functions of the London Market for hedging operations by the smelters at a reasonable cost", the Executive commenced lending tin to the London Metal Exchange at a rate of £2:10:0d. per ton.

Actual sales of cash tin began in June 1939, when the price reached the upper limit of £230 per ton. The Executive "was then able to suggest to the I.T.C.that a moderate increase in the quota for the third quarter of 1939 could safely be made". The "moderate increase" referred to was from 40% to 45%, which was, however, successively increased to 100% and 120% after the outbreak of the war.

In September, the rate of sales from the stock was accelerated: by the middle of the month, the stock was exhausted. "This had been anticipated by the Executive and arrangements were made temporarily to replenish the holdings by the re-purchase of Standard Tin previously sold forward." During the first period of wartime price control in the U.K. -

at £230 between October and December 1939 - the Buffer Stock provided 25 tons of tin a day for some weeks for disposal on the London Metal Exchange. Across the Atlantic, the New York price shot up to ¢75 per lb. in September, and varied between ¢49 and ¢56 for the rest of the year - which was much higher than its London counterpart. When the British Government lifted the price control in December, tin price rose to £272.

As far as is known, no operations in the market were undertaken by the Buffer Stock after the end of 1940, but the liquidation of the account was not completed until the end of the Third Quota Agreement in December 1942.

The average net price realised after charging auditing interest and London overhead, was slightly under £231. This represented a good profit for the contributors, since, during the period of stock accumulation, price varied between £188 and £225 - averaging about £205. The total sum of money available for distribution amounted to nearly £3,550,000. This included profits made by jobbing operations and interests earned on the cash balances, as well as the sale profit. The gross turnover was nearly £9,300,000. Overhead expenses for the 3½ years were a little under £19,000.

48. The advocates of the Buffer Stock Scheme readily claimed merits for its operation in 1938 and 1939:

"For the greater part of the Agreement's existence, there had been acute industrial depression in the world, particularly in the U.S.A. There can be no doubt whatever that without control, the drastic fall in consumption would have resulted finally in wiping out most of the Tin mining industry throughout the world and in permanent extinction of a large proportion of the plant. Neither Bolivia, Nigeria nor the Belgian Congo would have been in a position to supply the relatively large quantities of tin they are now producing in order to make good, as far as possible, during this critical period the shortage of supplies arising from the loss of the Tinfields in the Far East". (T.P.A.: op.cit. p.24).

Again "At the outbreak of hostilities....the existence of the Buffer or Stability Stocks....saved the Tin Industry from a dangerous situation. Had it not been in existence, the stampede of buyers for spot tin which did occur in New York and which sent the price there completely out of line with the London Market would have been far worse and prices would have sky-rocketed. The London Market was kept steady by the release of immediate supplies from the Buffer Stock, until the maximum price was fixed by the Government. This was only made possible by the foresight of the Executive in retaining all the Buffer Stock proceeds in London, instead of having a large proportion of them available in Malaya or New York, as was at one time suggested." (ibid., p.32).

The conclusion was that "it must be obvious to all rational people that immediately world supplies of tin once more became normal, an essential adjunct to the I.T.C. must be a Tin Buffer Stock".

49. It is true that the existence of a large stock of tin did help to steady the market when there was a sudden large increase in demand, but the market which was saved in this case was the London Market alone, and only for one or two months. If the London Market was saved from the panic at the outbreak of war by the presence of the stock of tin,

it is not clear why there should not also be a stock of tin in New York to save the situation there. It might be argued that London was the more important tin market; but given war conditions and the risks of transport at sea, the most important market then was in New York, nearest the biggest consumers. It might also be argued that with the limited size of the Pool, if it were to be divided between two places, neither market would have been saved. The answer is that the size ought to have been much larger, if the I.T.C. were to claim correct foresight and wisdom. Had the I.T.C. fixed buffer stock quotas at 30% or even 20%, instead of 10%, while export quota remained only 35% throughout the period, there would have been enough tin to "stabilise" both markets, and there would have been much more tin left over to help the war effort for a longer period than a few months.

The claim that without the Control Scheme, a large proportion of the Bolivian, Nigerian and Congo mines would have been "wiped out" by the 1938 depression was clearly exaggerated For one thing, the recession was of short duration and it was interrupted by the rearmament activity. For another, it has been shown in Chapter VI, that the mining capacity even in high-cost conditions is not easily wiped out by a fall of price, say, to £100, since if the prime cost is still covered by the price, the mine will continue to produce. The very fact that the average release authorised in 1938 was about 50%, clearly shows that compulsion had to be used in order to restrict output. It seems indeed strange to say that eight years' output restriction saved the mining capacity from being destroyed. Restriction involved the ban of new entry and left part of the existing plant idle for a long period, which, in some cases, meant complete scrapping. Tin mining labour had also been considerably reduced in number.

The claim that the I.T.C.'s policy was intended to benefit the United Nations' war effort is clearly contradicted by the fact that in September 1939, the I.T.C. had to make three decisions before the quota was raised to 100% for the third quarter of 1939. The fourth quarter release was only 60% at first. Again, the initial quota for the first quarter of 1940 was 60%. All these percentages were subsequently revised upwards owing to pressure from consumers and Governments. As late as in February 1940, the quota for the second quarter was fixed at only 80%.

It remains obscure why the Executive Body of the Buffer Stock was maintained in existence from 1940 to 1942, during which period no activity was recorded, except the supervision of a cash balance of about £2,500,000.

## (D) OTHER SUPPLEMENTARY ACTIVITIES OF THE I.T.C.

50. As has been mentioned earlier, there were also agreements among the four original signatories, and subsequently among all the signatories of the 1937 Agreement, covering researches into the technical application of tin in

industry and the statistical services. The International Tin Research and Development Council and the Tin Research Institute had performed useful work in their spheres, although, in the words of the International Tin Study Group, the Statistical Bulletin still "included a number of estimates, and the statistical book-keeping of tin is not yet completely disentangled". The Tin Research Institute is still functioning at Greenford, Middlesex. The statistical work has, since 1946, been taken over by the International Tin Study Group working in Holland.

51. Early in the Spring of 1939, there were reports that, pursuing their policy of building up stocks of strategic commodities, the U.S.A. Government suggested a big barter deal with the British Government, involving tin and rubber against cotton and wheat. The negotiations lasted a few months and difficulties were reportedly on the terms for tin. Towards the end of June, the two Governments concluded an agreement for rubber and cotton only.

The Agreement for tin was signed a year afterwards, on June 28th, 1940, between the Metals Reserve Company (M.R.C.) Reconstruction Finance Corporation representing the U.S. Government on the one hand, and the I.T.C. on the other. The M.R.C. undertook to buy up a maximum of 75,000 tons of tin at a price of 50 cents per lb., c.i.f. U.S. ports by June 30th 1941. The I.T.C. committed itself for this purpose to increase the quota to 130% from July 1940, to maintain that percentage for a period of one year, and to recommend all producers to increase exports and sales of tin in stocks as well as currently produced, at no more than the agreed price. The metal thus acquired by the M.R.C. was to be held, barring national emergency, for a period of no less than three years from the beginning of 1941. Three months before the liquidation of the stock was to begin, the M.R.C. had to notify the I.T.C. of its intention, and the release from the reserve stock must not exceed 5% of the holding, or a maximum of 5,000 tons, in any three months period. The agreement was renewed in 1941 for a further period of six months, and involved a further 87,500 tons.

The arrangement regarding the release from the reserve stock drew a remark from American authors: "Civilization might be liquidated, but not tin producers." (See Note 21). This remark was unjust, in view of the inconsiderate action of the American authorities at the end of the First World War. On the other hand, the claim that the I.T.C. "was able to implement the agreement by which to the immeasurable benefit of the United Nations, the U.S. obtained 260,000 tons of refined tin in the two years 1940-41,

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<u>Note 21</u>. George W.Stocking and Myron W.Watkins: Cartels or Competition (The Twentieth Century Fund, 1948) p.169, note 35.

compared with only 120,000 tons in the two preceding years" is definitely an exaggeration.

In October 1940, the M.R.C. also entered into a contract with the Bolivian Government and Bolivian producers (other than the Patino group), for the acquisition of Bolivian ore with a tin content of 18,000 tons a year for a period of five years. A clause in the Agreement stipulated that in the event of quotas under the Restriction Scheme being reduced below the 130% level, Bolivian supplies for the U.S.A. should be reduced proportionately.

(E) INTERNAL RESTRICTIVE MEASURES.

(a) Provision in the Agreements.

52. "The contracting Governments (to the Quota Agreement) undertake to take such measures as may be necessary to maintain and enforce the scheme in the territories to which their respective obligations apply....so that the production and export of each territory shall correspond as closely as possible throughout the year to the quota, allowance being made in the case of production for the permitted stocks." (IV:3(a) - see also I:13 and 14; II: 12 and 13; III: 16). Article 9 of the Fourth Agreement provided that the contracting Governments were to co-operate with each other to prevent smuggling, evasion and other abuses of the Scheme. In the first two Agreements, it was stipulated that each signatory government was responsible for allotting its quota among its

individual producers (I : 15; II : 15). In the last two Agreements, it was specified that stocks of tin and concentrates within any territory must not at any time exceed 25% of the standard tonnage of the territory. (III : 18; IV :6).

The practice in the case of the N.E.I. presented no difficulty, since the Dutch Government and the Billiton Company had complete control over the mines. In other countries the Governments issued decrees or laws forbidding production and exports of tin without permission, and allotted, or appointed Committees to allot, quotas among existing mines. Detailed regulations differed from territory to territory.

(b) <u>The New Members</u>.

53. There was no serious problem regarding the apportionment of permissible exports for new members of the quota scheme, owing to the liberal terms they secured for their standard tonnages. For the original members of the scheme, however, specific problems arose, particularly when quota cuts were very severe.

Siam joined the scheme in 1931, but favoured by the flat rate privilege and increasing standard tonnage, tin mining in Siam was restricted only in the very early stages. Prospecting was stopped, and mines starting production after September 1931 were not entitled to production certificates. Assessments and distribution of quota were then based on the previous performance in one of the years 1929, 1930 or

1931. The ban on prospecting was soon relaxed(in 1933) and new mines were allowed to come into production. Dulang workers in Siam were allowed to produce up to 36 kg. of ore per month, which was about double the quantity permitted their counterpart across the borders in Malaya. In 1937, after a successful negotiation for a higher standard tonnage, the Siamese Government reserved some 30% of the total quota for the State and disposed of it by auction. While this measure was probably intended to ensure the best allocation of resources as well as replenishing the State treasury, it led to a higher money cost of production - a result of the control agreement.

(c) Bolivia.

54. In Bolivia, the Government at first concentrated their attention on the bigger producers, to whom quotas were allotted. Small mines were more or less allowed to produce as much as they wished. With the growing intensity of restriction, in 1932 it was decided to curtail the output of small miners in the same degree and manner as the larger ones. Assessments for individual mines were based on the 1929 output. This brought about protests from new and developing concerns, such as the Hochschild group, who claimed from the beginning that their quotas ought to have been at least double the permissible amount. (See Note 22). The controversy, in

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Note 22. See Mauricio Hochschild's article in the Mining Journal of 25/6/32, p.430. Also 10/7/37, p.657, 4/9/37, p.800 and 17/9/38, p.872.

particular, between Hochschild and Patino culminated in July 1938, and resulted in stormy representations being made to the Government that in their distribution of quota, more consideration should be given to those concerns which had expended large sums in developing ore reserves for Bolivia's future. A technical commission of three experts was appointed to investigate the matter. The Commission reported that the reserves and productive capacity of the Patino group was on the decline, while the Hochschild group had created large reserves and had an increasing productive capacity. The recommendation of the Commission was partially accepted by the Government, and in October, a Presidential decree reduced Patino's share of the total Bolivian quota from 50% to 46%, and increased Hochschild's share from 19% to 26%. The Aramayo and other medium-sized producers also had their share reduced. A few months later, following changes in the political situation, the relative shares were again altered: this time Hochschild's was lowered and Patino's and Aramayo's slightly raised. The domestic assessment of permissible outputs for individual mines in Bolivia appeared to be essentially a matter of local politics.

(d) Nigeria.

55. In Nigeria, a committee comprising representatives of all classes of producers, together with Government officials, was appointed early in 1931, to draw up the terms of reference by which the Quota Committee would be guided.

it was stipulated in the terms of reference that "Development initiated after January 1st, 1931 shall give no claim for any quota." In practice, this was interpreted to mean that no mining lease taken up after that date had any claim for quota: this involved great hardship for enterprises which had spent large sums in proving the ground without taking up mining leases before the date.

The Quota Committee included the Chief Inspector of Mines, an administrative officer and six representatives of the miners - two each from large, medium-sized and small-owner concerns. In the beginning the quota for each individual mine was made up of:

(i) The "basic" quota of three tons per quarter for each mine irrespective of size: this was intended to help small miners.

(ii) The "ordinary" quota, based on 1929 output.

(iii) The "special" quota, based on the mines' development work in 1930.

At the beginning of 1932, a new method of distribution was adopted, by which the basic and special quota were abolished but reappeared under different guise. The "admitted claim" was based on the producers' potential production at the end of 1930. Small miners were given a "compensating allowance", at the discretion of the Quota Committee, up to a maximum of 12 tons per year. The Quota Committee, however, had the power to reduce, but not to increase, any "admitted claim, in the light of actual declarations and fulfilments". At the same time, following the example of Malaya, grouping of mines both inside a company or associated companies and between companies was allowed, thus making the production certificates marketable.

In order to give more flexibility to the Nigerian mines whose work was subject to seasonal climatic variations, the quotas were allowed to be carried over from quarter to quarter, but not from year to year.

56. The arrangements of the Quota Committee were on the whole favourable to the large companies. There were two big mines producing over 100 tons per month. Complaints were made that these were very influential with the Authorities. Specifically, there were complaints that in the few months in 1931 before the official export licences were issued, some of the large producers, close to the circle advocating restriction, were endeavouring to send their surplus stocks out of the country. (See Note 23). This led to a surplus of several hundred tons of exports over the licences issued. The excess was subsequently taken off all producers, pro rata, "instead of the penalty being borne by the large producers responsible for the surplus". The medium-sized companies were against the special quota and preferred to have the quota based on the output of 1929, in which year most of them

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Note 23. Mining Journal, 10/9/32, p.614.

reached their maximum capacity. The small workers, who were private mine-owners, were dissatisfied with the maximum quota (including compensating quota) of 12 tons per year. They argued that many of them produced on the average nearly 40 tons per year. A "Private Mine Owners" Association (mostly European) was formed early in 1932 and a petition asking for a compensating allowance of 24 tons was sent to, but rejected by, the Chief Inspector of Mines. The latter was reported as saying that the time had come to consider the reduction of compensating allowqnces, and suggesting that "all sentiment should be excluded."

Prospecting was severely restricted after 1931. The areas under Exclusive Prospecting Licences fell from 910,000 acres in 1928 to 92,000 acres in 1931 and 53,000 acres in 1932 (See Note 24). During the subsequent recovery, it rose again to only 196,000 acres in 1937. In the early stages of the restriction, the Government insisted on full work on prospecting licences. Consequently a large amount of development was done in 1931, resulting in a considerable addition to developed reserves. Old mines were privileged by the fact that leases could be pegged in order to replace exhausted areas, whereas,no new mines were allowed to start after the end of 1930. The number of tin mining concerns

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Note 24. The figures in this paragraph are from the Annual Reports of Nigerian Mines Department.

dropped from 70 individual mines and 74 companies in 1929 to 39 and 31 respectively in 1938. This was due partly to the restriction of new entry, partly to the encouragement given to grouping and financial integration.

(e) Malaya

57. In Malaya, the problem of assessing domestic shares of production for individual mines was much more difficult, since the number of mines was much larger than in Bolivia or Nigeria, and the expansion of output capacity was largest in 1929/1930. Towards the end of February 1931, pending the publication of the legislation for tin control, the acting Senior Warden of Mines issued a statement declaring some general principles regarding the operation of the scheme. A warning was then given that "as assessment will include the output from mines and machinery which have come into operation since 1929", a more drastic reduction of the assessments was necessary.

According to the Tin and Tin Ore Restriction Act, a committee known as the Central Committee was appointed, presided over by the Chief Warden of Mines, with three representatives of European mines and two of Chinese mines, The responsibility of the Central Committee was to hear and decide appeals against decisions of the Assessment Committees, and its decision was final. The actual assessment was carried out in each State by an Assessment Committee consisting of the Warden and Assistant Warden of Mines and two other appointed persons, the warden having the power of veto. Each mine was allotted an assessment in accordance with its performance in 1929 and/or 1930, and its capacity for production in the future was judged by the equipment. No certificate of production was issued for land unworked in 1929 and 1930 until it was proved that the producers began development in 1930 and that production had actually begun in 1931. The earlier assessment was subsequently scrutinised by a sub-committee appointed by the Central Committee in September 1931. The initial assessment, as far as the relative shares of individual mines were concerned, was found to be, on the whole, satisfactory.

How the discrepancies between the actual assessment as a whole and the agreed Standard Tonnage led to over-exports in 1931 and to subsequant cuts in the domestic quotas, has been related earlier. Within the country, there has been no evidence of the assessments being unfair to any group of miners The Chinese miners' share of the total Malayan output had declined from 61% in 1921 to 39% in 1929. Between 1931 and 1939, the declining trend of the Chinese percentage was slowed down: the figures being 35% and 31% at the respective dates. Dulang washers' output was limited to about 40 lb. per month per head, then lowered to 20, and subsequently raised to about 27 lb. from 1935. This represented a smaller restriction than was applied to other methods of production.

Groupings of quota were allowed by special permission of the Central Committee; but the latter could cancel such certificates of grouping on giving three months notice. During the periods of rapid increases in quotas, encouragements were given to the transferences of production certificates: for instance, in 1936 the producers were not called upon to give any reasons for applications to transfer quotas. The transferability of production certificates raised the problem of the "parasitic" mines, which were in receipt of a quota but were not producing tin ore. Following a request for the re-assessment of the mines, a sub-committee was appointed in December 1935 to examine the situation and a half-hearted measure was taken by making it compulsory for a mine to produce or forgo its quota. This did not solve all the problems of the "parasites". A tributer working on a piece of land on sub-lease, or sub-sub-lease could not, when the land became exhausted, transfer his quota to another piece of land without prior consent of the owner or sub-leasee of the old piece of land. There were cases in which this consent was exchanged for pecuniary gains. This is another element making for higher production cost.

58. During the depression, restriction on prospecting was applied in most tin mining countries. In Malaya, prospecting and alienation of land for mining purposes were first restricted towards the end of 1929 and some small

relaxation did not really occur until the boom of 1937. The area of land alienated for tin mining in the F.M.S. was about 182,000 acres in 1930 ; it fell to about 173,000 acres in 1932. In 1937 it rose to 180,000 acres and another 4,000 acres were added during the next year.

According to the regulation enforced in the F.M.S. from November 1929, applications for mining land or for conversion of agricultural to mining titles outside the existing mining areas were not considered, except in special cases, and within such mining areas, alienation or conversion were not approved of "unless it was essential for the efficient development of the existing undertaking." This created a hereditary race of miners. For Malaya as a whole, the restriction would have had an effect similar to a ban on new planting in agriculture . After ten or fifteen years of continuous restriction, the existing mining land would become exhausted of its mineral values, and the relative position of the country as a tin producing territory would be seriously affected. Within the country, and among old producers, a small miner, with 10 or 15 acres of land approached exhaustion much earlier than a big company which had large reserves of ore. In practice, in Malaya, a new piece of mining land was usually granted to the miner whose deposit had become exhausted ; but much discretion was left to the Mines Department, whose responsibility it was to decide whether the alienation of land "was essential for the efficient development of the existing undertaking". On the other hand, however, it was claimed that the applications for smaller areas of land received greater consideration from the Government than those for large areas. (See Note 25).

The question of prospecting was raised by the F.M.S.Chamber of Mines in 1934. (See Note 26). A sub-committee appointed by the Chamber to study the question, suggested the issue of prospecting licences which should be convertible into mining leases only as and when the Government permitted, or alternatively, the issue of boring permits giving the holder a prior right to take up the area when the Government thought fit. This proposal was turned down by the Senior Warden of Mines who, in a memorandum issued in December, made the following points: (a) With normal production, sufficient dredging land had been alienated to last for 15-20 years; (b) restriction would go on for many years, and since potential dredging, open cast or gravel pump areas were fairly well known, prospecting would not take long and it would be a grave mistake for Government to tie its hands; (c) it would be very difficult to discriminate "between desirable and undesirable applicants." The F.M.S.Chamber of Mines in its

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Note 25. Mining Journal, 27/2/37, p.197.

Note 26. Yearbook of the F.M.S.Chamber of Mines, 1934.

reply, pointed out that other tin producing countries were prospecting actively, and that Malaya would be at least 7 years behind them. This question was further raised in the F.M.S.Federal Council soon afterwards.

A small concession resulted. In November 1935, a communique announced that "full consideration will be given to applications from lessees or holders of assessments for permission to prospect potential mining land within the F.M.S. "This applied only to the lands which had already been classified as "mining lands" ; the result was therefore small. With the intensive prospecting of mining land during the boom in the 'twenties, there was little chance of large areas of fresh mineral bearing ground being found within lands already set aside. Towards the end of 1936, the local Press reported that a number of prospecting licences covering about 6,000 acres had been approved, while others covering about 60,000 acres had been refused.

After the renewal of the international control in 1937, the question of reassessment and freedom of prospecting was raised again in the Federal Council and in March, the F.M.S.Chamber of Mines repeated its petition to the High Commissioner for the resumption of the issue of prospecting licences. In April, an official announcement was made to the effect that no general re-assessment of tin producers would be undertaken during the existing period of restriction. It was, however, added that the Central Committee would retain powers to revise individual assessment "where and when such revision was in their opinion considered essential". Two months later, the Senior Warden of Mines issued another Communique repeating the above statement, but notifying that "applications for prospecting licences, mining leases, and (what is more important) the conversion to mining land of agricultural land and reserves, where practicable, would be considered from lessees or holders of assessment and from local mining engineers who had a long record in bona fide prospecting and floatation, and who had obtained a certificate of approval from the Federal Secretary".

Following the communique, applications for conversion into tin mining of land under reserves of various kinds poured into the land offices. Very few conversions were granted, owing primarily to the reluctance of officers in control of these reserves. The mining industry was dissatisfied and Chairman after Chairman made complaints in their annual meeting speeches. In October 1937, the Chairman of the F.M.S. Chamber of Mines addressed to the Federal Secretary a memorandum advocating a general policy: "firstly to discover all the deposits in Malaya, secondly to arrange that these should be mined in an orderly and economical manner over a period of years, thirdly to arrange that no tin-bearing land is alienated for other purposes until the tin has been extracted."

It was clear that, the policy of tin restriction apart, the question of land alienation and utilisation was a wide issue involving several conflicting claims, and affecting several administrative departments. Early in 1938 a Regional Planning Committee was set up in the State of Perak, composed of an unofficial Chairman and representatives of the Mines, Agricultural, Forest, Drainage and Irrigation Departments, of the planting community, of the Malay population and of the F.M.S.Chamber of Mines. The Committee discussed the problems of land utilisation on a regional basis. In his report upon the mining industry of Malaya, Sir Lewis L.Fermor spoke highly of the working of this Committee. Partly thanks to this Committee and partly owing to the relaxation of restriction, the total acreage of land for tin ore mining in the F.M.S. rose from 179,200 at the end of 1937 to 188,200 at the end of 1939 and to nearly 218,700 at the outbreak of the Japanese War. When fighting began, the question of the land utilisation policy was still unsettled.

## CHAPTER X

## THE PROSPECTS OF TIN CONTROL

### (A) THE EFFECTS OF THE PAST SCHEMES.

1. The effects of the past restriction schemes can be summarised as follows :-

(a) Price Level The I.T.C. was successful in the early stages in preventing price from falling below £100 a ton in the depression. After the Spring of 1933, the price of tin was maintained, except for a few short intervals, above £200. The control was reputed to be the most successful commodity scheme on this account.

(b) Price Stabilisation. In normal years, the ITC was successful in keeping price fluctuations within narrow bounds. With sudden changes in demand, day-to-day fluctuations were much more violent with the control than without it. The Tin Pools operated by producers did not materially contribute towards price stabilisation. The Control also brought with it extra elements of uncertainty with regard to quota decisions and the renewal of the agreements.

(c) Consumers' Reaction. High tin prices encouraged substitution. Researches into the question of substitutes and retrenching the quantity of tin in existing uses on the whole outpaced the research into the expansion of tin consumption. Consumers and Governments of the consuming countries resented the control exercised solely by the producers. Consumers' representation on the I.T.C. was not effective.

(d) Smelting With mine output severely restricted, the capacity of the smelting industry exceeded the mine output by a greater margin. The share of the British Empire in world tin smelting was much reduced.

(e) Allocation of Resources in Tin Mining. The quota system froze production in existing firms and at existing locations. The opportunity and right to produce were not based on efficiency or ability to produce at low costs, but on government decrees and on the payment to old concerns. New technique was discouraged. Old concerns and high-cost producers profited from the scheme, sheltered by high prices and legal privileged. Low cost producers earned good profits, paying dividends over 90% in some cases; but they were prevented from expanding, and found their costs considerably increased during periods of severe restriction.

(f) New and Privileged Producers. Tin production in the countries which remained outside the Control Scheme was stimulated. Some doubled their output; others only entered the list of producers as a result of the successful operation of the I.T.C., still others were prevented from reducing their output or going out of production. New members of the Control Agreements were allowed to expand their output. The share of the original four members in world production fell from 85% to 65%.

(g) Excess-Capacity in the Mining Industry. The high capacity of the tin mining industry, developed before the

Control, was thus not only maintained, but increased. Even with a reasonably high level of demand, the termination of control in peace time would have entailed a big crash in price and a long depression. A vicious circle was created in which the control was necessary to maintain price, high price perpetuates excess-capacity, and the latter called for the permanence of control.

(h) Employment and Income. With flexible wages and other costs, employment in the tin mining industry would have been fairly stable without the control. Under the I.T.C., output was varied following the oscillations in consumption and wide fluctuations in employment followed. The individual income of the worker in full-time employment was more or less stabilised; but the aggregate income varied from boom to slump.

Since the quota system entailed recurrent stoppages, there was a tendency to replace labour by more intensive use of machinery. The result was a declining trend in employment and in the aggregate wage in mining countries.

(i) Politics. Within a restricting country, the administration of the Control Scheme was entrusted to officials and was open to abuse or undue political influences, e.g. the case of Bolivia. Among the restricting governments, renewals of agreements provided opportunities for political log-rolling.

(B) POST-WAR SITUATION AND POSSIBILITIES.

2. The recent World War substantially affected the tin industry in a number of ways, some of which are likely to have long-term implications.

On the production side, important mining areas of South-East Asia were under the control of the Japanese who, having too much tin for their military needs, left the majority of the mines unused, dismantled and moved some of the dredging and other machinery, and left the rest in a more or less dilapidated state. The Allies on the other hand were deficient in tin and the output from Africa and South America was much enlarged. Since the end of the war the output from these latter fields has slightly declined. The Far Eastern mining countries made slow recovery at first; recently the rate of increase in production has accelerated. World production at the end of 1948 was at an annual rate of about 150,000 tons, and is expected to reach the pre-war level of 230,000-240,000 tons early in the 1950's.

3. On the side of consumption, there is still restriction in the main consuming countries, and control is likely to remain in force for some time. Tin is the only material still subject to international allocation by a combined committee.

In several uses, the war-time and post-war restriction has only reinforced the movement away from tin which was already caused by the producers' control. The technical development of such products as plastics, cellophane, nylon, solder and babbitt with reduced tin content, etc., and the cheapness of aluminium create a strong tendency towards the substitution of these materials. In some uses, the restriction in consumption may have only temporary effects. On the whole, the competitive position of tin has been much weakened.

The most important development in the consumption of tin is the emergence of electro-tinplate production. As time goes on this method of making tinplate is to an increasing degree replacing the older method of hot dipping. It is thus possible to reduce the amount of tin in tinplate by between a third and a half. This in itself would tend to reduce the cost and price of tinplate, and thus stimulate its consumption, unless the prewar restrictive practice in the tinplate industry is resumed. Moreover, the new electro-plate may find its own market outside food canning. It remains true, however, that the power of the consumers to fight high tin prices has increased considerably.

World tin consumption at the end of 1948 was at the annual rate of 140,000 tons. It is currently estimated that on the assumption that consumption control is lifted, the world absorption in the early 1950's will be between 175,000 and 200,000 tons a year (presumably at about the current price) Taking consumption and production alone, the latter is likely to overtake the former in a few years time and there will be a strong tendency for price to be pressed downwards.

4. Meanwhile, there is a new element of considerable importance in the post-war tin situation. Both the U.S.A. and the U.S.S.R. (and presumably a few others) have been building large stockpiles of tin and keeping them apart from the ordinary industrial stocks. Little is known of the activities of the U.S.S.R., except that the Russians have been buying abnormally heavily in the East. The U.S.Government have made known their intention of accumulating some 300,000 tons of tin. By the end of 1948, the amount acquired for this purpose has been estimated at 36,000 tons. The total annual intake of tin can thus be expected to exceed actual consumption by a large tonnage for some years to come.

This post-war accumulation of large stocks in consuming countries may be due mainly to the unsettled international political conditions; but it has also tactical significance in economics. It partially satisfies the crave for national self-sufficiency for tin and it strengthens the consumers' hand in any future tin dealings or marketing organisation. On the other hand, it causes considerable anxieties to the producers, because it creates an exaggerated temporary demand for tin, which brings additional investment into the industry. At the same time, the continuation of control on consumption is made necessary while stocks are accumulated. It is feared that once the required tonnage is reached and extra purchases stopped, the price of tin will inevitably collapse. The de-control of tin uses will have some favourable effect on consumption; but it will be negligible compared with the increase in output capacity, and if a trade recession coincides with the cessation of stock-pile purchase, or worse still, with the release of tin from the stockpile, there will be practically no limit below which price cannot fall.

The Havana Charter for an International Trade Organisation, in Article 32, has made it compulsory for a member to give prior public notice of his intention to liquidate non-commercial stocks. It provides that the liquidation shall be carried out in a manner that will avoid serious disturbance to world markets for the commodity concerned.

5. Commercial stocks of tin, meanwhile, have increased considerably during the war and still remain at a very high level.

Table X.1.

Stocks and Price of Tin 1937 to 1947.

(Stocks : end of year, '000 tons) (price, annual average)

| | 1937 | 1941 | 1945 | 1947 |
|---|---|---|---|---|
| World Stocks | | | | |
| Visible stocks | 42.3 | 117.1 | 150.2 | 103.9 |
| Declared Consumers' stocks* | 17.7 | 61.7 | 20.1 | 23.4 |
| World Total | 60.0 | 178.8 | 170.3 | 127.3 |
| U.S. Stocks. | | | | |
| Visible stocks | 12.6 | 80.8 | 61.2 | 52.3 |
| Consumers' stocks | 17.7 | 58.5 | 15.0 | 14.4 |
| U.S. Total | 30.3 | 139.3 | 76.2 | 66.7 |
| Price (£ per ton) | 242 | 262+ | 302 | 428 |

Source I.T.S.G. * = 1937 USA only, subsequently USA and UK.
+ = average of 11 months.

Total world visible stocks at the end of 1947 were nearly double the tonnage at the depth of the depression in the early 1930's, and were equivalent to about nine months' current consumption. In normal peace time, this would have meant very strong pressure on price. The abnormality of the situation is reflected in the height to which price has risen. In 1948 it has reached £570 under government control. The large commercial stock is the result of the control in consumption, and it may be a temporary phenomenon; but it is serious enough as a source of anxiety for producers.

6. A large proportion of the smelting plants was damaged by the recent war. At the end of 1948, Malayan smelting output reached an annual rate of just below 50,000 tons, or about 40% of the pre-war capacity. (See Note 1). The Dutch smelters have been much slower in their recovery. On the other hand, smelting output in Belgium reached the record of over 12,000 tons in 1947, although that in the colony, much expanded during the war, has correspondingly declined. The new factor in this sphere is the Texas smelter with a capacity up to 90,000 tons of tin, which corresponds to over half of the pre-war mine production. The legal obstacles to the flow of concentrates from the British Empire have been removed, and the U.S. Government have buying contracts outstanding with Bolivia, Siam and the Netherlands. It is difficult to see how far American smelting will be able to stand competition, and how far the trade in tin concentrates will be altered after the present dollar shortage is improved. There is, however, every indication that the Americans are determined to maintain the smelter in their territory. Their success will be mainly at the expense of British and Dutch smelters. In any case, the problem of surplus capacity in the tin smelting industry, which already existed before the war, will be much intensified.

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<u>Note 1</u>. This is due partly to the reduced supply of ores.

7. Post-war discussions on tin control are carried out against the background of the general commercial policy. It is recognised by the majority of governments that there is a need for an International Trade Organisation (I.T.O.), in order to encourage the expansion of trade and employment. All cartels and other restrictive practices are to be under the supervision of the I.T.O.; but a distinction is made between the cartels of manufactured goods and those of primary commodities. Private international business arrangements in the former have to be discouraged, whereas inter-governmental arrangements for the latter have to be controlled and supervised by an international body. This trend of attitude culminated in the Proposals for Consideration by an International Conference on Trade and Employment, transmitted by the U.S.Government to the British Government at the time of the loan negotiations in 1945. The Government of the U.K. was stated to be in full agreement on all important points in these proposals. (See Note 2).

After several conferences, the final version of the Proposals appears in the form of a Charter for an International Trade Organisation, drawn up at Havana in March 1948.(See Note 3)

Note 2. Cmd. 6709.

Note 3. Cmd. 7375. Chapter VI, articles 55 to 70, deals specifically with the problems of primary commodities. Other articles concerning primary commodities are 27,28 and 32. The Charter is known as the Havana Charter.

According to this document, inter-governmental commodity agreements are recognised as appropriate, among other things, for preventing or moderating pronounced fluctuations in the price of primary commodities and for preventing or alleviating "the serious economic difficulties which may arise when adjustments between production and consumption cannot be effected by normal market forces alone as rapidly as the circumstances require". (art.57). All agreements for this purpose must undergo the procedure of "study" and "conference" before coming into force. In certain circumstances, a commodity control agreement is permitted. A control agreement is defined as an agreement involving the regulation of prices or the regulation of production or the quantitative control of exports or imports in a restrictive manner. It is permitted when it is found that "a burdensome surplus of a primary commodity has developed or is expected to develop..." or "widespread unemployment or under-employment in connection with a primary commodity....has developed or is expected to develop..." (arts. 61 and 62). A commodity control agreement is administered by a Commodity Council acting within the framework of the I.T.O.

8. A conference on tin was held in October 1946 in London, attended by delegates of eight governments, among them the U.S.A. and China (both attending an international tin conference for the first time). In the communique

released to the Press at the end of the conference, no mention was made of the existing Tin Control Agreement of 1942, due to expire at the end of the year. It was decided that there was a possibility of a production surplus in the future; and basic working principles were proposed for the formation of a Tin Study Group.

A second conference followed in April 1947 at Brussels taking the form of a study group. The membership of the International Tin Study Group was made open to all producing and consuming countries. Its function is to "consider possible solutions to the problems which are unlikely to be resolved by the ordinary development of world trade in tin". A permanent secretariat was set up at The Hague, and a Management Committee elected to supervise the establishment and work of the Secretariat. The Management Committee consisted of the representatives of the Governments of Belgium, Bolivia, France, China, Netherlands, United Kingdom and United States of America. Subsequently "British Colonies" replaced China on the Committee.

At the next meeting of the Tin Study Group in Washington, April 1948, a Working Party was set up to examine the appropriateness and practicability of framing an inter-governmental agreement on tin according to the Havana Charter. The Working Party reported to the third Study Group meeting in the Hague in October 1948, at which a draft agreement was proposed. No details have been published of this draft;

but it is understood that the proposal is in the nature of a control agreement, in the sense of Section C, Chapter VI of the Havana Charter. It has been circulated to the fourteen governments which are members of the Study Group. A Tin Conference in the sense of Art.59 of the Havana Charter is expected in the Spring of 1949. This will be an important step towards the setting up of a Tin Council.

(D) QUOTA AND PRICE COMPETITION.

9. Outside the official circles, the debate on the future of commodity control goes on. The Tin Producers Association repeats its arguments in support of output regulation. In the already cited pamphlet, published during the war, several arguments are put forward to justify the actions of the I.T.C., and the pamphlet concluded with these words:

> "After the War Tin Control will have equally important functions to perform. The maintenance of world prosperity demands that the work of primary producers shall be kept remunerative. The tin industry is ready to play its part and the machinery of control remains in existence to meet the needs of the post war world".(p.29)

These arguments have been reiterated in the successive issues of the T.P.A.'s bulletin "Tin" and other publications of the producing interests.

The case for quantitative control of output in primary commodities has the support, more or less qualified, of various writers such as Feis, Haley, Condliffe,Yates. (Note 4 on the next page). It is generally admitted that a producers' restriction scheme has serious short-comings;

but it is argued that the quota regulations have, in the words of Feis, "important potential merits if formulated and directed with long-sighted moderation". This is the general attitude towards primary commodities control quite common among people close to the American States Department. According to Mason, "there is a school of thought in the U.S. that abhors cartels as private treaties restrictive of trade but embraces commodity agreements as intergovernmental arrangements inevitably serving the public interest." (See Note 5). Among the arguments put forward for quota schemes, the following are the most common: that they are necessary in the short-run to foster the income of the producers and to avoid a sharp reduction in world trade owing to the drastic fall in the incomes of primary producing countries; that they are necessary for static or contracting industries, and that they are essential in order to remove deep-rooted long-term maladjustments.

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Note 4. Where specific reference is not made, the works of the authors mentioned in this chapter will be found in the Bibliography at the end of the thesis.

Note.5. E.S.Mason: Controlling World Trade: Cartels and Commodity Agreements (Committee for Economic Development Research Study, 1946). p.X.

Some improvements on the past schemes have been suggested: the principal being the more effective representation of consumers, the ancillary measure of buffer-stock operation and concerted measures for penalising non-participants. (See Note 6).

The new pattern of quota schemes is no doubt an improvement upon the pre-war type. It provides, however, no answer to the problems of the elimination of high-cost capacity or the efficient allocation of resources; nor is there any assurance that the high cost producers, if politically strong, will not secure for themselves a larger share in the output, to the detriment of the consumer and low-cost producers. The new scheme would still perpetuate the mal-investments. Any hope of an early termination of the scheme, as soon as the crisis is over, is bound to be an illusion, as past experience has clearly shown. The sentimental reason for helping the primary producers often heard in this connection is a misrepresentation of fact, at least as far as tin is concerned, since the people whom the scheme is intended to help are not the poor native small producers, but big organisations with heavy overhead costs. (See Note 7.)

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Note 6. See G.H.C.Hart: Towards Economic Democracy in the N.E.I. (Netherlands and Netherlands Indies Council, I.P.R. 1942) pp.120 - 122.

Note 7. In any case, backward natives can be much more effectively helped to improve their living standard by more direct means.

The defects of the control scheme, summarised in the first paragraph of this chapter, and in particular the instability of price, income and employment of tin miners, find no answer in the proposals for quota schemes in the new guise. What P.T.Bauer says about rubber applies to tin with equal weight: "the blunt truth is that a period of price competition is long overdue." (See Note 8).

10. Price competition is the most effective way of encouraging the efficiency of producers and the introduction of new improved technique. It will shift productive resources from high cost units to low cost units. A lower price will moreover strengthen tin's competitive position against substitutes. Applied to the tin industry, however, competition cannot be expected to solve many outstanding problems, especially in the post war conditions as outlined above. The process of eliminating the surplus capacity would require a very long period of extremely depressed price. A large proportion of small low-cost producers would be eliminated together with some high cost producers, since in a protracted economic struggle for survival, financial strength, rather than efficiency is the test. Moreover, free competition postulates not only the abstention on the part of the governments from sponsoring control agreements, it requires positive State

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Note 8. The Rubber Industry (London School of Economics 1948) p.332.

actions to prevent the formation of private monopolistic arrangements. In tin, the structure of the industry is such as to create a very strong propensity for combined action among producers. Effective State action in this sense would be extremely difficult, if at all practical. With large stock-piles of tin in consuming countries like the sword of Damocles hung over them, producers have some justification for protective action.

Pure price competition is not likely to eliminate the cyclical fluctuations in tin. Free dealings in futures can be a stabilising factor as far as short-term price movements are concerned and speculators do perform some useful function. With large changes in demand in the course of the trade cycle, however, speculators, expecting the movements to continue one way or another for some time, tend to buy when prices are rising and sell when prices are falling, thus exaggerating the fluctuations.

(E) A BUFFER STOCK PLAN FOR TIN.

11. It is now a more widely accepted idea that in order to deal with cyclical fluctuations in the demand for, as well as climatic fluctuations in the supply of, primary products, the measures taken by Joseph in the Book of Genesis (Chapter 41) have to be revived. The plan is known in the present terminology as Buffer Stock scheme. The principle is to create a central international authority with large cash

resources to start operation during a period of low demand or glut in supply. A stock of primary products will then be accumulated for release during the period of shortage. The Authority is to fix a basic price for the commodity under control, which is to correspond to its long-term average price. As the market price reaches a percentage above or under the basic price, the Authority will step in to sell or buy unlimited quantities in the open market. The basic price is subject to alteration according to the long-term trend of costs and demand; but cyclical and seasonal oscillations are eliminated. The Buffer Stock Authority is to be self-financing, but not profit making. (See Note 9).

The Buffer Stock Scheme as outlined above has the support of such bodies as the League of Nations Delegation on Economic Depression, the I.L.O., the British Government Delegation at the Hot Springs Conference, and the F.A.O. Tin producing interests have paid eloquent tribute to its principle, though the practice of the I.T.C. was to make the scheme an adjunct of the quota control. Among economists, Keynes, Benham, Meade, Bauer, Riefler and Zaglits can be

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Note 9. For more detailed proposals regarding the organisation administration and finance of a buffer stock scheme, see W.W.Riefler: A proposal for an International Buffer Stock Agency (JPE. Dec. 1946), p.538; I.L.O.: op.cit.,pp.xxxviff; J.M.Keynes: The Policy of Government Storage of Foodstuff and Raw Materials (EJ.1938) pp.449-460.

mentioned as supporting it. Other writers on the subject of primary commodities, while on the whole accepting its principles, are more sceptical about its practicability. It is the opinion of the present writer that a buffer stock scheme for tin can be made to work satisfactorily as a necessary supplement to the principle of price competition. (See Note 10.)

12. K.E.Knorr expresses the feeling of many critics when he concludes that "a buffer stock scheme is far from being a cure-all". (See Note 11). This criticism does less than justice to the proponents of the scheme, for none among the above-mentioned authors has shown such "sanguine hopes." The scheme is put forward as a specific remedy against price fluctuations. A large stock operation, properly conducted, goes a long way towards correcting the defective elasticities of supply and demand in primary products, and in the case of mineral commodities, it allows production to be stabilised over the trade cycle without impeding efficiency. The problems of primary production are numerous, each one has to be solved by a proper measure. The buffer stock proposal carries with it a number of pitfalls which must be avoided.

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Note 10. When applied to a number of important primary commodities, the Buffer-stock scheme would need only a short step to be converted into a policy of Commodity Reserve Currency advocated by Gilbert Lewis, Benjamin Graham, F.D.Graham, F.Hayek, R.Harrod, etc. (See Bibliography) It is however impossible adequately to discuss this important proposal in this study.

Note 11. op.cit. p.295.

Such considerations however do not provide sufficient ground for rejecting it off-hand. A buffer-stock operation on a large scale will, for instance, eliminate some of the activities of speculators, because as price is stabilised over long periods, long-term speculative dealings will be redundant. Within the limits of the buying and selling prices legitimate hedging still has a full part to play. One of the chief merits of a buffer stock plan is to remedy the short-comings of price competition. Producers with prime costs over the buying price will be eliminated. There will be no need for a struggle for survival by any other criterion than that of costs. Small and big producers alike can feel assured that as long as their products cost them no more than the expected buying price, they can always go on producing.

13. Concern has been expressed that a buffer-stock plan would be a failure because the "controlling authority would almost inevitably find itself subject to the dictation of the producing interests." (See Note 12). This objection applies much more strongly to the quota system. However, recent trade conferences and opinions have shown that the principle of effective representation of consuming countries

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Note 12. Herbert Feis: "Raw Material Prices and Controls" (Proceedings of the Academy of Political Science, New York) January 1945, p.36.

with the power to vote equal to that of producers is widely accepted and put into practice. Indeed, the danger now lies in the fact that, as in the Wheat Conferences, a situation of bilateral monopoly will develop in which a deadlock on the question of price may result. The question of price determination is the crux of the matter. The suspicion of producers' control is natural and arises from past experience. It calls for assurances that the administration of the buffer stock will be according to some automatic, objective rules. This question and that of price determination will be taken up presently.

14. Some sections of tin producers have in the past shown an adverse attitude towards the establishment of a buffer stock. This antagonism arises mainly because in the past buffer-stock schemes were connected with the quota system and the criticism was directed against the question of standard tonnages. Once this prejudice is cleared, producers' opposition should be less strong. (See Note 13). Most producers felt that they had benefitted from the Bandoeng Pool, despite its limited scope. Fears are not uncommon among producers that a large size of stock will have a depressing effect upon the market. These can be allayed by making it plain that the

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Note 13. High cost producers will still prefer quota control.

Buffer Stock Authority is not going to sell under any circumstance unless and until price reaches the upper limit. Another resentment of producers against past buffer pools was that they were charged interest for the money advanced to them against their own metal which they were not allowed to sell. This should not arise in a system of outright buying and selling.

15. E.S.Mason's doubt is of a different kind. "The effective administration of price controls by an international buffer stock requires as a prerequisite the existence of national controls of output and exports", because "an offer to buy on a large scale even at a price below the market would be likely to lead to an increased output, and thus augment the surplus which the Buffer Stock Control was attempting to eliminate". (See Note 14). There is a real danger that when a buffer-stock scheme for a single commodity starts supporting price during a slump, the producers of other commodities whose prices are not so supported might switch over to tin. The danger will obviously lessen if there are several commodities under similar schemes at the same time.

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Note 14. E.S.Mason: "The Future of Commodity Agreements" in Food for the World edited by T.W.Schultz (University of Chicago Press, 1945) pp.224/5, also op.cit.pp.219-223. Cf J.B.Condliffe: The Common Interest in International Economic Organisation (ILO, Montreal 1944) p.105.

Even in the absence of such widespread operation, a way out of the difficulty is to anticipate it and have the buying price correspondingly lowered. Another way out is to increase the financial resources of the Buffer Stock Authority so to enable it to cope with the increased inflow of tin. These two solutions can be adopted simultaneously or as alternatives.

16. This leads us to the problem of financing the operation. Yates raises the question: "Would not such a scheme be quite impossibly expensive?" and on the calculation that stocks varying from 50 to 100% of the annual volume of world trade are carried, with 3% interest on the capital funds, finds that the cost in interest would only add 1.5 to 3% to the price of the commodity. "Looked upon as an insurance against price fluctuations this cannot be reckoned a costly arrangement". (See Note 15). Keynes estimated a slightly higher cost at 4%, although still small compared with the values involved. As to the capital funds, Riefler, assuming that his scheme includes a number of commodities at the same time, estimates that the agency would need financial resources of a somewhat larger order of magnitude than those of the International Bank for Reconstruction and Development. The funds should be provided by subscription from the member nations, and the agency should be empowered to borrow "in such a way as to make its bonds prime securities in the market". (See Note 16).

<u>Note 15</u>. op.cit.,pp.224-5. <u>Note 16</u>. loc.cit.pp.541-542.

In the case of tin, some concrete estimates can be made. The size of the visible stocks at the bottom of the pre-war depression approximated 60,000 tons. Adding the maximum amount carried by consumers, estimated at 30,000 tons, and assuming that the two maxima coincide in time (which is not necessarily the case), we have about 90,000 tons as total maximum stock at any one time. The size of stock carried by traders and consumers for "convenience" will probably be reduced as a result of the existence of a central stock. (See Note 17). Assume that this convenience stock is reduced to no more than 20,000 tons (about six weeks to two months consumption during the depression), the tonnage to be taken up by the Buffer Stock Authority will be about 70,000 tons. After allowing for all the likely differences between the past and the future, the tonnage of tin in the buffer stock can be estimated at about 100,000 tons. (A more pessimistic estimate would put it at 150,000 tons) At a buying price of £160 per ton (See Note 18), the total capital fund needed for holding 100,000 tons of tin will not exceed £20 million. The current

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Note 17. In order not to attract normal trading stocks into the Buffer Pool, keynes suggested a requirement of a month's notice of delivery and withdrawal and a minimum period of deposit of three months. (loc.cit., p.456). In Keynes' scheme, the commodity taken into storage remains under the ownership of the depositor. Similar measures can be taken in the case in which the Buffer Stock Authority buys the commodity outright. Selling price can be graded upward according to the promptness of delivery.

Note 18. See paragraph 18 below.

storage cost, on the basis of prewar Malayan charge of 2 Straits cents per ton per day, will amount to £90,000 per annum. (This can be considerably reduced by adopting, during the worst period of depression, a modified version of the Lovett scheme of keeping some stock in the ground.) (See Note 19) The interest charge at 3% will cost another £600,000. The current cost of the Buffer Stock operation in tin will be no more than £700,000 a year during the worst period of the slump, which is a small figure for a world-wide public relief policy. (On the more pessimistic calculation, the current expense will amount to £900,000 per year.) In more normal years and in boom years, the Authority will carry much smaller stock and current expenses accordingly reduced. All expenses of course will be financed out of the margin between buying and selling prices.

17. The most important problem is the price policy. On this subject, a commodity agreement will stand or fall. Twice in recent months the draft Wheat Agreement has failed

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Note 19. This scheme was advocated in 1930 by Mr.J.Lovett, Chief Inspector of the FMS Department of Mines. Its main feature is to allow a mining company to sell to a central organisation a certain tonnage of tin not to be delivered until the price has risen to the basic level. The company must not produce that tin before the date of delivery. The price paid by the central body for such tin is the current price plus half the difference between the current price and the basic price. See details in the Mining Journal 25/10/30, p.839.

of acceptance, the first time because a principal importing government thought the price was too high, and the second because exporters thought the price was too low.

There is no price which is fair or reasonable to everybody. The Havana Charter Article 57(c) states as one of its objectives to achieve "a reasonable degree of stability on a basis of such prices as are fair to consumers and provide a reasonable return to producers, having regard to the desirability of securing long-term equilibrium between the forces of supply and demand." The latter clause can be interpreted in an unambiguous way if the forces of supply and demand can be objectively estimated; but an objective criterion on which prices can be judged fair, or return reasonable, has yet to be found. (See Note 20).

In practice, in most present day international agreements, the price is likely to be determined at conference tables. There is scope for political influences and for quid-pro-quos - e.g. a higher price for tin in return for a higher price for wheat. In this way the prices agreed for individual commodities - if agreement is reached at all - can be far and away from the long-term equilibrium between the forces of supply and demand.

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Note 20. These seemingly ethical terms are very common in the documents of pre-war restriction agreements. Recent documents are not free from them. See the passage from the Third Inter-American Conferenceon Agriculture, Caracas, 1945 quoted in FAO: Report of the Preparatory Commission on World Food Proposals. (Cmd.7031) p.29.

Yet it is highly important for the success of any long-term plan for a commodity that price should be determined as near as possible to the long-term equilibrium. With too high price, stocks will go on accumulating, straining the financial resources of the Buffer Stock Authority. An opposite error will create chronic shortage,with the result that the buffer stock will be too small to ensure stability. In either case the system will break down.

18. The long-term equilibrium price of tin in the period between the two wars was definitely below £200. When production was unrestricted in 1940 and 1941, world tin output exceeded the annual average consumption during the period by about 80,000 to 85,000 tons. Allowing for all temporary factors such as the rearmament boom and patriotic and other motives calling for an increase in output, the excess of productive capacity at price around £200 or above was of the order of magnitude of between one quarter and one third. If the cost analysis in Chapter VI is correct, and if short-run demand for tin can be assumed to be fairly inelastic, the equilibrium price of metallic tin in the period under study should be about £180. On this basis, if a buffer stock scheme as outlined here had been formed in 1930, with a buying price of £160 and a selling price of £200, the stock accumulated during the depression - probably totalling about 70,000 to 80,000 tons

in the last year of the slump - would have been sufficient to supplement current output during the boom.

19. When we turn to the future, we tread on much more slippery ground. The equilibrium price over the next ten years cannot be estimated very accurately. There are a number of unknown factors at work and likely to come in. The purchasing power of the Sterling or dollar in terms of commodities cannot be forecast with certainty. It is impossible to say exactly how far the tin industry in the Far East will be developed: all that can be said is that its capacity will recover to the pre-war level in a few years time. It is impossible to foretell what influence the changing political scene and the growth of trade union movements in the Eastern countries will exert on the mining costs and their flexibility. It is equally impossible to predict, now as in the past, the trade activity which is the important determinant of tin consumption. For the moment, we are limited to saying that if all relevant conditions are as they existed in the 1930's, then the equilibrium price is about £180. The developments both on the cost and consumption sides must be closely observed.

Nevertheless there are some less vague principles which can be formulated for the price policy of a future buffer stock scheme. Firstly the rate of flow of tin into the buffer stock and the size of world stock can be used as a check against the error in price fixing. If the stock is very high and increases rapidly, there is a prima facie case for stating that the basic price has been fixed too high; and conversely in the opposite event. During the initial stage, while research into the cost and demand conditions must be carried out in detail, the Buffer-Stock Authority must be allowed to operate in this trial and error manner, without leaving too much discretion to the Executive.

Secondly, assuming that the present general expectation regarding the rate of recovery in tin production is correct, world production will overtake consumption in a few years, unless price falls sharply. There will be a state of excess-capacity. The Buffer Stock Authority will be operating in an extremely difficult condition. High cost producers will go on producing even at a price below their prime cost if they have reason to expect that by so doing they can defeat the financial strength of the buffer stock. In these circumstances, the prerequisite to the success of the Scheme must be a very low purchase price, probably around £140 on the pre-war basis. The financial backing of the Executive must also be so large as to create confidence in it and to preclude speculation on the exhaustion of its stocks or on its breakdown.

Thirdly, owing to the fact that it is impossible accurately to forecast trade activity, and owing to the low purchase price necessitated by the possibilities discussed above, the range between the buying price and the selling price must be sufficiently wide to allow some flexibility in the system. This price range can be narrowed down as experience is gained and more command of the facts is obtained. Estimated again on the pre-war basis, if the basic price is fixed at £180, the buying price can be fixed at £140 or £150 and the selling price at £210. Some stability is temporarily sacrificed in the first stage in favour of security and confidence. After a year or so of existence, the range may be narrowed down to £160 - £200, or even to figures nearer to £180.

20. The price fixed for the Buffer Stock Authority should not be subject to too frequent changes. This is desirable not only to create stability, but also because each new conference would afford a fresh opportunity for bargaining and political interference. On the other hand, we have seen that at the initial stages at any rate, price policy must be made flexible enough to correct errors. This dilemma can be solved in this way: The Buffer Stock Agreement is made for a period as long as 8 to 10 years - the minimum is 5 years in the first instance. The basic price is fixed ahead either uniformly during the whole period or as a trend as in the Wheat Agreement. Flexibility can be obtained by introducing some rules for automatic price adjustments. To give a concrete example: Suppose the basic price is fixed at £180 with the limits of buying and selling prices at £160 and £200

respectively. It can be specified that these prices will be operative only when the total world stock is between 30,000 tons and 80,000 tons. As total world stock falls below or rises above these limits, the basic price will automatically move in the opposite direction, on a sliding scale depending on the change in the stock figure. The upper and lower limits of price will be adjusted accordingly. The Buffer-Stock Executive will thus have the responsibility of declaring the prices according to pre-arranged terms, not of determining them.

The success of this operation clearly requires a considerable improvement in the statistics of tin. Closer international co-operation for increasing the comprehensiveness as well as the reliability of tin statistics is seriously needed in any case.

21. The operation of the suggested plan will result in the elimination of a number of high cost producers. This will no doubt create some hardship, as any scheme for the elimination of surplus capacity must do. There are high-cost producers in all the countries where tin was mined before the war; but if certain conditions are not changed, the hardship is likely to be concentrated in Bolivia.

The Havana Charter (article 63(d)) provides that the countries participating in a control scheme "shall formulate and adopt programmes of internal economic adjustment believed to be adequate to ensure asmuch progress as practicable within the duration of the agreement towards the solution of the commodity problem involved" Such programmes of internal adjustment will obviously vary from country to country; but they will inevitably take time to yield any result. Immediately relief measures will be necessary. Meanwhile, there is the danger that various arguments will be put forward for the adoption of restrictive measures which will in turn help to postpone the required internal readjustment.

In the case of Bolivia, we have seen that the cost of tin mining is high because of (a) natural conditions and (b) institutional reasons in the form of a complicated system of high taxation. The former causes are difficult to remedy, but they are partly offset by the superior richness of the tin content of the mines. The latter defects are man-made and should be corrected. Bolivia urgently needs political stability and a reform of the fiscal policy. A simplification and reduction of the tax on tin production and exports will go a long way towards reducing the costs, and on the operating cost alone, many Bolivian producers can well stand against Eastern competition. (See Note 21). These measures for helping

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Note 21. The chief remaining worry will be the high treatment cost of low grade ores. The writer is not qualified to give opinion on technology; but it is possible that the smelting process for lower grade ores can be improved and their smelting costs much reduced. With the destruction of the German tin smelters, there remain few smelters specialising in low grade ores. On the other hand, the capacity for high grade ore smelting has grown much in excess of the mine output before the war.

Bolivian producers to stand on their own feet as far as natural conditions allow,will be superior to those permitted under article 27 of the Havana Charter, according to which subsidy is allowed,for the stabilisation of the return, to producers of primary commodities in certain circumstances. Advantage can, however, be taken of this allowance as a short-term relief measure. The rate of subsidy should be fixed by the I.T.O. Authority and made to decrease over a number of years.

As a supplement to the internal reform, Bolivia will probably need external assistance from the World Bank or from the United States. The Bolivian Development Corporation set up jointly by the Bolivian Government and the U.S. Export-Import Bank during the war, provides machinery for this purpose, but its work has yet to be seen. If the U.S.A.wishes, for security reasons, to preserve Bolivian tin mines in working condition, there is a prima facie case for a special bilateral agreement allowing the former to buy a fixed quantity of ores for a period of years for special defence purpose at a price which may be higher than the market price. Such an agreement will have to be approved and under the constant supervision of the I.T.O. Authority.

With such assistance from outside in order gradually to put their own house in order, the Bolivian Government is more likely to accept the scheme of price competition supplemented by a tin buffer stock. Correspondingly, there will be less justification for producers and governments of producing countries to establish a quota system again.

22. A leading student of primary commodity problems stated recently: "In many fields it is common to keep threshing over broad ideas while avoiding the very difficult chore of developing them in a blue print which can be subjected to critical tests". (See Note 22). The suggestions put forward in this study for tin may not satisfy the criteria of a blue print - nor is it certain that a blue print in the rigorous sense of the word is desirable in our branch of study - but they can certainly be subjected to tests and they should profit from criticisms and amendments.

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Note 22. Joseph S.Davis: International Commodity Agreements: Hope, Illusion or Menace (Committee on International Economic Policy, 1947) p.30.

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