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RECENT TRENDS AND EVENTS IN MINING IN LATIN AMERICA

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/Chile

INTRODUCTION

The mining industry of Latin America is divided into two categories which, so far as this analysis is concerned, differ mainly by virtue of the final destination of their production: one supplies the world markets with metals and various other mining products, and the other supplies raw material to the industry feeding the domestic market. There is no clear dividing line between the two, as in some countries varying percentages of exportable ores are processed and consumed on the domestic market. This consumption must increase in direct proportion to the increase in industrialization, but at present, except in the case of iron ore, it is of no importance when compared to the tonnage exported.

In this report recent developments and trends are analyzed in relation to five mining products: iron ore, copper, tin, lead and zinc. The study of the iron ore situation will be made separately, since in some important areas the mining of this particular mineral has been organized with the definite object of meeting the needs of the national steel industry. On the other hand, domestic consumption of the other four non-ferrous industrial metals still represents only a very small percentage of the entire production.

They also have common problems which justify examination together with some factors affecting Latin America, such as the variations in exports caused by cyclical fluctuations in the industrial countries, and also the continuously diminishing use of these metals in the manufacturing countries for any given volume of industrial activity, at constant prices.

/Iron Ore

Iron Ore

Introduction

Latin America possesses abundant reserves of iron ore. In the year 1948, a very conservative estimate placed these reserves at 37,166 million tons of metal content of commercially exploitable ores, or say, approximately 18.6 per cent of the world reserves. This does not take into account recent discoveries in Venezuela (at least 1,000 million tons) and in El Salvador, the extent of which are not yet definitely known. In contrast to these figures, the 1948 pig-iron production represented only 0.7 per cent of the world total.

In the main, these ores are not being worked at present, the basic reason being that the industrial countries have set up their steel industry close to their ore deposits, even though these deposits are mostly on a much smaller scale than those existing in Latin America. There has consequently been but little international trade in iron ore, although the following particular cases may be quoted:

a) The exchange of iron ore from Lorraine for Ruhr coal;

b) Imports of high grade ore from Spain, Sweden, and on a smaller scale from Brazil, by the European industrial countries to improve their own low grade ores;

c) The plant at Sparrow Point, Baltimore, Maryland, which imports iron ore from Chile, Cuba, Brazil and other Latin American countries the long ocean journey being counterbalanced by the short haul of the finished product to the nearby steel markets;

d) Far Eastern trade in iron ore; and imports by the United States from Latin America, to improve low grade ores, and for special applications.

The expansion of the steel industry in the United States, especially since the beginning of the late war, has reduced the visible iron ore supply in that country and, as will be seen later, has compelled the industrialists to prepare alternative or supplementary sources. At the same time, several Latin American countries, by opening up new steel industries or by pressing ahead with existing ones, have created a domestic market for the ore.

During the period under review, iron mining in the area has had

/two separate

two separate objectives: the supply of high grade ore to the steel industry on the East coast of the United States, and the supply to the expanding steel industry in Latin America, which, although much smaller in quantity, is probably much more important to the countries concerned. As the situation is analyzed, country by country, these two objectives of the mining industry will be dealt with separately.

It is not proposed to review here the position of Europe in the world iron-ore market. Whilst it is agreed that steel production has increased in the industrial countries, it is not probable that they will obtain their ore from Latin America since their own reserves will last for many more decades and, furthermore, the quantity being mined in Algeria is being increased with the object of supplying high grade ores for mixing with their own.

The principal source of supply of the United States steel industry is the Mesabi, Minnesota, deposit, whose proven ore of 50 per cent grade, plus that which can be easily concentrated to this grade, is estimated at 1,271 million short tons. In 1948 46 million tons were extracted which would give the deposit a life expectation of some 28 years. The rate of pig-iron production in the country is bound to increase, but on the other hand, it is possible that the reserves have been slightly under-estimated, because the State of Minnesota taxes the private ownership of mineral reserves. At best, it has been estimated that the present rate of extraction might be maintained for a further 40 or 50 years.

Consequently, the big United States steel producers have begun preparing other sources of ore to supplement or replace that of Mesabi. In the same district there are reserves of a low grade iron ore (25 to 35 per cent) called "Taconita" which can be concentrated to 60 per cent by means of a complicated process, and two pilot plants have been constructed with an annual capacity of 200 thousand tons of concentrate. If this shows good results, there will be an additional 1,700 million tons of 50 per cent grade concentrates available, which means approximately 40 years supply at the 1948 rate of extraction. Two large United States steel firms have signed a contract involving the joint investment of 60 million dollars, with the object of building a plant capable of

/concentrating

concentrating 2.5 million tons of Taconita per year. If they achieve the success which they expect, they will invest a further 100 million dollars so as to raise the annual production of Taconita concentrates to 10 million tons.

It is obvious that the concentrating of Taconita means an increase in the cost of the ore, and for this reason high grade ore reserves in other countries again become a commercial proposition, in spite of the fact that they have to be transported a greater distance to the metal-working districts than those of Mesabi, across the Great Lakes.

Amongst the foreign deposits are those in Labrador and New Quebec in Canada, in which 200 million dollars are being invested (including the construction of a railway 576 kilometres long, ports etc.). Proven reserves cover about 323 million tons of 55 per cent grade ore and the present plan involves the extraction of some 10 million tons per year. The distance which the Mesabi ore has to be transported to Cleveland is 147 kilometres by rail, and 1,340 kilometres on the Lakes, as against 576 kilometres by rail and 1,400 on the St Lawrence river and on the Lakes, from Labrador. The difference between these hauls, therefore, will not greatly change present conditions.

Although more distant, the ores which they are preparing to work in Venezuela are more important. Reference in greater detail will be made to these deposits later on. Bethlehem Steel is investing 50 million dollars in preparations for the extraction and export of some 3 million tons per year of 65 to 68 per cent grade ore. United States Steel plan to invest 200 million dollars in installations capable of extracting some 10 million tons per year. The distance from Venezuela to Sparrows Point (Baltimore) is 1,813 nautical miles, which must be compared with 4,367 miles from El Tofo (Chile), whilst Chile is at an additional disadvantage in that there is a surcharge of 1.25 dollars per ton of freight passing through the Panama Canal.

Due to the higher grade of the Venezuelan ore compared to that of Mesabi, the projects which are being developed in that country represent 33 per cent of the ferrous material extracted from Mesabi in 1948.

Finally, Republic Steel is developing the ore of Bomi Hill, 72

/kilometres from

kilometres from the capital of Liberia.

Twenty million tons of 68 per cent grade ore have been proven. Eight million dollars are being invested in preparation for the working and shipping of this ore, but it is not known what export tonnage is anticipated. The distance from Monrovia (Liberia) to the East coast ports of the United States is 3,900 nautical miles.

Analysis by Countries

a) Argentina. The small blast furnace at Palpalá is working with ore from the Zapla deposit, and with charcoal which at present comes from the forests of Santiago del Estero, but which will later be supplied from plantations. (This furnace commenced operation on 11 October 1945. It has an annual capacity of some 18 to 20 thousand tons of pig-iron, and since the ore is 45 per cent grade on the average, it must consume some 45,000 metric tons per year.) No details are available regarding this plant. In the Argentine steel plan, mention was made of the intention to construct two similar furnaces in the same region, but no further news has been received regarding the present state of this project.

b) Brazil. Brazil has the largest iron ore reserves in Latin America, estimated at approximately 20,000 million tons of 48 per cent average grade of ore. One of the pre-eminent deposits is Itabira in Minas Gerais, which contains more than 1,000 million tons of ore, of a grade varying between 46 and 69 per cent. A contract was signed in 1942 by the Governments of Brazil, Great Britain and the United States, forming a private Brazilian company in which the Government owned part of the stock, La Companhia Vale do Rio Doce, with the object of exporting 3 million tons of ore per year. Later, this was reduced to 1500,000 tons, since it was found that a further investment of 50 million dollars would be required to recondition the railway from Itabira to the port of Victoria. Up to the end of 1949, 70 million dollars had been invested of which 25 million had been lent by the Export-Import Bank, Washington. The exports from 1945 are shown in Table 1. During 1949, exports were 471,910 tons, and a further 18,000 tons were supplied for domestic use, while by 1950 the export figure had risen to 721,765 tons. Mining is still done manually, and it will not be possible to attain the proposed 1500,000 tons per year without mechanization, which, it is hoped, will

/be completed

be completed in 1952 if the Company's present negotiations for an additional loan of 5 million dollars are successful. Approximately 75 per cent of the 1949 production went to the United States, and the remainder mainly to Canada, although small quantities also went to France, Belgium and Holland.

The steel plant at Volta Redonda, whose furnaces have a capacity for producing 1,000 tons of pig-iron daily, commenced operation in 1946 and uses ore from its own deposit at Lafayette, less than 230 kilometres from the plant. The consumption of ore at Volta Redonda has been added to that of the steel industry which has been in existence since the beginning of the century, using charcoal, and which also has expanded considerably. The most important concern is the Compañía Siderurgica Belgo-Mineira (Minas Gerais) with plants at Sabará and Monlevado. In October 1949 the Compañía Acos Especiais Itabira commenced to operate another furnace using charcoal, with an annual capacity of 60,000 tons of pig-iron. This is the largest plant of its type in the world.

Iron mining in Brazil at present operates more to meet the needs of the national steel industry, than for export. In spite of rapid expansion during the past few years, iron and steel production is still considered to be insufficient, and the Export-Import Bank has already granted a new loan to cover the construction of a second blast furnace and steel works at Volta Redonda which will double the output of pig-iron.

The extraction and export of iron ore, with Itabira shown separately, and the production of pig-iron in 1938 and from 1945 to 1949 is shown in the table below.

Table 1 Production of Iron Ore in Brazil, Production of Pig-Iron, and Gross Exports of Ore
(in metric tons)

Year	Production of iron ore a/	Production of pig-iron	Exports of 68 per cent grade ore	
			Totals	From Itabira
1938	538,400	122,352	368,400	
1945	944,863	259,909	300.000	101,694
1946	1,352,886	370,722	64,800	40,962
1947	1,607,929	480,929	196,800	174,290
1948	1,441,119	551,813	598,800	385,252
1949	1,433,600	508,219	675,600	471,910
1950		570,000 b/	900,172	721,765

Source: United Nations Monthly Bulletin of Statistics and Annual Statements of the Compañía Vale do Rio Doce, S.A.

a/ Estimated by adding consumption and exports.
b/ Estimated from the first nine months of the year.

/The table

The table shows a steady increase in the production of pig-iron, excepting the year 1949. The drop in that year was due to the fact that the Volta Redonda blast furnace had to be temporarily shut down in order to renew the refractories. Once this was accomplished the total production again started to rise, assisted by the output from the new blast furnace of the Companhia de Acos Especiais Itabira.

The overall export of minerals has exceeded, by approximately 200,000 tons per year, that of Itabira. Exports from Itabira should continue to increase as its new installations are completed, especially the railway to Victoria and its branches.

c) Chile. Since 1914 the Bethlehem Steel Company has been working the 60 per cent grade ore at El Tofo. The ore extracted has been exported to the United States, mainly to the plant at Sparrows Point opposite Baltimore, where it has been made into pig-iron together with ore from Cuba and other overseas sources. During the war, two special ships designed for the transport of this ore were lost, and shipments were suspended until 1945. At the present time the Company has eight of its own ships employed on this traffic.

Under agreements between Bethlehem Steel and the Chilean Government, the company must sell to Chile the ore which that country needs for its national steel industry. Up to 1950, only the Corral plant, with two small charcoal blast furnaces having an annual capacity of some 20,000 tons, were using the Bethlehem Steel ore, but in that year the new blast furnace at Huachipato commenced operation with a daily capacity of 650 tons of pig-iron.

The production and export of these minerals is shown in Table 2. In 1949 the output was 1,663,556 metric tons of metal content, or say about 2,770,000 tons of ore. At present, El Tofo has a proven reserve of only 15 million tons, and if to these exports is added domestic consumption which, including the operations at Concepcion, might rise to 400,000 tons per year, the El Tofo deposit has a life expectation of only five years.

For this reason Acero del Pacifico, representing the Chilean Development Corporation and the Government of Chile agreed with Bethlehem Steel in 1949 to bring into use the El Romeral deposit, which has a proven reserve of 20 million tons of 63 per cent grade ore.

/According to

According to this agreement, the opening up of the mine, the port and the means of transport necessary for an annual extraction of 1,000,000 tons, will require an investment of 8,250,000 dollars, of which 2,550,000 will be subscribed by the Acero del Pacífico who will have the right to acquire up to 350,000 tons of the ore per year. The work is well in hand, and should be completed by 31 December 1952. In order to meet its commitments, the Chilean Government is trying to obtain a loan from the Export-Import Bank. The agreement contains clauses which permit either party to withdraw and to receive from the remaining party the return of investments not amortized.

The Chilean iron ore production capacity will therefore remain at around 3 million tons until December 1952. From then on, until the exhaustion of the El Tofo reserves in 1956, it will be 4 million tons per year falling by one million tons after 1956, when that deposit ceases to produce. This, naturally, is always assuming that Bethlehem Steel does not open up any of the neighbouring reserves such as the Algarrobo mine, for instance (which has approximately 50 million tons of proven 61 per cent grade ore). Nothing has been made public about Bethlehem Steel's policy in this direction, but it is worth noting that the mines which this company is opening up in Venezuela will produce 3 million tons a year, equal to the present capacity of El Tofo, and will have a much shorter ocean journey to Sparrows Point, in addition to avoiding the Panama Canal tax.

Production of iron ore in Chile, exports and production of pig-iron in 1938, and annually from 1945 onwards, are shown in Table 2 below.

Table 2 Production of Pig-Iron in Chile and Production and Export of Iron Ore

(in metric tons)

Year	Production of iron ore	Export of iron ore	Production of pig-iron a/
1938	1,608,000	1,570,000	—
1945	276,000	217,500	13,440
1946	1,176,000	1,183,800	13,560
1947	1,740,000	1,747,000	11,400
1948	2,712,000	2,625,000	14,400
1949	2,748,000	2,742,000	18,600
1950	2,964,000	2,715,000	108,000 b/

Source: Monthly Bulletins issued by the Banco Central de Chile.

a/ Excluding a small amount produced by the Siderurgica de Talca.

b/ Estimated.

/The consumption

The consumption of the Huachipato steel mills may rise to about 300,000 tons per year, and since it seems that the productive capacity of El Tofo is greater than its present output, which is mainly limited by the carrying capacity of its ships, it is most probable that the extraction will rise to a figure slightly higher than 3 million tons in the coming years.

d) Colombia. In July of 1950 the Government of Colombia issued a Decree, imposing a tax which will produce an annual revenue of 9 million pesos (about 4.5 million dollars at the official rate of exchange) to finance the construction of a blast furnace at Paz del Rio, near Bogotá, with a daily capacity of 355 tons. With a guaranteed income from this tax, French bankers are going to advance 20 million dollars, partly in cash and partly in machinery towards the construction of the blast furnace and steel works, and to bring into operation the coal and iron mines in the district. The construction will be directed by United States consultants, but so far there is no news of how long this may take.

A blast furnace of this size might consume up to 170,000 tons of ore per year.

e) Cuba. Cuba is second to Brazil in Latin America, in richness of iron ore deposits, reserves being estimated at 3,000 million metric tons. The exploiting of minerals was commenced in 1884, when almost the entire output was exported to the United States. The principal mines were Daiquirí-Juraguamen on the south coast and Mayarí on the north coast. In 1936 the reserves of pure iron ore were almost exhausted, the average grade of ore at Daiquirí-Juraguamen having fallen to 56.7 per cent for hematites and 32.0 per cent for silicates, whilst Mayarí showed an average grade of 54.9 per cent. Between 1884 and 1938, Cuba exported a total of approximately 27 million tons of ore.

The large remaining reserves consist of iron ore carrying additions of chrome and nickel, both of these being important constituents of special steels. However, they complicate the metallurgical process to an extent which almost renders the ore valueless. For this reason, iron exports from Cuba have fallen to very small quantities which are used by Bethlehem Steel at Sparrows Point for special purposes or for experimental work.

/The exports

The exports of iron ore from Cuba are shown in Table 3 below.

Table 3 Exports of Iron Ore from Cuba

Year	Metric Tons
1937	456,827
1939	166,739
1945	165
1946	84,675
1947	15,381
1948	36,017

Source: Anuarios de Comercio Exterior de Cuba.

f) Mexico. Mexico is rich in good quality iron ore, and is the only Latin American country which has important reserves of high-coking coal. For this reason, the production of pig-iron has increased in the last few years, although to a much lesser extent than in Brazil. Furthermore, the export of moderate quantities of iron ore has been maintained, almost the entire quantity being sent to a steel plant in Texas.

The production of the Mexican blast furnaces has become insufficient to meet the country's needs and it is intended to enlarge the Monclova plant.

It appears that the chief difficulty lies in producing sufficient coal and in washing it to reduce the ash content, to meet at least partially the requirements of the steel industry. This problem is being very carefully examined, and amongst others, a commission of the United Nations has made a study of the exploitation and preparation of the coal from the Coahuila formation which supplies fuel to the existing blast furnaces. In September 1950, the Export-Import Bank, with the guarantee of the Nacional Financiera, granted a loan of 2.7 million dollars to one of the Mexican coal-mining companies in order to increase the production of coke.

The Mexican production of iron ore, and of pig-iron, and exports of the former are shown in Table 4.

This table also shows the upward trend of the Mexican steel industry as shown by the production of pig-iron, whilst the exports of iron ore merely consist of the unused surplus.

/Table 4

Table 4 Production of Iron Ore and Pig Iron, and Exports of Iron Ore from Mexico
(in thousands of metric tons)

Year	Production of iron ore a/ (fine metal)	Production of pig-iron	Exports of iron ore (fine metal)	Fine metal content of the pig-iron and exports
1938	99.6	98.4	10.8	109.2
1945	175.2	218.4	32.4	250.8
1946	170.4	282.0	9.8	291.8
1947	225.6	337.2	47.3	384.5
1948	226.8	283.2	108.0	391.2
1949	246.0	358.8	--	--

Source: United Nations Monthly Bulletin of Statistics.

Note: The gross tonnages given in the annual reports on foreign trade have been reduced to fine metal content, using the average grade of 1948, when 159,720 tons of ore produced 107,941 tons of fine metal.

g) Peru. At the beginning of 1950, the Peruvian Government allotted the necessary funds (600,000 dollars) for the construction of a Tysland Hole electric furnace at Chimbote, with a daily capacity of 100 tons of pig-iron. The electric power will come from the Rio Santa (Los Patos Valley, in Huallancas), the reducing agent will be anthracite from the Valle del Santa, and the iron ore will come from Marcona, south of Lima. Preparations are going ahead in the deposit, and the road to the sea and and the port of San Juan are being prepared to take the traffic. Some years will be needed to complete this work, and until then it is improbable that the exploitation of the iron ore will be commenced.

h) El Salvador. Outcrops of iron ore have recently been discovered, and the deposits are being investigated. Nothing has so far been announced regarding the analysis of the ore, nor the extent of the deposit. However favourable the results of the analysis may be, therefore, it will be some years before exploitation can be commenced.

i) Venezuela. Two big projects are being developed in Venezuela for the exploitation of iron ore. The older one is that of Bethlehem Steel, who have concessions in El Pao which are estimated to contain more than 300 million tons of iron ore of a grade higher than 60 per cent. It is estimated that 50 million dollars have been invested, and production, which should start at the end of 1950, will be 3 million tons per year.

A railway 52 kilometres long will connect the El Pao deposit with the port of Palúa on the Orinoco, from whence the ore will be transported in 4,000 ton barges to Puerto de Hierro on the Gulf of Paria, where it

/will be

will be embarked on ocean-going ships. The second and more important project is that of United States Steel Corporation, but on this subject nothing definite has as yet been made public. One of the concessions held by United States Steel is Cerro Bolívar, which is estimated to contain 300 million tons of ore. It is said that the company proposes to extract 10 million tons per year, and that the total investment is at least 200 million dollars.

Since some points of the plan were still undecided at the beginning of 1950, in particular the method of transport to the coast, it will be some years before this company commences to export Venezuelan ore.

Finally, it must be recorded that the reserves in these concessions are much greater than the figures given, which only include the tonnage of ore of a grade higher than 65 per cent which, according to information published by the grantees, has definitely been proven. In these concessions there is, therefore, an additional unknown quantity of high grade ore, and also a considerably greater amount of ore which, although of a lower grade, is still better than the average grade of Mesabi, United States. Furthermore, El Pao and Cerro Bolivar are not the only known iron ore deposits in Venezuela, although very little information is available regarding the remainder.

Summary

The production of iron ore and of pig-iron, and the exportable surplus of ore from the Latin American countries is shown in Table 5. This table also shows the price of Mesabi ore placed on the Great Lakes in the United States, and the cost of Latin American ore also placed in the United States.

/Table 5

Table 5 Production of Iron Ore and of Pig-Iron, Exports of Ore, and the Value of these Exports, placed in the United States, for all Latin America

Year	Fine Metal Content			Value per metric ton of fine metal (dollars)	Total value of exports (thousands of dollars)
	Production of iron ore	Pig-iron	Exports of iron ore		
	(in thousands of tons)				
	a/	a/	a/ b/	c/	
1938	1,506	220	1,285	10.03	12,888
1945	878	492	386	9.25	3,570
1946	1,507	684	823	10.22	8,411
1947	2,098	849	1,251	11.22	14,036
1948	3,041	867	2,174	13.30	28,914
1949	3,086	895	2,192	14.46	31,686

Source: Metal Statistics of the American Metal Market, United Nations Monthly Bulletin of Statistics and the publications of the Direcciones de Estadística of the various countries.

a/ Includes an estimate for Argentina for 1947-49 and for the exports from Mexico and Cuba in 1949.

b/ Exportable surpluses.

c/ Prices of Mesabi ore placed Lake Superior, according to the Metal Statistics of the American Metal Market.

The export values include ocean freight, amortization of machinery and profits and the other expenses overseas, so that the Latin American countries have not received the whole of these amounts.

Assuming that iron ore exports, as in the case of most other minerals, give their country of origin an income amounting to 60 per cent of their value, placed in the United States, then the net amount derived from this ore in 1949 was probably about 20 million dollars. On the other hand, a much greater saving of foreign exchange is achieved from the 900,000 tons made into pig-iron, which provided the raw material for nearly 28 per cent of all the iron and steel used in Latin America. In fact, had this been imported as pig-iron, its value would have been about 54 million dollars, and if the labour and fuel used in making it into finished steel is taken into account, there is a total saving of more than 85 million dollars.

Both these figures should rise in the near future: that of the export of iron ore because of the greater output from Itabira in Brazil, and the commencement of production in El Pao in Venezuela. The total may

/rise to

rise to double the 1949-1950 figure. The output of pig-iron, and the subsequent manufacture of steel will increase after June 1950, when production commenced at Huachipato in Chile, and also because of enlargements of plants at present being carried out in Brazil.

General Comments on Copper, Lead, Tin and Zinc

These four occupy the leading position in world mining of non-ferrous industrial metals. They are also the most important to Latin America, because of the value of their exports which amongst mining products is only exceeded by that of petroleum. Aluminium, of which very little is produced in Latin America, has recently become equally important amongst the industrial metals. The recent developments and trends of petroleum will be reviewed separately, and aluminium will be mentioned only in passing, for the reason already given.

These mining products have common problems from the Latin American point of view in that the mining of each of them is directed almost entirely towards exports. For this reason the analyses of markets and price trends have been grouped into a single chapter, with separate chapters covering the supply and demand situation as it affects each metal.

The changes which have taken place in the United States will receive special attention, since that country is the major consumer, and the cyclical variations there largely determine the prices. It is there also that the latest technical modifications are first introduced, which may give rise to new applications, or to the discontinuing of others.

The United States Market

The United States, besides being the chief market for these four metals, is also the chief producer of three of them: copper, lead and zinc, although no tin is produced.[1/]

In order to give a superficial idea of the development of the United States market, Table 6 shows the consumption of virgin metal, of

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1/ Analysis of the United States market for copper, lead and zinc is complicated by the fact that the country is a traditional importer of the ores, re-exporting them, either totally or in part once refined. As regards tin, in 1942 a refinery was opened in Texas, with an annual capacity of about 44,000 tons, working with imported concentrates, but this does not meet the requirements of the United States market, and must be supplemented with imports of refined pig-iron.

/any origin

any origin and production from domestic ores, in average figures for the years 1927-1929, 1936-1938 and 1947-1949.

Table 6 Consumption of Virgin Metals in the United States, and Production from Domestic Ores

(thousands of metric tons)

	1927-1929		1936-1938		1947-1949	
	Consumption	Production	Consumption	Production	Consumption	Production
Copper	775	849	456	606	1,015	705
Lead	664	608	378	365	586	456
Zinc	528	567	555	519	820	550
Tin	81.4	0.1	64 a/	0.1	54.6 b/	--

Source: Yearbooks of the American Bureau of Metal Statistics, except where otherwise stated.

a/ Metal Statistics of the American Metal Market 1949, page 441.

b/ International Tin Study Group 1949-1950, page 47.

c/ Metal Statistics of the American Metal Market 1949, page 451.

It may be seen from the table that the consumption of zinc has risen in each of the three periods, whilst tin, on the contrary, has fallen. Copper declined in 1936-1938 as compared with the 'twenties, but since the war has risen far above the original figures, whilst lead, which also fell during the 'thirties, increased in 1947-1949, although even in this latter period it never regained the 1927-1929 level.

The consumption of industrial metals depends on the manufacturing output, but over a long period there are other influencing factors, as is shown by the different reactions of the four metals in question during the periods covered by the table. Later, an attempt will be made to discover what these factors are.

Table 7 gives an analysis of virgin metal consumption and production from domestic mines, showing the apparent supply surpluses or shortages.

/Table 7

Table 7 Apparent Balances Between the Consumption and Production of Copper, Tin, Lead and Zinc in the United States.
(+ = exportable surplus, - = balance to be imported)
(in thousands of metric tons)

	1927-1929	1936-1938	1947-1949
Copper	+ 74	+ 150	-309
Lead	- 36	- 13	-130
Zinc	+ 39	- 36	-270
Tin	- 81.3	- 63.9	- 54.6

Source: Yearbooks of the American Bureau of Metal Statistics for copper, lead and zinc; and for tin: International Tin Study Group, Statistical Yearbook 1949, Tin 1949-50, and Metal Market Statistics 1949.

Except in the case of tin, where consumption has fallen considerably, the table shows that the United States must depend increasingly upon foreign supplies. For instance, from being a net exporter of copper and zinc in the 'twenties, the United States has become a net importer of quantities equal to 44 and 49 per cent respectively of domestic production. The 1947-1949 imports of lead equal 28 per cent of the production of the United States mines.

Canada and Latin America benefited most from this expanding market, finding there, to a greater or lesser degree, an outlet for the metals which Europe and Japan have ceased to buy since the war. Disregarding the present rearmament activity, which, whilst it lasts, ensures a steady market for all the possible Latin American production, doubt has been widely expressed regarding the possibility of the United States maintaining the present high consumption level (for civilian use only).

It is expected, however, that the revival of industrial activity in Europe, which should result from the maturing of plans set in motion by the Governments in 1948, will increase the demand in these countries.

It is obvious that the exporters of ores are only interested in the possible variations in consumption of virgin metal, but actually scrap, which returns to the market after having been used, is acquiring increasing importance.

At the same time, the percentage of each of the metals re-used as scrap has varied at different periods. There is, in general, an upward trend, but for each metal this depends upon the usage of the

/metal.

metal.

For instance, lead which is used for batteries returns as scrap very quickly, but that which is used as tetra-sthyl for increasing the octanerating of gasoline is permanently lost, in combustion. Over a short period the proportion also changes according to the position within the economic cycle. During cyclical downswings, when prices fall, the proportion of secondary metal increases. This is due to a number of causes, amongst which may be mentioned: a) the majority of the equipment which is dismantled is liquidated during these periods of reduced activity thereby increasing the quantities of available scrap; b) the expenses of refining and transportation of scrap are its only actual "costs", so that during the cyclical downswings, when the fall in prices excludes the production of many marginal deposits, scrap may continue to flow into the market.

This does not mean that during recessions the quantum of secondary metal used will remain the same as during the upswings, 1/ but simply that the proportion increases in relation to the total. Table 8 shows the total consumption of the four metals in the United States between 1925 and 1949, including the proportion of scrap recorded by the statistics, i.e. that part which has been refined. The table also shows the percentage of scrap.

1/ In practice, during the cyclical upswings, the statistics omit an unimportant proportion of secondary metal, which is bought up by small industry, and used without being refined.

/Table 8.

Table 8 Total Consumption of Metals in the United States

Proportion of Scrap

(thousands of metric tons and percentages)

	Copper		Lead		Zinc		Tin	
	Consumption	Scrap %	Consumption	Scrap %	Consumption	Scrap %	Consumption	Scrap %
1925	737	9.0	778	20.4	525	6.7		
1926	820	9.3	816	14.3	564	6.6		
1927	748	10.6	762	19.0	529	7.4		
1928	892	11.7	844	26.2	568	7.8		
1929	1,015	14.9	882	25.0	575	7.6		
1930	733	16.9	696	18.8	408	7.8		
1931	551	10.4	514	22.2	336	5.9		
1932	305	19.9	377	27.2	235	5.8		
1933	347	23.4	407	42.5	317	8.6		
1934	378	26.5	443	40.0	326	5.5		
1935	524	24.5	488	35.3	429	6.2	72.3 a/	21.4
1936	733	16.2	574	40.6	528	7.2	84.3 a/	17.8
1937	796	17.8	615	27.6	553	8.3	91.5 a/	19.0
1938	473	17.3	495	29.2	382	7.6	60.7 a/	19.6
1939	725		665	37.0	568	8.0	83.7 a/	19.2
1946	1,144	15.8	864	38	726	5.6	82.2 a/	32.6
1947	1,255	19.8	1,063	41	713	7.6	88.6 a/	28.9
1948	1,220	19.8	1,024	42	731	7.6	91.8 a/	29.2
1949	935	22.8	787	44.5	637	7.8	72.6 a/	30.3
1950								

Source: Except where otherwise indicated the Yearbooks of the American Bureau of Metal Statistics.

a/ Consumption of primary and secondary tin, according to the U.S. Bureau of Mines.

Except where otherwise stated, the figures do not include the metallic content of either ore or scrap which has been made into chemical products, nor the secondary metal in brass, bronze or other copper alloys. Consequently, the figures do not represent the absolute totals of metals consumed, but statistics which have been compiled in the same manner over a period of many years make it possible to deduce the trends affecting demand and supply.

/In constructing

In constructing this table, it has been assumed that all the secondary metal has been absorbed by the domestic market, and that exports consist entirely of virgin metal.

In the case of zinc the percentage of scrap has not increased since the 'twenties, but in the cases of the other three, secondary metal is being increasingly used to supply the market. This has obviously reduced the rate of increase in virgin metal consumption. Table 9 shows the variations in the consumption of metals, and the influence of scrap.

Table 9. Increase in consumption of industrial metals in the United States in 1947/1949, compared with 1927/1929 (percentages)

	Copper	Lead	Zinc	Tin
Total consumption	28.2	52.0	25.0	7.0
Consumption of virgin metal	16.9	31.0	25.0	- 7.3

Source: Yearbooks of the American Bureau of Metal Statistics.

The different trends shown by the various metals are extremely interesting, and help to explain a series of market developments. These will be analyzed later, when each of the metals is discussed separately.

Tables 8 and 9 indicate that the development of total consumption is not closely related to the production of virgin metal. These tables also show that due to the increased proportion of scrap during the cyclical downswing virgin metal oscillates more sharply compared with total consumption. This phenomenon is proved in the case of the four metals under review, including zinc, in which case, as previously mentioned, the proportion of scrap has shown no tendency to increase during the course of the years.

Relation between Metals Consumption and Industrial Activity in the United States

Table 8 shows that there is a definite relationship between industrial activity and metals consumption in the United States, in that the latter was high in the years 1929, 1937 and 1948 when there was considerable industrial activity, and low in 1932, 1938 and 1949 when

/there was

there was less industrial activity than in the first years mentioned.

Table 10 shows the industrial activity indices, at constant prices, together with the consumption indices for the metals, taking 1935/39 as a base.

All the metals show a long-term trend towards a reduction in consumption for a given volume of manufacture. This phenomenon may be more clearly seen from Table 11 which shows the weight of metal consumed for each 100 dollars of manufacture, at 1938 prices.

This data is shown as curves in Chart 1, where this same trend can again be observed, although short-term variations will be noted as a result of cyclical variations in consumption. These vary in importance, depending upon greater or lesser percentages of the particular metals which are used for the manufacture of capital goods, or durable consumer goods.

The downward trend in the consumption of lead is so great that the reduction over-shadows the increase which should have occurred during the 1935/37 cyclical upswing. The chart only shows the rise in 1939, and those since the war. Copper, in its turn, varies more sharply during the cycles, probably due to the large proportion used in the manufacture of capital goods, whilst the decrease in consumption rate, compared with the 'twenties has been less than that of lead.

The decline in the consumption of zinc during the period 1925/39 was very small, and the extent of the cyclical variations much smaller than those of other metals. On the other hand, zinc consumption has fallen sharply since the war, as compared with 1935/38, and it has fluctuated in a most erratic manner during variations in manufacturing output. In the case of tin, of which a large proportion is used in the manufacture of consumer goods, (such as tinplate for containers) the cyclical variations are small, but there is a very sharp downward trend in consumption, especially if the postwar period is compared with that immediately before.

/Table 10.

Table 10. Comparison between United States Manufacturing Output at Constant Prices and the Consumption of Industrial Metals a/

(Index 1935-1939 = 100)

	Manufacturing output	Consumption			
		Copper	Lead	Zinc	Tin
1925	84	113	139	107	
1926	95	126	144	115	
1927	96	115	135	108	
1928	99	137	149	116	
1929	110	157	156	117	
1930	90	113	123	83	
1931	74	85	91	68	
1932	57	47	67	48	
1933	68	53	72	64	
1934	74	58	78	66	
1935	87	81	85	77	93
1936	104	113	102	107	108
1937	113	122	109	113	117
1938	87	73	87	78	78
1939	109	112	118	113	107
1946	177	177	153	148	105
1947	194	193	188	145	113
1948	198	188	182	149	117
1949	183	144	139	130	93
1950					

Sources: For manufacturing output - Statistical Abstracts of the United States. For metal consumption Yearbook of the American Bureau of Metal Statistics.

a/ Including secondary metals, according to the figures in Table 8.

/Table 11.

Table 11. Consumption of metals per 100 dollars of manufacturing output at 1938 prices

(in kilos)

	Copper	Lead	Zinc	Tin
1925	4.41	4.66	3.14	
1926	4.36	4.34	3.00	
1927	3.96	4.03	2.80	
1928	4.51	4.26	2.87	
1929	4.92	4.28	2.79	
1930	4.31	4.09	2.40	
1931	3.93	3.67	2.40	
1932	2.82	3.49	2.18	
1933	2.69	3.16	2.46	
1934	2.68	3.14	2.31	
1935	3.21	2.99	2.63	0.443
1336	3.80	2.98	2.74	0.437
1937	3.75	2.90	2.60	0.430
1938	2.84	2.97	2.29	0.365
1939	3.48	3.20	2.72	0.357
1946	3.55	2.68	2.25	0.255
1947	3.45	2.92	1.96	0.244
1948	3.31	2.77	2.01	0.249
1949	2.73	2.30	1.86	0.206

Sources: For metal consumption the Yearbooks of the American Bureau of Metal Statistics. For manufacturing output E.C.E. European Steel Trends in the Setting of the World Markets and Statistical Abstracts of the United States.

The present trends are more clearly seen in Table 12, which compares 1936/39 consumption with that of 1946/49, for a given volume of manufacture.

Table 12. Comparison of the average metals consumption per 100 dollars of manufacturing output in 1936/39 and 1946/49, at 1938 prices

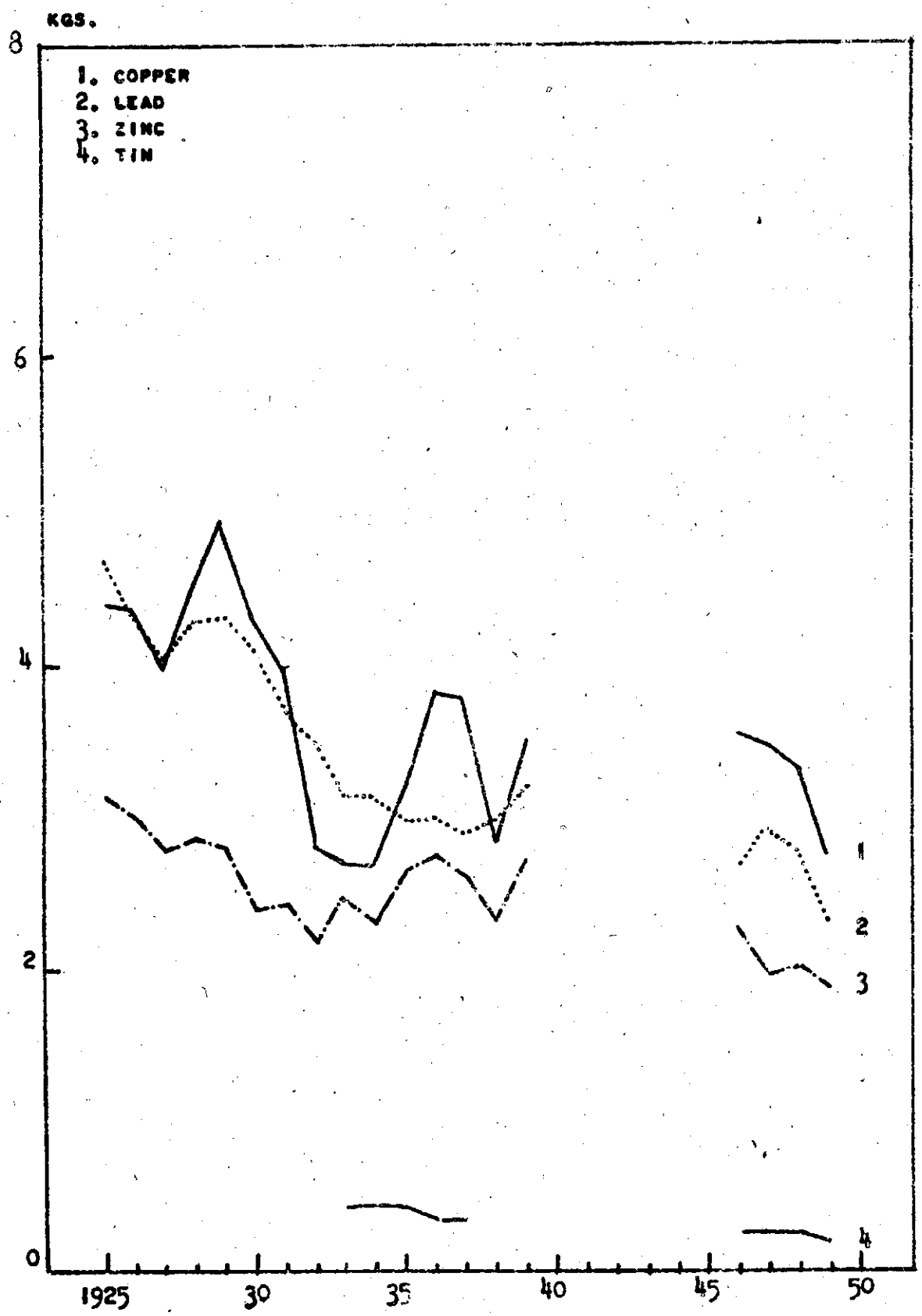
	Consumption in kilograms		
	1936/39	1946/49	Percentage drop
Copper	3.47	3.26	6
Lead	2.99	2.48	17
Zinc	2.59	2.02	22
Tin	0.397	0.238	40

Sources: For manufacturing output Statistical Abstracts of the United States. For metals consumption Yearbook of the American Bureau of Metal Statistics and International Tin Study Group.

/Factors which

CHART I

METAL CONSUMPTION IN THE UNITED STATES PER 100 DOLLARS OF MANUFACTURING OUTPUT AT 1938 PRICES



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Factors Which Determine the Decline in Consumption of Metals, for a Given Volume of Manufacturing Output

The differences in the reductions shown in Table 12 lead to the assumption that they are governed by separate factors in the case of each metal. Actually, the metals market of any country is in a permanent state of flux; new applications are introduced, and others which have been in use for many years are discontinued, so that the increase or decrease in consumption depends upon the resultant action of these opposing factors. Apart from influences peculiar to one metal, there are others which have a wide application, and which affect all metals, and of these the following may be mentioned: a) Technical improvements which enable more efficient use of metals, greater output being achieved from the use of any given quantity; b) The invention of plastic and synthetic products, which replace metals in many applications; c) The replacement of the four metals under review, in some of their uses, by aluminum, because of its special properties, and also the relative cost reduction thereby achieved.

The factors affecting the particular situation of each metal will be reviewed in the relevant chapters.

In considering factors affecting the decline over the whole field, special attention must be paid to technical advances, which enable the attainment of the same results with a much smaller quantity of metal. It is interesting to note, for instance, the reduction in the weight-output ratio of certain items of electrical machinery since the beginning of the century.

Table 13. Weight of electrical equipment per unit of power

Index 1950 = 100

Year	Steam turbo-generator of 60.000 K.W.	Transformers, weight of nucleus per watt	7 1/2 H.P. Electric Motors
1950	100	100	100
1945	114	100	120
1935	135	110	120
1925	202	133	147
1915	270	171	147
1905	- -	280	180
1900	- -	400	428

Source: The Westinghouse Engineer, 1900-1950, July 1950.

/The table

The table shows that improvements in these items since the beginning of the century have reduced the weight by 25 per cent. These results have been achieved by means of a number of small inventions, and by the ability to manufacture more suitable materials, mainly special steel alloys. Similar progress has been, and continued to be made, in many directions towards the reduction of the quantity of raw material, including metal, used for any given volume of manufacture.

It is difficult to give detailed figures covering metal substitution by plastic or synthetic materials, but it should suffice to draw attention to the number of personal and household articles in which this replacement has been effected in the past few years.

Price Fluctuations of Industrial Metals

Apart from the factors reviewed in the foregoing, in those cases when it is technically possible to use indifferently either one metal or the other, consumption is governed by comparative prices. Since such a substitution entails technical preparation, or at least a change of tooling in the industries concerned, some time must elapse from the moment of price-change to the time when the change in consumption becomes effective.

It should be mentioned that price changes due to cyclical movement, or temporary causes, have very little influence on consumption variations, which only occur when the price changes are due to more lasting reasons.

In order to analyse the situation regarding the metals under review, Table 14 has been prepared to show the average prices in New York in each five-year period since the beginning of the century, and the average for each year since the war.

The same information is presented in Chart 2. In the course of the half year covered by these figures, the prices of the various metals have experienced different individual variations. Between 1900/04 and 1945/49, lead and zinc, which are usually found together in the same deposit have risen by 194 per cent and 124 per cent respectively. These increases reflect the combined action of increased costs to an extent which, in the United States, it has been impossible to counter-balance

/by increased

CHART 2

ANNUAL OF FIVE-MONTHS AVERAGE PRICES OF INDUSTRIAL METALS IN THE UNITED STATES.

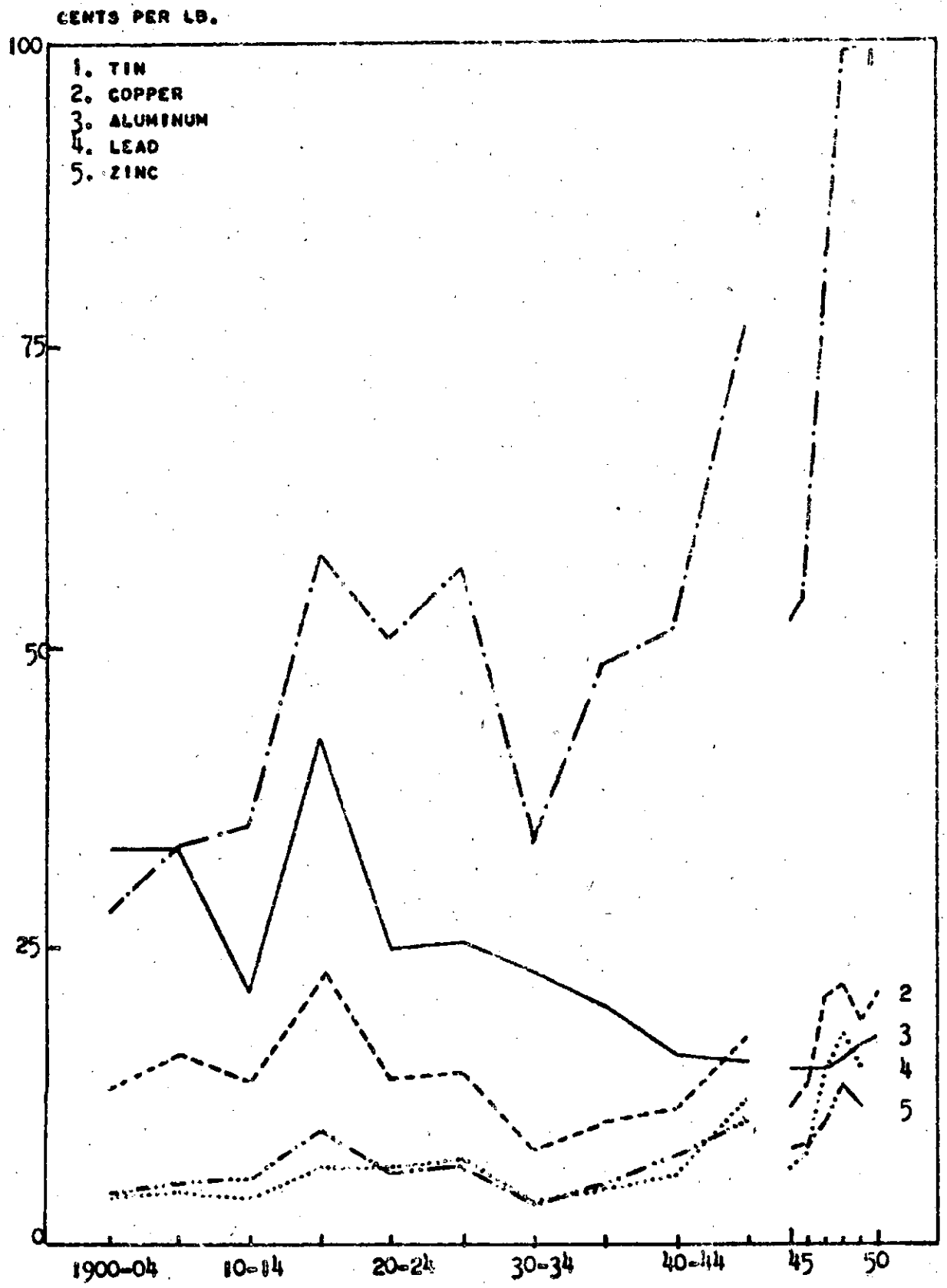

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Table 14. Average Prices of Industrial Metals in the United States

(Yearly or five-yearly averages, in United States cents per pound)

Period	Aluminum	Copper	Lead	Zinc a/	Tin
1900/04	33.50	13.449	4.263	4.753	27.902
1905/09	33.29	16.212	4.832	5.504	33.712
1910/14	21.32	14.065	4.314	5.668	40.211
1915/19	42.39	22.995	6.698	9.859	58.140
1920/24	24.99	14.157	6.720	6.199	50.882
1925/29	25.48	14.687	7.466	6.750	56.622
1930/34	23.05	8.421	4.139	3.852	33.896
1935/39	20.22	10.451	4.915	5.092	48.766
1940/45	16.04	11.684	6.091	7.712	51.565
1945/49	15.55	17.559	12.538	10.642	76.616
1945	15.00	11.775	6.500	8.250	52.000
1946	15.00	13.820	8.109	8.726	54.544
1947	15.00	20.958	14.673	10.500	77.949
1948	15.73	22.038	18.043	13.589	99.250
1949	17.00	19.202	15.364	12.144	99.336
1950	17.57	21.540			

Source: Engineering and Mining Journal. Yearbook of the American Bureau of Metal Statistics.

a/ Prices in St. Louis

by increased productivity. The most important factors in the increased costs have been the progressive lowering of the average grade of ore worked, and the greater depth of the workings. In countries where the exhaustion of mineral resources is not so extensive as in the United States, the greater margin allowed by the price increases has been consumed by taxes which often surpass that margin, with a consequent reduction in the profits which the producers used to receive. Whilst on this subject, it must be stated that the United States financed mining in Latin America has introduced in the main the same technical improvements which have increased productivity in the United States into its mines in those countries. The margin available for profit and taxation has therefore been increased by these investments. On the other hand, lead, zinc and copper are subject to import duty and consumer tax in the United States, and these impositions must be discounted from the market prices, in order to discover the amount received by the Latin American producers for metal exported to that country.

Between 1900-1904 and 1945-1949 tin rose by 175 per cent, 1.9 less than lead and more than zinc. Since the United States does not produce tin, these increases show to a certain extent the increases in costs in the producer countries. These increases are due to factors similar to those affecting lead and zinc mining in the United States, to higher taxation in the producer countries, and finally to the rising standard of living of the workmen. Increased productivity has partly off-set the greater costs. The balance between these various conditions has not been achieved in the same way in the various countries, the reason for this being that both the quantum of their production and their share of the total extraction have been changing with the passing of time.

The increase in the price of copper between 1900-1904 and 1945-1949 has only been 31 per cent, and, in fact, this has only taken place since 1946.

This really constitutes a relative reduction in price, and is due to the extraordinary increase in productivity caused by mass exploitation of open-cast mines as against the selective working of seams which was usual at the beginning of the century. The new method was introduced in the

/United States

United States before the first world war and later was extended to Canada, Chile and both British and Belgian Africa. The price of copper remained fairly steady for nearly half a century, varying only from about 13 to 15 cents per pound, instead of falling after the general adoption of the new type of mining.

This allowed many seam mines to continue operation, but at the same time gave excellent profits to the owners of the new open-cast mines. In the United States the average grade of ore worked has been falling in the course of the years, and this, added to the increased costs and higher taxation has nullified the initial advantage held by the open-cast mines, and for this reason copper is now tending to increase in price in common with lead and zinc.

In some of the other countries, where the reserves are so abundant that there have only been isolated instances of a reduction in the average grade of ore, taxes have risen at varying rates, increasing both the percentage of the value of the copper which benefits the respective economies, and these economies' dependence on the demand for copper.

Finally, the price of aluminium has shown an almost unbroken decline during this period, due to improved production methods, to the increase in size of the operations and to the greater availability of electric power, which is one of the most important items in the production of this metal.

The continued decline in the price of aluminium whilst the prices of lead, zinc and tin were rising, has given increasing impetus to the replacement of the former for the other three metals. On the other hand, the trend of copper prices, which remained parallel to that of aluminium until 1935-1939, commenced to change from that time to such an extent that, even in the midst of war, the unit price of aluminium fell below that of copper and this adverse comparison is increasing.

Consequently it may be affirmed that the price reasons for the substitution of aluminium for lead, tin and zinc have steadily increased since the beginning of the century in direct proportion to the perfecting of the technique of each application. In the case of copper, this appeared only recently, in 1935-1939, but the incentive has increased

/progressively

progressively [1] since that period in proportion to the price increase rate.

Increases in Manufacturing Output

As stated earlier, certain special factors tend to increase the consumption of some metals and decrease that of others. Amongst these factors are the increase of population and the raising of the standard of living, which later is generally caused by, and in proportion to, greater manufacturing output.

Chart 3 shows the manufacturing output per inhabitant in the United States between 1900 and 1949 and the average trend of this output is also plotted. The corresponding equation [2] is

$$y = 45.28 + 2.3645\ t$$

in which y is the index of manufacturing output (1935-1939 = 100) and is the number of years since 1900. As may be seen from the graph, this trend of manufacturing output is the result of all important influences affecting industrial activity in the United States: the two world wars and the great depression of the 'thirties.

The existence of a general trend towards a raising of the standard of living and therefore of manufacturing output was a universally accepted principle of the nineteenth century and up to the end of the 'twenties in the present century. The great depression, which reduced manufacturing output in the United States to such an extent that the period 1925-1938 showed a downward trend, gave rise to doubts as to the validity of this axiom. Since the rise has recommenced, it seems feasible to assume that the rate of the first half-century is representative of the average trend of manufacturing output in the comming years.

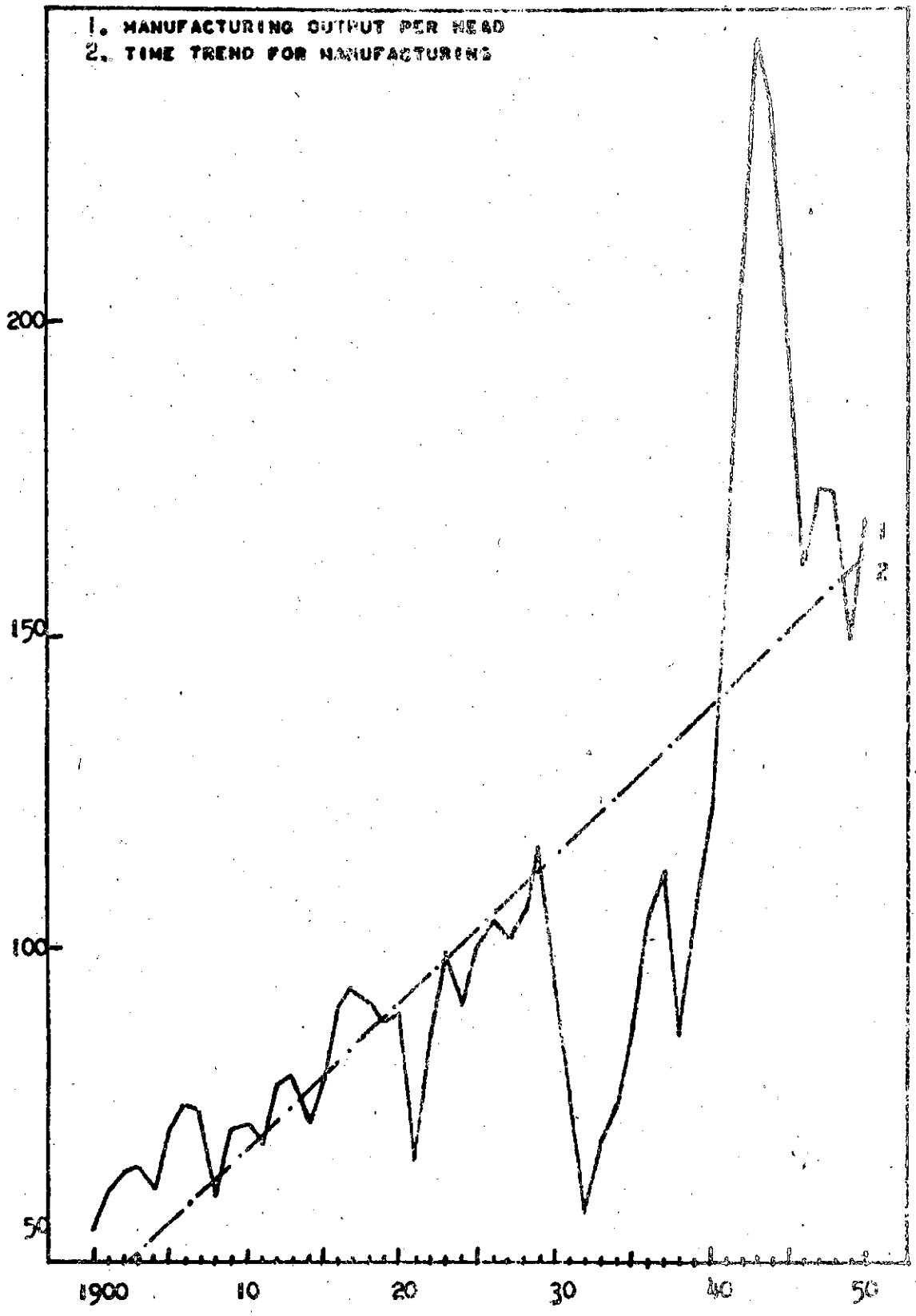
1/ This does not include the substitution of aluminium by copper in Germany before the war, due to the abundance of the former and the shortage of dollars for buying the latter.

2/ Determined by the method of least squares.

/According to

CHART 3

INDEX OF MANUFACTURING OUTPUT AND TIME TREND FOR MANUFACTURING



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According to the equation, the average trend of output per inhabitant of the United States, at constant prices, was an increase of 1.35 per cent per year between 1900 and 1949. On the other hand, the population of the country increased by 1.77 per cent in 1949; if it is accepted that this figure may be maintained for a few years, a total increase of 3.12 per cent per year may be expected in manufacturing output.

In practice, this increase does not follow a straight line such as that determined by the equation of the trend, but rather varies in accordance with the cyclical movements which, discounting the two world wars, have been as follows:

Table 15. Decline in Manufacturing Output During the Cyclical Downswing in Relation to the Preceding Upswing

Years Being Compared	Percentage Fall
1906 - 1908	20
1920 - 1921	25
1929 - 1932	50
1937 - 1938	23
1948 - 1949	14

Source: Historical Statistics of the United States 1789-1945 and Statistical Abstracts of the United States 1949.

The great difference between the amplitude of the variations of manufacturing output during the different cycles compels the discounting of any forecast concerning the extent of the next recession, and the most which may be established are the possible maximum and minimum figures. Each of the metals reacts differently to the variations and the outlook is further complicated by the fact that these reactions are affected by changes in the mode of consumption. Any evaluation of the results of these various factors must consequently be made separately for each metal and this will be attempted later in the relevant chapters.

It must be made quite clear, however, that the supply of metals should be sufficient to cover the demand during cyclical upswings, as otherwise a further reason would be provided for their replacement by others available in greater quantities, or by substitutes. In view of the impossibility of producing mining output at will, this condition can only be satisfied by one of two methods: a) that the productive capacity is sufficient to meet consumption during the peaks of the cycles and that it is only partially used during the remaining period, or b) that the

mining industry should develop only in order to supply the necessary average tonnages, and working the whole time at full capacity, accumulate stocks during the downswings in order to meet demand during the whole cycle, as has been attempted in other years in the case of tin.

The Supply of the Sterling Area

Table 16 shows the development of production and consumption of these four metals in the sterling area. The United Kingdom, which is the principal consumer, has been separated from the remainder which constitute its source of supply within this monetary area.

Table 16. Average Production and Consumption of Industrial Metals in the Sterling Area for the Periods 1927-29, 1936-38 and 1947-49 (in thousands of metric tons of virgin metal)

Metal	1927-29		1936-38		1947-49	
	Consumption	Production	Consumption	Production	Consumption	Prod.
United Kingdom						
Copper	152.0	--	273.7	--	347.4	--
Lead	266.3	8.5	362.2	29.3	177.0	2.4
Zinc	184.0	0.8	221.7	6.5	218.5	--
Tin	23.4	2.9	21.7	2.0	24.1	1.1
Remainder of the area a/						
Copper	20.1	48.8	35.1	263.0	63.3	299.9
Lead	35.3	251.6	31.6	343.9	47.0	241.4
Zinc	23.9	177.7	54.8	214.7	78.1	179.0
Tin	..	86.5	6.1	94.2	9.4	59.0

Sources: Yearbooks of the American Bureau of Metal Statistics and the statistics of the International Tin Study Group.

a/ Some figures are estimated: in general, the data of the following countries has been taken: India, Cyprus, Rhodesia, South West Africa, Union of South Africa, Australia, New Zealand, Burma, Siam (Thailand), Nigeria, Malaya and Egypt.

The table shows a general downward trend in United Kingdom production, as against an increase in the remainder of the area. However, the general trend is obscured in the post-war years by the temporary destruction of the means of production in the Far East, especially Burma in the case of lead and zinc, and Malaya, Burma and Thailand in the case of tin. A table showing the annual development from 1945 to 1949 would show the rate of post-war recovery, but this is being left until the individual analysis of each of the metals.

/With regard

With regard to consumption, the table shows a steady upward trend in the under-developed areas, although the post-war figures for this group are still insignificant. A steady increase in the consumption of copper in the United Kingdom may be seen, together with an irregular variation in the case of the other metals. As in the case of the United States, therefore, this leads to the conclusion that metals react differently to variations in industrial output.

The average trade balance of the four metals in the sterling area group is shown in Table 17.

Table 17. Apparent Balances between Production and Consumption of Industrial Metals in the Sterling Area.

(thousands of tons: + exportable surplus, - to be imported)

Metal	1927-29	1936-38	1947-49
Copper	- 123.3	- 45.8	- 111.7
Lead	- 41.5	- 20.6	+ 19.8
Zinc	- 29.4	- 55.3	- 117.6
Tin	+ 66.0 a/	+ 68.4	+ 26.6

Source: Yearbooks of the American Bureau of Metal Statistics and publications of the International Tin Study Group.

a/ The consumption of the under-developed zones of the sterling area, which may have totalled some 5,000 metric tons per year in 1927-1929, have not been taken into account.

In the case of copper, an increase may be noted in production within the sterling area between 1927-29 and 1936-38 which exceeds the increases in consumption, thereby improving the self-sufficiency of the area. During the post-war period the proportion becomes less satisfactory, but expansion plans under way will tend to increase once more the degree of self-sufficiency to such an extent that there may even be an exportable balance if there are no substantial new increases in consumption. The fall in production of lead in Burma and Australia was offset by a much greater reduction of consumption within the United Kingdom, so that there is an exportable balance which will be varied partly by the new production which has been planned and partly by possible increases in demand. The figures for zinc mainly show the very small contribution made by Burma, and those of tin are obviously affected by the delay in reopening the mines of Malaya and Thailand.

/Over a short

Over a short period, metal consumption in the United Kingdom is undoubtedly related to manufacturing output, and is modified, in the course of time, by technological factors which tend to vary the pattern of consumption for any given quantity of manufacturing output. The effect of these technological factors is always more delayed in the United Kingdom than in the United States, due to the more conservative nature of the industrial structure in Europe in general. For the same reason, cyclical variations which originate in the United States affect Europe to a lesser degree.

Table 18 shows the manufacturing output in the United Kingdom in thousands of millions of 1938 dollars, together with the metal consumption in kilogrammes for each hundred dollars of manufactured goods (at 1938 prices).

Table 18. Consumption of Virgin Metal in the United Kingdom per Hundred Dollars of Manufactured Goods at 1938 Prices

(Thousands of millions of dollars of manufactured goods at 1938 prices and consumption in kilogrammes per hundred dollars of manufactured goods)

Year	Manufacturing Output	Consumption in Kgs. per 100 dollars of manufactured goods			
		Copper	Lead	Zinc	Tin
1935	6.15	3.93	5.40	3.26	0.349
1936	6.78	3.82	5.19	3.29	0.323
1937	7.28	4.17	4.77	3.17	0.357
1938	6.70	3.88	5.80	3.15	0.273
1947	7.23	4.63	2.67	3.12	0.379
1948	8.10	4.47	2.60	2.78	0.312
1949	8.62	3.75	2.04	2.34	0.242

Sources: Consumption of metals: Yearbooks of the American Bureau of Metal Statistics and International Tin Study Group. Manufacturing output: Economic Commission for Europe, European Steel Trends in the Setting of the World Market.

The data given in this table certainly cannot be used for a comparison similar to that made for the United States in Table 12, since the consumption of scrap has not been taken into account, and this, in the case of lead, represented 45 per cent of the United Kingdom total supply in the year 1948.

The table does not show any fall in copper consumption in the post-war as compared to the pre-war period, for a given volume of manufacture, even though the figures for 1947 and 1948 could be considered abnormal and unduly high, possibly due to the meeting of demands deferred because of the war. On the other hand, it may be argued that these years were in

/fact normal

fact normal and that 1949 was unduly low because of limitations imposed by the shortage of dollars. This will undoubtedly become more clear in the coming years and for the moment it can only be stated that there are no clear indications of any reduction in copper consumption in the United Kingdom.

In other metals such a tendency towards reduction is obvious, especially in the case of lead, but this situation will be discussed in the chapters covering each separate metal.

The equation of the variation of manufacturing output per capita, in terms of time, in the United Kingdom for the period 1920-1937 is: $x = 113.1 + 2.54\ t$. where $t = 0$ in 1928. The average rate of increase of manufacturing output per capita in 1937 was therefore approximately 1.96 per cent,[1/] which is considerably more than that of the United States for the period 1900-1949, the figure for 1950 being 1.35 per cent. On the other hand however, the increase in the population of the United Kingdom is less since in 1949 this was only 0.6 per cent. Assuming that the upward trend in manufacturing output per capita, which was shown in 1920-37 is continued in the post-war period, this output as a whole may increase in a manner similar to that of the United States for the average of the cycles that is $1.96 + 0.60 = 2.56$ per cent compared with the 3.12 per cent noted for the United States.

Supply and Consumption of Industrial Metals in Europe

Table 19 shows the consumption and supply of Europe from domestic sources and dependent territories, in averages for 1927-29, 1936-38 and 1947-49.

1/ Economic Commission for Europe, European Steel Trends in the Setting of World Markets, page 112, which in its turn took the figures from tables prepared by the League of Nations: Industrialisation and Foreign Trade, 1945.

/Table 19.

Table 19. Production and Consumption of Industrial Metals in Europe and Dependent Territories (Excluding Russia and the United Kingdom)

(in thousands of tons of virgin metal)

Metal	1927-29		1936-38		1947-49	
	Consumption	Production	Consumption	Production	Consumption	production
Austria, Germany, France Belgium and Sweden						
Copper	391.0	35	544	40	356	16
Lead	418.0	206	445	132	170	90
Zinc	477	220	482	248	247	138
Tin	...	--	30.1	--	16	--
Remainder of Europe						
Copper	76	85	115	108	93 a/	37 a/
Lead	93	246	120	233	82 a/	34 a/
Zinc	80	167 a/	113	134	98 a/	54 a/
Tin	..	--	11	1.4	7.4	--
Dependent Territories						
Copper	--	110	--	129	--	163
Lead	--	41	--	42	--	46
Zinc	--	43	--	32	--	60
Tin	--	38	--	44	--	39
Total						
Copper	467	230	659	277	449 a/	216 a/
Lead	511	493	565	407	252	170 a/
Zinc	557	430 a/	595	414	345	252 a/
Tin	...	38	41.1	45.4	23.4	39

Sources: Yearbooks of the American Bureau of Metal Statistics and the International Tin Study Group.

a/ Excluding Yogoslavia, Poland and Rumania.

The table shows a rising trend in the production of the metals in the dependent territories but in the case of tin, as in the sterling area, the same delays may be seen in the revival of production, especially in Indonesia. Plans for expansion, some with private United States financial backing and others assisted by Marshall Plan funds, will undoubtedly result in an increase in production in the course of the coming years.

It will probably be difficult for production within Europe to regain the pre-war maximum, since this was achieved by exploiting some deposits

/to the point

to the point of exhaustion. The European figures for post-war extraction are also affected by the lack of information on Yugoslavia, Rumania and Poland, which all produced relatively important quantities.

The consumption in the six principal consumer countries which are given separately, shows the same upward trend as the rest of Europe in the pre-war period and a notable reduction since the war. This fall is particularly serious in the cases of lead, zinc and tin in the six principal consumer countries. As in the case of production, consumption comparisons between the periods 1936-38 and 1947-49 are made somewhat difficult by the absence of information in respect of some countries, and even in the six countries shown separately there is no information regarding post-war activity in East Germany.

Incidentally, it is interesting to note that the group called "Remainder of Europe" had an exportable balance of lead and zinc which came mainly from Poland. If free trade is not re-established between Eastern and Western Europe the latter will have to import considerably greater quantities.

The balances for Europe and its dependent territories, with the exceptions imposed by post-war lack of information in respect of Eastern Europe are shown in Table 20.

Table 20. Apparent Balances of Production and Consumption of Industrial Metals in Europe and its Dependent Territories a/

(in thousands of metric tons: + exportable surplus; - to be imported)

	1927-29	1936-38	1947-49
Copper	- 237	- 382	- 233 b/
Lead	- 18	- 158	- 82 b/
Zinc	- 127 b/	- 181	- 93 b/
Tin	...	+ 4.3	+ 15.6

Sources: Yearbooks of the American Bureau of Metal Statistics and International Tin Study Group.

a/ Excluding Russia and the United Kingdom.
b/ Excluding Poland, Rumania and Yugoslavia.

Examination of Table 19 and 20 shows that in 1947-49 Europe and its dependent territories used considerably more metals of their own production than in 1936-38. This of course was due to the fall in

/consumption,

consumption, since the production shown in the tables is also less than before the war. The reduction of manufacturing output in many countries as a result of the devastation caused by the war, is certainly one of the factors producing this reduction in consumption; another may possibly be the existence of a trend towards a change in the industrial structure similar to that which has been seen in the United States. In order to make this point more clear, Table 21 shows the consumption of virgin metals per hundred dollars of manufactured goods (at 1938 prices) in the six countries shown separately.

Table 21. Consumption of Virgin Metal in the Group of Six European Countries per Hundred Dollars of Manufacturing Output at 1938 Prices

(In thousands of millions of dollars of manufactured goods at 1938 prices and consumption per hundred dollars of manufacturing output)

Year	Manufacturing Output	Consumption in Kgs. per 100 dollars of manufactured goods			
		Copper	Lead	Zinc	Tin
1935	13,450	3.72	2.91	3.28	...
1936	14,530	3.20	2.828	3.12	0.182
1937	15,820	3.33	2.93	3.08	0.188
1938	15,630	3.68	2.84	3.29	0.207
1947	9,510	3.49	2.07	2.27	0.139
1948	11,260	2.77	1.52	2.02	0.169
1949 b/	13,580	3.19	1.32	2.17	0.121

Sources: For manufacturing output: Economic Commission for Europe; European Steel Trends in the Setting of World Markets; and for the consumption of metals; Yearbooks of the American Bureau of Metal Statistics and the Statistics of the International Tin Study Group.

a/ Germany, Austria, Belgium, France, Italy and Sweden
b/ Estimated.

It may be seen from the table that whilst the fall in consumption of copper per hundred dollars of manufactured goods has been very small, that of tin, lead and zinc has been considerable. By combining the data shown in Tables 20 and 21, it is possible to appreciate to a certain extent which part of the drop in consumption is due to the reduction of manufacturing output, and which part may be attributed to basic changes in industry. It is obviously a purely hypothetical calculation, since

/only a minor

only a minor change is needed in the volume of a country's manufacturing output to change the index of consumption of raw material.

Table 22. Distribution of the Fall in Consumption of Industrial Metals in the Six European Countries a/

(Percentage loss in 1947-1949 compared with 1936-1938)

Metal	Consumption in 1936-38 (thousands of metric tons)	Total drop in 1947-49	Fall in manufacturing output	Structural fall in consumption
Copper	544	33.0	25.4%	7.4%
Lead	445	61.7	25.4%	43.0
Zinc	482	48.8	25.4%	32.0%
Tin	30.1	46.9	25.4%	25.6

Sources: Data from tables 19, 20 and 21.

a/ Austria, Germany Belgium France Italy and Sweden
b/ Arithmetical averages.

This definitely shows that the post-war fall in the consumption of copper is mainly due to the reduction of manufacturing output, which in its turn was caused by the slow recovery of the economies of Italy, Austria and especially Germany. In the case of the other metals, the fall is also due to a change in the consumer structure which will later be discussed separately.

As in the case of the United Kingdom and the rest of Europe, these countries formulated plans in 1948-49 for the development of industry, and these have now been put in motion. These plans, which should achieve their objectives in 1952-53, will also be examined in the separate studies on each metal in an attempt to estimate future consumption trends.

In any case, examination of Table 21 shows that in 1947, with the sole exception of tin, there was a higher consumption of copper lead and zinc for a given amount of manufacturing output than in the following years. It must not be forgotten that part of the reduced use of these metals in Europe may be due to the shortage of means of payment which, owing to Marshall aid, were more plentiful in 1947.

Post-war Prices of Metals and Ratio between Supply and Demand

During the late war, the Governments of the United Kingdom and the United States were the only buyers of those metals available to the Allies.[1/]

1/ Excluding Russian production.

/Prices were

Prices were stabilised at slightly higher levels than those prevailing in the pre-war period. Consumer tax and import duties were therefore suspended on the 29 March 1942 and, in view of the additional demand created by armament production which caused a substantial increase in manufacturing output various means were adopted to foster mining output from all countries with natural resources.

Some of these encouraged capital investment for the expansion of productive capacity, either by means of direct loans or by authorisation for extraordinary amortisation by special investments, or finally through the commitment of the United States Government to buy during a certain period that part of the production which the mines could not sell in the usual markets. Also, subsidies were given to meet the costs of production from marginal ores, paying a certain subsidy over and above the basic price.

Latin American mining thus received a substantial stimulus during the period 1942-45. In 1946, after the war was over and before the controls were relaxed and reconversion to civilian activity completed, there was a slight recession whose extent cannot be clearly seen from the statistics, since it coincided with a period of considerable labour troubles and strikes in almost all the mining areas of the world.

Once these conflicts were settled and restrictions lifted,[1/] a new recovery can be seen in mining activities since demand always exceeded supply, up to the first quarter of 1949. During this period, the existing installations, transport systems and manpower were all working to capacity, and even so, except in a few cases, the high war-time levels were not held. This was apparently due to consequences of the war, such as wearing out of the equipment and disequilibrium between exploitation and development work. Finally after the war, labour troubles reappeared.

At the beginning of 1949, an economic recession commenced in the United States which lasted until October of that year, resulting in a fall in metal consumption. This recession extended to some European countries,

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1/ Tin constitutes a special case since the restrictions were not relaxed until 1949. Consequently, the study of production development of tin during the period 1946-50 will be made in the relevant section.

/especially in the

especially in the form of an acute shortage of dollars, which is the currency in which most metal transactions are carried out, and as a result, with few exceptions the consumption of metals also diminished in that continent.

The great world producers of the various metals agreed to reduce extraction during this period, so as to avoid the accumulation of unsold stocks which would have caused a further fall in prices. Between August and October 1949, the situation was completely reversed: there was a recovery of manufacturing output in the United States with a consequent increase in the consumption of metals. The devaluation of the pound sterling, which was rapidly followed by that of many other currencies, caused some uncertainty in prices, since because of the devaluation some metals especially lead and zinc were offered at reduced prices. The suspension of duties and taxes, which had been postponed for varying periods for the different metals began to be discontinued and these impositions were reinstated. In June 1950, when manufacturing output was approaching record peace-time levels, the events in Korea intervened and as a result of these the objectives of mining production became: a) the maintenance of supply for civilian consumption at high levels of manufacturing output; b) the separation of quantities of metals to augment the strategic reserve of the United States, and finally c) meeting the needs of the armament industry which was commencing to develop.

Obviously this triple programme could not be met with the existing world mining capacity. It therefore became necessary to resort to the expedients previously mentioned to increase productive capacity, and as from the first quarter of 1951 metals for civilian use were rationed.

Table 23 shows the manner in which these variations in demand and supply affected metal production month by month from June 1946 to December 1950.

/Table 23.

Table 23. Average Monthly Prices of Metals in Cents per Pound Placed in the United States, According to the Engineering and Mining Journal

		Copper New York a/	Lead New York	Zinc St. Louis	Tin New York
1946	June	14,055	8,180	8,250	52,000
	July	14,150	9,250	9,228	52,000
	August	14,150	8,235	8,25	52,000
	September	14,150	8,25	8,25	52,000
	October	14,150	8,25	8,865	52,000
	November	17,036	10,437	10,120	64,522
	December	19,275	12,190	10,500	70,000
1947	January	19,270	12,931	10,500	70,000
	February	19,349	13,182	10,500	70,000
	March	20,911	14,957	10,500	70,000
	April	21,225	15,000	10,500	80,000
	May	22,105	15,000	10,500	80,000
	June	21,348	15,000	10,500	80,000
	July	21,226	15,000	10,500	80,000
	August	21,225	15,000	10,500	80,000
	September	21,225	15,000	10,500	80,000
	October	21,209	15,000	10,500	80,000
	November	21,200	15,000	10,500	103,000
	December	21,200	15,000	10,500	85,385
1948	January	21,200	15,000	11,077	94,000
	February	21,200	15,000	12,000	94,000
	March	21,200	15,000	12,000	94,000
	April	21,200	17,212	12,000	94,000
	May	21,200	17,500	12,000	94,000
	June	21,200	17,500	12,000	103,000
	July	21,375	17,808	12,462	103,000
	August	23,085	19,500	10,000	103,000
	September	23,200	19,500	15,000	103,000
	October	23,200	19,500	15,240	103,000
	November	23,200	21,500	16,786	103,000
	December	23,200	21,500	17,500	103,000
	Average for 1948	22,038	18,043	13,539	99,250
1949	January	23,200	21,500	17,500	103,000
	February	23,200	21,500	17,500	103,000
	March	23,190	18,907	17,056	103,000
	April	21,700	15,154	14,058	103,000
	May	18,022	13,720	11,880	103,000
	June	16,525	12,000	9,548	103,000
	July	16,906	13,56	9,360	103,000
	August	17,325	15,032	10,000	103,000
	September	17,325	15,050	10,005	102,087
	October	17,325	13,420	9,320	95,720
	November	17,981	12,522	9,750	91,190
	December	18,200	12,000	9,753	79,038
	Average for 1949	19,242	15,364	12,144	99,336
1950	January	18,200	12,000	9,763	76,070
	February	18,200	12,000	9,750	74,352
	March	18,200	10,963	9,940	75,694
	April	18,640	10,630	10,664	76,430
	May	19,609	11,721	11,973	77,495
	June	21,995	11,808	14,647	77,688
	July	22,200	11,660	15,000	89,715
	August	22,272	12,926	15,052	102,194
	September	22,900	15,800	17,100	101,250
	October	24,200	16,040	17,500	113,420
	November	24,200	17,000	17,500	137,217
	December	24,200	17,000	17,500	144,940
		21,151	13,279	13,865	

a/ Up to the 7 September.

A considerable demand was thus caused in 1951 for copper and zinc, both of which have wide armament applications, and this was shortly followed by an increased demand for lead, which may be substituted for the other two in many applications. The price of tin, whose variations in producti n are not the same as those of the other metals and which will be examined separately later rose to heights never before achieved, partly due to a fear that the Western world could not count much longer on supplies from the Far East, and partly to the fact that the 1950 production fell far below the programmes and forecasts of the producers.

COPPER MINING

Introduction

Throughout this study, the term "production of copper" is to be understood as meaning the metal content of ores, concentrates and bars, refined or otherwise, which the mining industry in the various countries delivers ready for consumption or for export. By "consumption of copper" is meant the gross weight of metal processed, that is to say, the ores or concentrates directly transformed into copper sulphate, into bars, refined or otherwise, used in alloys, and refined bars used for sheet metal. In accordance with this, the copper contained in manufactured articles, which are the object of international trade, will be taken as consumed in the country in which the sheet metal is made.

In spite of the fact that the consumption of copper in Latin America has greatly increased since the thirties, rising from 5,517 tons in 1935 to 53,580 tons in 1949, Latin American copper mining is still directed towards export and consequently is greatly influenced by variations on the world market.

Changes in the World Pattern of Copper Trade

Up to the beginning of World War II, the United States was at the same time the greatest producer and the greatest consumer of copper in the world, and except in 1932, was a net exporter of this metal. At the end of the war, changes in the outline of world trade and in manufacturing output in the United States turned the country into a net importer. Table 24 gives figures illustrating this situation.

/Table 24.

Table 24. Copper: Consumption, Production and Balance in the United States

Period	Annual Averages Consumption	Production (in metric tons)	Balance + Exportable - To be Imported
1926-29	688,000	836,000	+ 148,000
1936-38	456,200	606,600	+ 150,400
1947-49	1,015,000	705,600	- 309,400

Source: Yearbooks of the American Bureau of Metal Statistics.

In 1936-38, therefore, both production and consumption of copper fell in the United States, whilst on the other hand net exports remained almost constant.[1/] During the post-war period under review, production, compared with 1936-38 was turned into an average annual import of 310,000 tons mainly supplied by Latin America with a small quantity coming from Canada and other countries.

The increase in the price of copper, which will be discussed later, induced the United States to undertake the expansion of existing installations and the opening up of new mines. Magma, at San Manuel, Arizona is certainly the most important of these projects. It is a mine which was discovered in 1943 and up to date represents one of the greatest additions to the copper reserve of the country since already 460 million tons of 0.8 per cent grade ore have been proven. The first stage, which is at present in course of execution, is to produce on the basis of 70,000 tons per year, and this is expected to be increased in the future. Nothing is known about the size of the proposed investment.

The Kennecott Copper Corporation is increasing the productive capacity of their Ray mine by 150 per cent, or say some 40,000 tons per year. They are also installing a new electrolytic refinery at Garfield, Utah, capable of producing some 170,000 tons of electrolytic copper per year with an investment of 16 million dollars. The Phelps Dodge Corporation is investing 80 million dollars in increasing the productive capacity of its mines at Morenci, Ajo and Bisbee, all in Arizona. At Morenci and Ajo work already begun will mean an annual

1/ By net exports is meant the net trade balance after deducting the amount taken into the United States for smelting, refining or both operations, and which afterwards is re-exported.

/increase in production

increase in production of about 60,000 and 16,000 tons respectively. The new investments at Bisbee are being used mainly for work on the lead-zinc ores in the deposit.

The Anaconda Copper Mining Company is investing 20 million dollars in 1948-50 on deep workings of their Butte mine. The ability to work this deposit as a sound economic proposition had added 1,300,000 tons to the copper reserves of the United States. This company hopes that this same mine will give a production of 15,000 tons in 1951 and 45,000 in 1952.

To these projects of the big companies must be added also those being undertaken by the smaller companies, about which it has been impossible to obtain information. If the probable totals resulting from the work at Magma and in the small mines is added to the figures already mentioned, it is no exaggeration to estimate that more than 200 million dollars were being invested in the increase of copper ore production in the United States before the beginning of events in Korea.

Since the outbreak of hostilities in Korea it has become obvious that the world copper production accessible to the United States is insufficient to meet, simultaneously, the requirements of civilian consumption and those of the armament industry, added to the need for setting aside copper for the stock pile. For this reason the Government has taken steps to provide assistance for increasing the extraction capacity of the United States, by means of direct loans and by rapid amortization of new private investments, and finally, by committing itself to buy from the companies over a certain number of years all the copper which they are unable to sell on the market. The following are some of the projects which have benefited by this assistance: the Copper Cities Mining Company has received an unspecified loan for opening up a mine in the district of Globe, Arizona, which within two years will be producing approximately 20,500 metric tons of copper per year; the Phelps Dodge Corporation has received a loan of 25 million dollars for opening up the high grade Warren mine in Bisbee, Arizona, the productive capacity of which has not yet been divulged. The Copper Range Company will probably receive a loan of up to 100 million dollars to speed up the installation of the White Pines mine in Michigan, which will increase its annual capacity by 75,000 tons.

By virtue of these enlargements, United States production, which

/was 779,000 tons

was 779,000 tons in 1948 and 693,000 in 1949, will increase to approximately 900,000 tons in 1950. Judging from the figures for the first seven months of 1950, civilian uses may be estimated at 1,101,000 tons per year and therefore the balance to be imported will be reduced from 309,400 tons shown in the table to only 173,000 tons.

In the foregoing figures only civilian consumption had been taken into account, and to this must be added the copper which the United States Government is purchasing for the stockpile, estimated at 220,000 tons during 1950, as well as the copper used for military requirements.

The needs of the armament industry must be very considerable, as will be shown later, but no figures have been made public. As on the other hand there is no immediate prospect of any appreciable increase in production, the United States Government issued a decree at the end of 1950 limiting the amount of copper for civilian use to 85 per cent of the amount used in the first quarter of 1950. Since in this quarter United States manufacturing output, and therefore copper consumption, still had not reached maximum value, the reduction would be proportionately greater if compared with the second half of the year. It is hoped that this measure will leave a quantity of between 20,000 and 30,000 tons available for military use, without including the 1950 purchases for strategic reserves.

On the other hand it has been announced that the amount set aside for the stockpile during 1951-1952 will be considerably less than in the previous year, and there will therefore be more than 300,000 tons available for direct military use during the year. This figure will increase more still as production expands in the United States and in the supplier countries, as a result of the series of developments mentioned in various parts of this study.

In view of this it may be expected that the United States will buy all the copper it can obtain in the world markets during 1951.

Table 25 shows the supply situation of copper in the countries of the Sterling Area.

/Table 25

Table 25. Copper: Consumption, Production and Balance in the Countries of the Sterling Area.

Period	Annual Averages		Balance to be imported
	Consumption	Production	
	(in metric tons)		
1926-29	170,200	34,500	- 135,700
1936-38	309,000	272,300	- 36,700
1947-49	410,000	300,000	- 110,000

Source: Yearbook of the American Bureau of Metal Statistics.

Making a rather over-simplified generalisation on the basis of these figures, it may be said that the consumption of copper in the Sterling Area increased very much during the 'thirties, assisted by a greater production within the area, especially in Rhodesia, South Africa and Cyprus. In 1936-38 there were almost no imports and in 1938 there was a small exportable balance which did not quite compensate for the imports of 1936 and 1937. A new increase in consumption (34 per cent), added to a fall in production in British Africa (15 per cent in comparison with 1938) has augmented the necessity for the Sterling Area to import copper. It is worth mentioning that the production loss referred to above, which was attributed to the wear and tear on the African railways during the war, had been almost completely rectified by 1948.

Work is going ahead on a four year plan to be completed in 1952-53 for increasing the productive capacity of the existing mines in British Africa and for solving the difficulties encountered by the railways in this region. In the technical press there has been some mention of using Marshall Plan funds for this purpose, in accordance with the general authorisation of March 1949. Before the Western Powers began rearming, the Sterling Area countries had been confident of producing in the near future more copper than was necessary for their own consumption. The United Kingdom therefore, in the agreements made with the United States during August and September 1949, as a prerequisite for the devaluation of the pound sterling, included copper amongst the products to be sold to the United States on long-term contract in order to improve the situation of the mutual balance of payments.

Very little information is available about projects for the amplification of copper mines in British Africa, and what is known refers

/only to three

only to three deposits: those of Tsumeb, Nchanga and Kilembe, of which the former produced 51,800 tons in 1949 out of a total of 302,600. A production of 148,000 tons is expected in 1952 by means of an investment of 5.7 million pounds sterling in Nchanga. At Kilembe there is a new deposit of 4 per cent grade ore which should produce between 30,000 and 40,000 tons of copper per year by 1953-54. Assuming that the remaining important mines at Mufulira, O'Kiep, Rhokana and Roan Antelope maintain the same production in 1952 as in previous years, British Africa as a whole will produce some 460,000 tons in that year, which, added to the production of India, Cyprus and Australia will give the Sterling Area a total production of 500,000 tons, compared with a consumption of virgin copper of 425,000 tons in 1948 and 398,000 in 1949. It is not improbable therefore, that in 1952 the Sterling Area will not only be self-sufficient but will also return to its 1938 position as a net exporter of small quantities of copper. This situation naturally has been modified in the interim by the additional requirements of rearmament.

British Africa's copper production during recent years is shown below:

Table 26. Copper: Production in British Africa

Year	Production (in metric tons)	Increase or Decrease
1945	220,532	
1946	213,780	- 3%
1947	232,230	+ 9%
1948	248,942	+ 7%
1949	302,593	+ 22%

Source: Yearbooks of the American Bureau of Metal Statistics.

In order to arrive by 1952 at the total of 460,000 tons estimated earlier, it will be sufficient if production shows a cumulative annual increase of 15 per cent during the next three years.

In the rest of the world, with the exception of Russia, Canada and Latin America, the zone known as "area of other currencies", which principally comprises Western Europe, Turkey, Japan, Belgian Congo, the Portuguese colonies and the French North Africa possessions, the situation has been that shown by the figures in Table 27.

/Table 27.

Table 27. Copper: Consumption, Production and Balance in the Area of Other Currencies.

Period	Annual averages Consumption	Production	Balance to be imported
	(in metric tons)		
1926-29	617,000	289,500	- 327,500
1936-38	832,600	343,600	- 480,000
1947-49	449,000	243,000	- 206,000

Source: Yearbooks of the American Bureau of Metal Statistics.

In this area, production has diminished considerably as a result of war devastation, but the fall in consumption is much greater, so that the needs of this group, particularly in France, Germany and Italy, have fallen to less than one third of the pre-war amount. The economic recovery of Western Europe is showing good progress, as is the restoration of the mines, especially in Africa and Germany. The installation of new copper industries in the dependent territories is going ahead well, partly financed with private United States capital, partly with Marshall Plan funds, and finally by direct loans from the Economic Cooperation Administration. It is estimated that in 1952-53 the countries of the Economic Cooperation Administration Group, including the United Kingdom, will use 20 per cent less copper from the Western hemisphere than in 1949-50:[1] that is to say, a quantity which may vary between 225,000 and 235,000 tons, always assuming that the level of manufacturing output continues to rise at the same rate as in the last few years.

The final balances resulting from combining Tables, 1, 2 and 4 should give the volume of the joint exports of Canada and Latin America.[2] The corresponding figures are shown in Table 28.

1/ R.L. Wilcox, Head of the Non-Ferrous Metals Section of the Economic Cooperation Administration, Engineering and Mining Journal, May 1950, page 89.

2/ The figures do not balance exactly since a) the stocks of copper at the beginning and the end of the periods shown in the table have not been included: b) the consumption is slightly augmented by the inclusion of a small quantity of scrap refined in the copper refineries whilst the production only contains virgin copper.

/Table 28.

Table 28. Copper: Balances of World Production and Consumption Excepting Union of Socialist Soviet Republics, Eastern Europe, Canada and Latin America.

Period	Annual Averages			Final Balance
	United States	Sterling Area	Area of other currencies	
	(in metric tons)			
1926-29	+ 148,000	- 135,700	- 327,500	- 315,200
1936-38	+ 150,400	- 36,700	- 480,000	- 366,300
1947-49	- 309,400	- 110,000	- 206,000	- 625,000

Source: United Nations Economic Commission for Latin America.

The figures given in the final column make it possible to establish that the export market for Latin American and Canadian copper has increased considerably since the war, in spite of the fall in consumption in Western Europe. Chile is the country which has benefited most from this greater market, as will be seen later.

However, these figures do not show the true present situation. The fact is that world production, except in Latin America, has increased more rapidly than consumption. If the purchases for the United States strategic reserves and increased rearmament were discounted, there would have been an overproduction of copper of approximately 80,000 tons in the year 1950. This rearmament, added to that of the European countries, has radically changed the situation and at the beginning of 1951 there was a shortage of the metal in world markets.

Alterations in the Structure of Copper Consumption.

As already seen in the section dealing with metals in general, the structure of consumption for a given amount of manufacturing output is subject to continuous change originating from technical progress, changes in price ratios of the metals among themselves, etcetera. In the particular case of copper consumption has declined less as the years went by than that of other industrial metals. Moreover scrap would have to be included in comparing conditions in the different countries in order to make such a comparison complete. As the information concerning scrap is only available in isolated cases, Table 29 shows figures for the consumption of virgin metal.

/Table 29.

Table 29. Copper: Consumption of Virgin Copper per 100 dollars of Manufacturing Output, at 1938 prices.

(kilogrammes)

Year	United States	United Kingdom	Germany, Austria, Belgium, France, Italy and Sweden
1935	2.44	3.93	3.62
1936	3.18	3.82	3.20
1937	3.10	4.17	3.33
1938	2.37	3.88	3.68
Averages	2.78	3.92	3.46
1947	2.80	4.63	3.49
1948	2.67	4.47	2.77
1949	2.08	3.75	3.19
Averages	2.52	4.28	3.15
Percentage decline	- 10%	..	- 8.7%
Percentage increase	..	+ 9%	..

Source: Industrial Activity, from the European Economic Commission, European Steel Trends in the Setting of the World Market. Metal Consumption: Yearbook of the American Bureau of Metal Statistics.

The first thing which attracts attention in this table is the increased consumption of the United Kingdom, which may be partly explained by the definition of consumption given earlier. Actually in 1936-1938 manufactured products equalling 9 per cent of the total were exported from the United Kingdom. These exports accounted for 15.4 per cent in 1947-49, so that the increase must be reduced by the difference between these two figures, that is, 9 - 6.4 = 2.6 per cent. This balance, which represents the real increase in copper consumption, should in turn result from the combined effect of a certain decline made inevitable by the discontinuance of the use of copper in many items, and an increase in the proportion of capital goods within the industrial structure, whether these be for domestic use or for export. It is therefore quite possible that this increase in the consumption of copper is due to the demand for capital goods which was deferred during the war, in which case it may be expected that the situation will become normal during the coming years.

Besides this anomaly in the trend of copper consumption in the United Kingdom as against that shown by other countries, it is also noticeable that consumption is higher for each 100 dollars of manufacturing output of

/the United Kingdom

the United Kingdom than in the other six countries of Western Europe, and this in turn is greater than that of the United States. Summarising this, taking consumption in the United Kingdom as 100 in the post-war period, that of the six countries of Europe is 74, and that of the United States 59. It is possible that there is a trend (in these industrial countries) to approach the modulus of consumption of the United States but it will take some years for this to come about. The problem is much more complicated and is related to the manufacturing output per inhabitant. The differences may be appreciated from the following table compiled for the years 1937 and 1948.

Table 30. Copper: Comparison of Industrial Activity. In 1938 Dollars, per Inhabitant.

	1937	1948
United States	165	252
United Kingdom	154	161
Average of the six countries	92	65
Germany	124	66
Austria	58	43
Belgium	129	112
France	83	84
Italy	42	34
Sweden	121	160

Source: Manufacturing output taken from the European Economic Commission, European Steel Trends in the Setting of the World Markets.

Consequently, even if a reduction in the consumption of copper may be expected in all these countries for each 100 dollars of manufacturing output, it will be many years before this decline reaches the low level of present consumption in the United States and to do this the manufacturing output per inhabitant will have to reach a figure approaching that of the United States. It is therefore most probable that there will be a net increase in the consumption of copper in the next few years, although at a rate slower than that of the manufacturing output.

It has been shown so far by various means that there is a tendency towards a reduction in the consumption of copper and amongst many other causes the following have been mentioned: greater efficiency in its use

/and possible

and possible substitutions by other metals due to more favourable prices. As already stated, the fact is that the metal market is continually changing: some applications are discontinued and other new ones are introduced. Among the former may be mentioned plated cutlery made with copper alloys, and amongst the latter, special steels containing small quantities of copper. Unfortunately for the copper producers, the principal characteristic of steel containing copper is its resistance against corrosion and it is used to a great extent in the chemical industry to replace tinned copper.

In the same way some articles containing copper are manufactured until the market is saturated and these afterwards fall into disuse, their place being taken (in the modulus of manufacturing output) by other articles. This has happened in the United States in the case of household electric washers, whose manufacture has been largely followed by air-conditioning apparatus, also for household use.

It is therefore interesting to compare the uses of copper during various periods in the United States, where technical modifications are more rapidly put to general use. This comparison is given in Table 31.

The distribution of the use of copper in the United States in the years 1927-29 and 1936-38 was estimated by the Copper Institute, which body, unfortunately, has only produced sporadic publications since the war, as will be seen from the last column of the table.

Since the figures given in the table show the average percentages used for each one of the items, variations in these percentages form a true reflection of changes in the structure of consumption. These may arise at any moment from cyclical variations or long-term trends. Amongst the former for example, is the fact that during an economic recession, telephone and telegraph investments diminish.

As previously stated, the long term trends cause a certain amount of movement in the metal market. Apart from examples already mentioned, there is also the increase in the consumption of copper in the building industry. Reference is made here to known applications covering items in regular use, as for example, where copper piping (amongst the many articles which are included in this item) has had to compete with galvanised piping. In spite of the fact that copper tubing is more expensive per unit weight, this piping may be made thinner and still be more durable, and at the

/same time requires

same time requires less labour for its installation. Amongst the diminishing uses, electric power distribution must be mentioned, which is made much cheaper by using a core of steel cable surrounded by aluminium cables which have the same electrical conductivity and tensile strength, and therefore the towers do not need to be so close together.

From the foregoing it will be seen that it is quite impossible within the limits of the present study to estimate precisely the degree by which one metal has been substituted for another, or will be in the future. It is doubtful if sufficient data exists to do this, nor would it be practicable to make a forecast with regard to inventions which will interest the markets in the future in sufficient quantities to constitute industries of economic significance. It may certainly be assumed that so long as there is copper available and the increase of manufacturing output continues, new applications will make their appearance, which partly offsetting those which are discontinued, will cause demand to increase, probably at a lower rate than manufacturing output.

In discussing the factors which have a general effect upon the market of the different metals, an examination was made of trends in the variations of manufacturing output and of population in the large consumer centres. According to the conclusions reached in that chapter, the following average trends may be expected in the course of the next few years:

a) An appreciable increase in the population of the United States (1.77 per cent in 1949) together with a relatively small increase in manufacturing output (1.35 per cent average 1900-49); a joint maximum of 3.12 per cent.

b) A small increase in the population of Europe, including the United Kingdom, probably not greater than 0.6 per cent per year, with an increase of manufacturing output exceeding that of the United States (1.96 per cent in the United Kingdom for 1930-37; 3.06 per cent for Sweden between 1925-38; 2.03 per cent for Germany between 1925-38 and - (minus) 1.7 per cent for France between 1925-38. This gives Northern Europe a joint increase in manufacturing output less than that of the United States and for the purposes of this analysis it will be assumed to be equal to that of the United Kingdom or say, 0.6 + 1.96 = 2.56 per cent per year.

c) A considerable

c) A considerable increase, of about 2 per cent, in the population of the underdeveloped countries is still too small to have any significant effect upon the total, and it may be concluded that the greatest increases should be expected in the United States. The European countries in turn, due to extraordinary development plans assisted by the Marshall Plan, will recover the tonnages lost by the devastation of war in the course of a very few years and the demand will continue to increase, although probably at a lesser rate than the United States, due to their lower rate of population increase. This will be the case, even though their present consumption appears to be very high for each 100 dollars of manufacture (at 1938 prices) giving rise to the fear of a certain amount of instability, which may cause a greater difference between the rate of increase of manufacturing output in Europe and the consumption of copper.

Summarising, it may be recorded that except for the next few years during which the plans for the reconstruction of European industry are being put into effect, and discounting the present armament activity, the trend of the 'thirties will be reversed, and the United States' percentage share of world copper consumption will again begin to increase.

As stated previously, the United States and the Sterling Area are increasing their production from national sources. Bearing in mind the scope of the changes in consumption caused by cyclical variations in the United Kingdom and the United States, and comparing these with the increases in these countries, the conclusion is reached that producers outside these areas can expect in the future a market even more unstable than that which they have experienced in the last twenty years. The main countries affected are Canada and Latin America, and, to a lesser degree, the Belgian Congo.

The heightened demand for copper for armaments will temporarily raise consumption in the United States, but this will increase the tendency towards instability of exports which will occur once the emergency has passed, due to the restrictions in its uses for civil consumption. Whilst the emergency lasts however, the copper producers have a sure market for the whole of their production at relatively high prices.

/The tax on the

The Tax on the Consumption of Foreign Copper in the United States.

A tax of 4 cents per pound on foreign copper used in the United States was introduced in June 1932. Foreign copper taken into the United States for refining and re-export was exempt from this tax.

On 29 March 1942, when production, import and use of copper became normal, foreign producers supplying the United States market were exempted from this tax. In November 1946 when this ruling was reversed, the tax was again brought into effect. However, in view of the need to import large quantities of metal, even though this need was believed to be only temporary and due to the deferred demand for capital goods and durable consumer goods, it was placed in suspense until 30 March 1949.

As a result of the agreements at the International Trade Conferences at Havana and Annecy, the United States' contribution to a plan for a general reduction of tariff barriers, was the reduction of this tax to 2 cents per pound, to be applied when the above-mentioned period expired.

At the beginning of 1949, before the end of this period, United States consumption was still as great as in 1947 and 1948. This increased the belief that the greater demand was not temporary, and would continue as long as the existing manufacturing output was maintained.

Three different points of view were expressed: the complete elimination of the tax, its suspension for two years, or its suspension for one year, and finally a compromise was reached and the tax was suspended for fifteen months, that is, until 30 June 1950.

Immediately after the approval of this measure came the temporary decline in consumption to which reference has been made earlier, and this caused increased pressure from the Western mining states for the bringing forward of the effective date of the tax. At the end of the period of suspension the question of its extension was the subject of considerable debate: the Government favoured the continued suspension of the tax, and the Chamber of Representatives approved a draft law to this effect, but the Senate refused its approval and therefore the tax of 2 cents per pound on foreign copper consumed in the United States was reimposed.

During the period 1932-40, whilst the tax of 4 cents per pound on imported copper was in force, hardly any copper subject to this tax entered the United States since, as will be remembered, the country was at that time a net exporter of the metal. During this period there were

/two prices for

Table 31. Copper: Estimate of the Uses of Copper in the United States.

(Percentages)

Item	Annual Average 1927-29	Annual Average 1935-38	Annual Average 1946-47
A) Items on the increase			
Electrical machinery and apparatus	22.7	23.4	
Wire, bars and trolleys	8.06	10.82	
Wire-grids and screens	0.71	0.90	
Munitions	0.63	1.91	
Building	5.93	9.32	
Naval construction	0.37	0.63	
Steel alloys with copper	0.19	0.47	
Radio receivers	0.89	3.04	
Electric refrigerators	1.59	1.84	
Domestic central heating equipment	0.13	0.26	
Automoviles	12.36	13.26	9,07
Air conditioning	-	0.88	
Clocks and watches	0.38	0.43	
Sub Total	53.94	67.16	
B) Items on the decrease			
Telegraph and telephone apparatus	12.53	3.76	6.74
Power transmission lines	11.71	9.78	7.35
Railway equipment	0.88	0.48	
Valves, bearings and castings	7.10	5.31	
Fire fighting apparatus	0.25	0.18	
Domestic washing machines	0.43	0.20	
Domestic water heaters	0.20	0.21	
Goods for export	6.61	5.24	
Sub Total	39.71	25.16	
C) Unspecified uses or which have not been shown separately	0.18	-	
Condensers	0.18	-	
Agricultural machinery	0.14	-	
Water metres	0.38	-	
Plated cutlery	0.66	-	
Safety razors	0.16	-	
Other uses	4.55	7.66	
Sub Total	6.07	7.66	

Source: Yearbooks of the American Bureau of Metal Statistics.

two prices for copper: one for the domestic market and another lower one for export. It is noteworthy that the difference between the two prices never rose to 4 cents per pound: in other words, the mining industry of the United States never took full advantage of the protection given to them by the tax.

As soon as the tax was suspended the difference between the two prices started to diminish and finally the situation was reversed: the export price rose to a figure slightly higher than that for the domestic market.

At the end of 1950, because of the shortage of copper on the market, the Latin American producers had succeeded in transferring the tax to the consumer: whilst copper produced in the United States was invoiced at 24.1/2 cents per pound, the tax was added to the imported copper as a separate item, a difference which was even applied to the very small quantity of domestic or foreign metal which might be contained in a bar of copper alloy.

Finally, in view of the increased requirements of the metal caused by the speeding up of rearmament, together with a high manufacturing output for civilian use, the tax on consumption in the United States was again suspended at the beginning of 1951.

These changes in the United States tariff policy justify the assumption that if that country's copper production later exceeds consumption, there will be an automatic increase in the pressure for effective tariff protection.

Production of Copper in Latin America Since the War.

Table 32 shows Latin American production of fine copper in bars, concentrates or ore since the war and in the year 1939.

Table 32. Copper: Production in Latin America
(in metric tons of fine copper)

Years	Bolivia a/	Cuba c/	Chile b/	Ecuador c/	México e/	Perú d/	Total
1938	2,885	13,426	351,482	----	41,851	37,529	447,173
1945	6,097	8,212	470,181	3,824	61,680	31,916	581,910
1946	6,127	11,194	361,038	2,618	61,053	24,952	466,982
1947	6,241	13,245	426,670	143	63,492	22,492	532,283
1948	6,622	15,240	444,929	408	59,076	18,024	544,343
1949	5,074	14,117	371,095	710	57,246	28,045	479,936
1950	4,748	20,912					

Sources: a/ Reports of the Banco Central,
b/ Estadística Chilena & Anuario de Minería
c/ Yearbook of the American Bureau of Metal Statistics
d/ Anuario de la Industria Minera del Perú
e/ Boletín de Minas y Petroleo de México

/In 1945, 1947 and

In 1945, 1947 and 1948 the companies tried to produce the maximum possible tonnage, and on analysing the events country by country, the reason is found for production in the last two of these years not approaching that of 1945, the low figure for 1946 being due to strikes and the slowness of the change-over to peace time economy. In 1949, United States owners of Chilean mines voluntarily reduced production in face of the reduced market requirements which arose at the middle of the year, and this explains why production for that year is lower than for 1948.

The volume and value of the production of copper in Latin America during 1938 and since the war is shown in the following table:

Table 33. Copper: Value and Volume of Latin American Production a/

Year	Production (metric tons of fine copper)	Average prices of electrolytic copper placed in New York (cents per pound) a/	Value of production at the price indicated (thousands of dollars)
1938	447,173	10,000	98,624
1945	581,910	11,775	151,087
1946	468,982	13,820	142,303
1947	532,283	20,958	245,978
1948	544,343	22,038	264,518
1949	479,936	19,202	203,186

Sources: Reports of the Banco Central, Estadística Chilena and Anuario de Minería, Yearbook of the American Bureau of Metal Statistics, Anuario de la Industria Minera del Perú, Boletín de Minas y Petróleo de México.

a/ Prices taken from the Engineering and Mining Manual.

It may be estimated that little more than 60 per cent of the value shown in the preceding table enter into Latin American economy, and that the rest is absorbed by freight, sales expenses, refining, servicing of financing, and imports of mining material paid for abroad. The given percentage is different for each country, but is actually very similar when applied to the larger producers, Chile and Mexico.

Review of Recent Developments and Trends in Copper Mining by Countries.

a) Bolivia

Almost the whole of Bolivian copper production comes from the Corocoro mine, which since 1936 has belonged to the American Smelting and Refining Company. This firm has increased the annual production

/capacity of the

capacity of the deposit from approximately 3,000 tons to approximately 6,500 tons. This is probably the limit determined by the reserves of the deposit, which are known to be not very great, although no information has been published recently on this subject.

The decline in production since 1948 is principally due to labour troubles.

b) Cuba

Cuban copper production comes almost entirely from the Matahambre mine, which up to 1946 was owned by the American Metal Company. The mine produced a maximum output of nearly 12,000 metric tons a year during the period 1936-40. As from this date production started to decline until it reached a minimum of 5,687 tons in 1944, apparently caused by the working out of the deposit. In 1946 the mine was bought by a company formed with United States and Cuban capital, and the new company was fortunate enough to discover reserves which enabled them to increase production to 18,240 tons in 1948, in which year work was commenced to expand productive capacity.

In 1949 production fell to 14,117 tons, since lightning caused a fire in one of the shafts and destroyed the machinery, but by 1950 production had exceeded 20,000 metric tons.

c) Chile.

Production of the Chilean mines during 1937 and 1938, and since the war is shown in the following table:

Table 34. Copper: Production in Chile.

(Metric tons of fine copper)

Years	Mines Financed with United States Capital			Mines Financed with Chilean Capital
	Chuquicamata (Chile Exploration)	Potrerillos (Andes Copper)	El Teniente (Braden Copper)	
1937	181,732	54,956	144,320	32,273
1938	148,010	55,355	119,777	28,178
1945	237,537	63,976	149,591	19,074
1946	210,346	63,231	85,023	3,384
1947	214,717	65,089	128,594	18,240
1948	207,929	67,930	149,005	19,945
1949	175,833	49,163	126,516	20,319

Source: Chilean statistics.

a/ Figures of metal exported, including mines producing both copper and gold.

/Chile Exploration Company

Chile Exploration Company.

During the late world war, the productive capacity of the Chuquicamata deposit was considerably increased; from a maximum pre-war production of 181,000 tons, this mine was able to produce 241,000 tons in 1944. The Company voluntarily reduced production in 1949, and although it has tried to work to capacity during the present year, strikes in the first half-year caused a loss of time estimated to be equal to 40 working days.

Apart from this, Chuquicamata's production is tending to decline for reasons connected with the structure of the deposit. It contains three classes of minerals: oxides, which are found on the surface; sulphides, which are in the deep deposit, and mixtures of the two. The plant at present in use has been in operation in the mine since 1915, and is only suitable for the extraction of oxides, and since mixtures of these and sulphides are already appearing in some of the workings faces, the sulphides cannot be used, and remain in the tailings.

The small quantities of ore containing a low percentage of sulphides are worked by extracting only the oxides, and therefore a part of the metal content of the ore is lost. No figures have been published recently regarding the reserves of copper as oxides in the deposit, but from statements made in the press it is understood that these reserves will barely last ten years as from 31 December 1949. In any case, it is quite probable that in 1951 and 1952 production will be less than that shown, since intrusions of sulphides are appearing in the mass of oxides, making access to them difficult, whilst the mill and the smelter are not completed.

Since a vast mass of sulphides exists below the oxides, towards the end of 1948 the Company began the construction of a plant for treating them, using the classical method of concentration and smelting. The first unit of this plant should be in operation in 1952, and it was expected that from that time it would be possible to achieve a production rate of 245,000 tons per year, adding the new sulphides section and that small part of the oxides section which will continue working. Unfortunately, according to the latest information the intrusions of sulphides are causing greater difficulties in the workings than had been expected, and it is feared that during the critical years 1952-53, production will not

/exceed 215,000 tons,

exceed 215,000 tons, which will be even less in 1951.

As the reserves of oxides diminish, further units of the new plant are being constructed, to be completed in 10 years, with an investment of 170 million dollars. It has been estimated that the first part of the work will require an investment of between 70 and 80 million dollars. Because of the agreement between the Chilean Government and the Company, the Chilean currency required for this work is being converted at Rate B of the official Exchange, that is, at 43 pesos per dollar in 1949, and 60 pesos at first, and later at 50 in 1950; this is one of the few instances where the Chilean Government has abandoned the rate of 19.37 pesos per dollar which has been in effect for the large copper mining concerns since 1934.

In 1960-62, when all the units of the sulphides plant should be working, the Chuquicamata mine should have a maximum productive capacity of nearly 275,000 tons.

Andes Copper Mining Company.

The Potrerillos deposit, like that of Chuquicamata comprises both oxides and sulphides. Since shortly after it commenced operations, however, this firm has had plants capable of treating both ores separately. In 1929, 74,000 tons were extracted but during the 'thirties the annual amount never exceeded 56,000 tons. It has been impossible to maintain the 1941 figure of 94,000 tons because of the progressive impoverishment of the ore, whose low grade now makes this a marginal mine. During the years 1943-45 the firm had to receive a subsidy from the United States government to cover the loss implies by the stabilisation of the price of electrolytic copper at 11.775 cents per pound, placed New York.

The situation improved with the rise in prices which commenced in 1946, but the fall in prices during 1949 meant that production was being sold almost at cost. The oxides section, whose maximum capacity was about 25,000 tons of electrolytic copper per year, has been most affected by this situation. At the same time the reserves of oxides are almost exhausted and for this reason the company decided to close down the section in July 1949.

During that year Potrerillos produced 49,163 tons of copper, composed of 6,951 tons from oxides and 42,212 tons from sulphides. In spite of

/having extended

having extended the sulphides extraction plant, the closing down of the oxides section reduced the maximum capacity of the mine to some 50,000 tons of blister copper per year.

The Company states that the remaining sulphides consist of one group which contains about 200,000 tons of extractable fine copper of 0.7 per cent grade, and another of even lower grade which contains about 600,000 tons of extractable copper. There are obviously two alternatives for the Company; the first would be to take advantage of the high prices ruling at the present time and work the better reserve at the maximum rate of 50,000 tons per year which would exhaust the deposit in 1954; the second would be to dilute these 200,000 tons with the remainder and extract the whole of the remaining 800,000 tons in 20 years. The alternative adopted will depend mainly upon the agreement reached with the Chilean Government, equally interested in not losing this reserve of ore which, although poor, is considerable, and would never be extracted if the mine were closed.

In any case, for purposes of this survey, it is estimated that 40,000 tons will be extracted in 1953, giving a safety margin of 10,000 tons as compared with the first alternative, but at least ensuring a further 20 years life expectation for the deposit.

Braden Copper Company.

Before the war, the highest production achieved by the El Teniente deposit was 143,000 tons in 1937. During the war this figure rose to 158,000 tons, in 1944. Since then, annual production has been slightly lower; except in 1946 and 1949, years to which special reference will be made, the main reason for this decline lay in the shortage of water for generating hydroelectric power, a secondary reason being the inadequate capacity of the convertors.

The Company is building a pipeline 1.80 metres in diameter and 11 kilometres long to make use of the outlet from the hydroelectric plant at Pangal in the Coya plant, from which it should be possible to generate several additional thousands of kilowatts.

This project will be finished at the end of 1951, and will help to prevent a repetition of the loss of production due to a shortage of hydroelectric power caused by insufficient rain.

/The two low figures

The two low figures since the war are explained by the fact that in 1949 the Company voluntarily reduced production from the deposit because of the decreased demand, and in 1946 the fall in production was caused by a fire in the mine in which more than 300 workmen lost their lives.

Mining Financed from Domestic Sources.

Table 34 shows the production from this group of companies, which consists of between 7 and 10 of the so-called medium sized mines which have their own concentrating plant, and some 400 small companies which seldom have more than hand tools and at times one truck. Many of these mines which were working in 1937-38 have become marginal and have closed down since the war, in spite of the high prices of copper. In a few cases the reason was the exhaustion of the deposit.

The whole of this group, specially the small firms, have costs much higher than the three United States financed companies, and for this reason the Government gives the national mines a more favourable rate of exchange, which is adjusted periodically so that this mining may meet the increased costs arising from the present inflation in the country. Even these concessions, however, are not sufficient to compensate for the very high costs of some of the firms, which either closed down completely or temporarily suspended operations during the fall in prices.

Completely surveyed and proven deposits exist, which this type of firm could work to advantage, and whose annual capacity might be about 10,000 tons of fine copper each, but the country cannot put up the necessary capital for this exploitation. Up to the present time, international financing organizations have never granted loans to this type of firm. Given good prices and a favourable exchange rate, these small mining companies can operate at a profit, and it is not unlikely that before 1953 they will again be producing tonnages similar to those of 1937, that is to say, about 30,000 tons per year.

Prospects of Increased Production in Chile.

As previously stated, if special measures are not taken, Chilean copper production in the years to come is faced with the prospect of a definite decline. The highest production up to date was 495,000 tons of fine copper, of which 23,000 came from the small mines. Once the new works are completed at Chuquicamata, the production of this mine together

/with Braden will

with Braden will be about 400,000 tons a year, and Potrerillos will definitely be closed down. Small mining might be able to add some 30,000 tons, giving a total of 430,000, which must be compared with the 495,000 in 1944.

So far as can be seen, in 1952-53 Chile will have fallen to second place as a world producer and British Africa will have taken the lead, since Rhodesia and South Africa alone will produce more than 460,000 tons. This does not include Belgian Congo which will produce a further 200,000 tons.

Discounting Potrerillos, which has been shown to have only about 800,000 tons of copper which is workable only at completely marginal prices, both Chuquicamata and Braden have reserves so tremendous that they have never been proven. Working on the basis of doubling the present production rate (to a joint total of 800,000 tons), these two mines must have a sufficient reserve for at least a further hundred years.

When work first began on these two deposits in 1908 and 1915 respectively their costs were amongst the lowest of the world. The rising standard of living of the workmen has increased these costs in Chile, but certainly not to the extent of the average of United States mining, since in Braden and Chuquicamata the average grade of ore has not become poorer, as is happening in general in the United States. The various taxes which the firms in Chile must pay have certainly increased, and this increase has probably been at a higher rate than that of costs in the United States. For this reason the extensions which are taking place in the world have been confined to the United States and British Africa, leaving Chile on one side.

However, since one of the main reasons for the increase in taxes is that the rate of exports is no longer on the increase, it should be possible to reach an agreement which will satisfy the needs of the Chilean Government, and at the same time provide the incentive of a sure profit to foreign investors.

d) Mexico.

Mexican copper production, which was greater than that of Chile at the beginning of the century, reached its highest point in 1929 with 78.7 thousand tons. During the 'thirties the highest production recorded was 48.7 thousand tons in 1939. In the course of the period under review (1945-50) production has varied at around 60,000 tons, with a maximum

/of 63,492 in 1947.

of 63,492 in 1947. In order to make it easier to understand the reasons causing these variations, Table 35 shows the production of some of the companies or groups of mines.

Table 35. Copper: Production in Mexico by Mines or Groups of Companies.
(in thousands of metric tons)

Year	Total for the country	Boleo	Cananea c/	Fresnillo	Ores and concentrates a/	Other smeltings of mixed metals b/
1938	41.8	8.1	14.2	-	6.1	13.4
1945	61.7	6.8	32.2	2.3	7.1	13.2
1946	61.1	5.5	33.8	2.3	7.8	11.7
1947	63.5	6.4	31.9	2.6	10.3	12.3
1948	59.0	6.1	29.0	2.2	8.9	12.8
1949	57.2	4.8	27.9	2.4	11.1	11.0

Source: For the total for the country, data from the Secretaría de Economía, Dirección General de Estadística. For the remaining figures American Yearbook of Metal Statistics.

a/ Figures for imports into the United States.
b/ Including smelting done on a toll basis for third parties in Cananea. Approximate figures; these may be changed, not only by variations in the stock of ores and concentrates at the end of each year, but also by discrepancies between the Mexican statistics and figures assembled by the American Bureau of Metal Statistics.
c/ Excluding copper ore smelted on a toll basis by third parties.

The economically workable reserves of the mine El Boleo of Santa Rosalía, Lower California, are rapidly and steadily diminishing. When the owners announced their intention to close down, the Mexican Government took over the mine in 1946 in order to continue working, and to seek new reserves. Whether or not the new exploitations have been successful has not been made public, but the production of this mine continues to fall, and the maximum output which has been registered was 11,686 tons in 1944.

The same remarks may be applied to the high grade ore existing in the Cananea mine in Sonora, property of the Anaconda Copper Company. From a maximum figure of 27.4 thousand tons in 1934, this mine's production fell to 13,700 tons in 1944, in spite of the considerable demand for copper during the war.

In 1942 the United States Government loaned to Anaconda the capital needed for building a plant in Cananea suitable for treating low grade ores,

/and for producing

and for producing some 24,000 tons of fine copper per year. This new installation commenced operation in 1945, in which year the production of the deposit was 32,300 tons. Up to the present it is not known whether any new reserves of high grade ore have been found in this mine to take the place of the worked out seams.

The greater part of the production shown in the column "Ores and Concentrates" of Table 35 comes from the Moctezuma (Nacozari de García) mine, Sonora, owned by the Phelps Dodge Corporation. The concentrates from this deposit are exported for smelting at the Copper Queen plant, Arizona. The production of Moctezuma was about 20,000 tons per year during the twenties, but from 1932 to 1937 work was suspended. Except for losses caused by labour troubles, this mine's production is again slowly increasing, rising to about 11,000 tons in 1949. No information has been published regarding either expansion plans or the reserves in the deposit.

Amongst the group of smelters of mixed metals is Fresnillo which is administered by the Mexican Government, in whose hands production has slightly increased and a fair standard of workmanship has been maintained. In this smelter, as in the remainder of its type, which produce a joint total of 13,000 to 15,000 tons per year of unrefined bars, copper is mainly associated with gold and silver, and the production depends more upon the market and prices for these last two metals than it does upon copper itself. Apart from the fact that the Howe Sound Company began in 1949 to produce about 1,000 tons a year from the Carmen mine, there are no changes in the position of this group.

Summarising the general situation, it seems that Mexican copper production will decline somewhat in the coming years because of the exhaustion of the rich ores of Boleo and Cananea. Apart from new installations, the only possibility of any increase would depend on the Phelps Dodge Corporation augmenting the export of concentrates from the Moctezuma mine.

c) Peru.

Copper production in Peru has been very considerably affected by changes in the output of the chief mine, Cerro de Pasco. In order to facilitate this analysis, Peruvian production is shown by groups of mines in Table 36.

/Table 36.

Table 36. Copper: Peruvian Production, by Groups of Mines.

Year	Total for the Country	Cerro de Pasco	Huarón	Ores and Concentrates from Other Mines
1938	37,529 a/	35,699	-	1,830
1945	31,916 a/	25,382	3,440	3,094
1946	24,952 a/	19,583	2,663	2,736
1947	22,492 a/	17,809	2,608	2,075
1948	18,024	12,848	1,912	3,264
1949	28,045	21,096	1,737	5,212

Source: Yearbook of the American Bureau of Metal Statistics.
a/ Figures taken from Estadística Mineral del Perú.

It may be seen that variations in total production are mainly due to those of the mine at Cerro de Pasco, which is owned by a small independent company, and financed with United States capital. The Cerro de Pasco deposit contains a variety of materials and in addition to silver, copper, lead and zinc there is also high-coking coal which is produced and coked in modern Curran Knowles plants. The copper production of Cerro de Pasco also includes a variable quantity of ores which the company smelts and refines on a toll basis.

The deposit was originally worked for silver; in 1904 it was changed to copper extraction; later, when the reserves of this metal also became scarce and with the appearance in the 'twenties of the selective flotation process for lead and zinc, operations turned towards the extraction of these last two metals, silver and copper being of secondary consideration.

In spite of this, the company has invested 6 million dollars in the last six years to open up a new copper mine (Yauricocha), to build a cable transporter from the mine to the railway, and to build an electrolytic copper refinery with a capacity of 24,000 tons per year. This refinery commenced operation in 1949 and it is therefore probable that the annual production of Cerro de Pasco will increase by several thousand tons in the course of the next few years.

The Huarón mine belongs to a French company which is also interested in the extraction of mixed ores of copper, lead and zinc. The company began operations in 1939 and since then has maintained a fair average output. Since copper is not the principal object of the exploitation, the volume of copper production depends upon the relative price situation for lead, zinc, and copper, as the company gives a certain amount of preference to the working of sections of the deposit which are more or

/less rich in

less rich in one of these metals.

Prospects of Increasing Peruvian Production.

The Toquepala deposit in the south of Perú is reputed to contain a very considerable reserve, similar to the Chilean deposits mentioned in the previous section. The property was in litigation for more than twenty years: judgment was given in 1948 in favour of an American company, and there was some talk at that time of plans for large scale exploitation. It is quite possible that these are still under review, although it appears that no decision has so far been reached. For this reason this ore has not been included in the possible sources of supply for the next few years.

SUMMARY OF THE TRENDS OF WORLD PRODUCTION AND CONSUMPTION

From the plans for increasing productive capacity which were published in December 1950, together with some estimates in those cases where there has been no mention of enlargements in the technical press, a comparison may be made between the 1948 production, and that which may be achieved in 1953 once the majority of these plans has been put into action. This comparison appears in Table 37.

Table 37. Copper: Production of Copper in 1948, and Probable Productive Capacity in 1952-53.
(In thousands of metric tons of recoverable fine copper extracted from ores in the respective countries)

Country or Area	Production in 1948	Planned Increases of Capacity	Productive Capacity in 1953
United States	775	305	1,080
Canada	218	75 a/	293
Chile	445	- 30	415
Remainder of Latin America	103	25 a/	128
Remainder of the Western Hemisphere	766	68	836
United Kingdom	-	-	-
British Africa	248	212	460
Australia	13	-	13
Remainder of Asia (excluding Japan)	52	10	62
Sterling Area	313	222	535
Europe	84	35 a/	119
Belgian Congo	155	97	252
Formosa	5	2	7
Remainder of the World excepting Russia and Japan	244	134	378
TOTAL	2,098	729	2,829
Chilean Percentage	21.3%		14.7%
Latin-American Percentage	26.2%		19.2%

Source: 1948 Production: Yearbook of the American Bureau of Metal Statistics. Information contained in the technical press.

a/ Estimated

The productive capacity which may thus be achieved by 1953, will not be sufficient to meet the civilian requirements for copper in that year if the manufacturing output continues to increase at least in line with the time trends since the beginning of the century. The deficit of copper will be much greater if, together with a high manufacturing output for civilian use, any appreciable armament production continues.

There is therefore room, or rather necessity for greater copper production than that which has been planned, which tonnage may be achieved with little effort or expense in Peru, and more especially in Chile.

The decline in Latin America's share in the total production, together with the increased extraction in the consumer areas or their dependent territories, leaves Latin America very vulnerable to cyclical variations. This clearly indicates the importance to the Latin American producers of securing for themselves access to the world markets, not only at times when the metal is of prime importance to the consumers, but more particularly at those times when cyclical downswings reduce consumption to such an extent that the production of the buyer countries renders them self-sufficient.

LEAD MINING

Introduction

The majority of world production of lead and zinc comes from mixed ore containing both these metals in varying proportion, and often containing also smaller quantities of gold, silver and copper. There are very few deposits containing only lead or zinc, although it is true that a few are being worked.

An almost complete separation of the two metals in the mixed deposits, by means of selective flotation, was becoming general in the United States during, and immediately after, the first world war, and this method came into use in Latin America at the beginning of the 'twenties. Up to that time it had been customary to work deposits where one of the two metals predominated, and the other was lost in the course of the metallurgical processes 1/. This same waste has also occurred since the war in mines whose extraction plants had insufficient capacity for separation, but which nevertheless wished to take advantage of the high prices of lead.

The flotation process, therefore, permitted advantage to be taken of the entire content of the mixed ore and some deposits became profitable which had previously been marginal, because they were only making partial use of the metal content. This increase in possible sources of supply, in turn caused a variation of the proportion of metal reaching the market which naturally had an influence on the relative prices. On the other hand, due to the selective mining imposed by the technical limitations at the beginning of the century, large quantities of relatively low grade mixed ores had accumulated in the tailings which could only be processed by means of selective flotation. A result of

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1/ In some cases, in the countries where the zinc ore smelted and refined was mainly imported (this applies especially to Belgium and Germany), the lead content is not attributed in the statistics to the country of origin, but to the country where the ore was refined.

/this was

this was that in the late 'twenties and early 'thirties, ores were processed which had been extracted many years before, so that there was an apparent production, which did not correspond to the actual amount of extraction.

Since this study is concerned with the trends and developments of the mining industry, the fact that lead and zinc are generally found in the same deposit justifies their treatment in one single chapter. Furthermore, an analysis of this type would be neither correct nor complete without considering silver at the same time, which, due to its high unit price, is generally a very important associate of lead. However, an analysis of the influence of the price and quantity variations of silver production upon the position of lead and zinc mining is beyond the scope of this study, which will therefore be confined to the situation of the two industrial metals.

Before continuing, attention must be drawn to a fundamental difference between the metallurgy of lead and that of zinc. Whereas metallic lead may be obtained easily from many types of lead ore and from widely varying concentrations, the production of metallic zinc presents considerable technical difficulties, and the ore must contain a certain minimum grade in order to be processed successfully. For this reason the production of pig lead, whether refined or in alloys (that is to say with a small gold or silver content), is scattered over the whole world, whilst both the refining and production of zinc slab are confined to a very few countries.

Consumption and Production of Lead in the United States

The United States is at the same time the greatest producer and the greatest consumer of lead in the world and it is therefore interesting to analyze its sources of virgin metal supply, its tariff policy, and the imports and the exports of the metal.

Table 38 shows the production of the United States mines, the imports of refined lead and of lead ores imported for refining in the country, together with total exports 1/.

1/ Manufactured products partly or wholly made of lead are not included.

/Table 38.

Table 38. Consumption of Lead in the United States

In metric tons

Year	Production of the U.S. mines	Imported as ore, concentrates or alloys	Imported refined	Total	Exported	Balance apparently consumed a/
1927	610,546	144,174	2,238	756,958	113,642	643,316
1928	589,499	140,055	599	730,153	105,480	624,673
1929	624,154	103,785	1,504	729,443	66,452	662,991
1936	362,888	19,072	2,330	384,290	16,613	367,677
1937	426,286	32,569	4,556	463,410	18,226	445,186
1938	344,406	55,036	1,779	401,221	41,610	359,611
1941	418,605	96,906	248,744	764,253	13,026	751,227
1945	354,154	63,516	206,359	624,029	1,276	622,753
1946	304,342	40,399	101,824	446,565	542	446,023
1947	348,565	47,475	144,709	540,749	1,372	539,377
1948	354,240	64,495	224,412	643,147	361	642,786
1949	366,537	99,531	249,697	715,763	791	714,972

Source: Yearbooks of the American Bureau of Metal Statistics

a/ Includes lead set aside for the stockpile.

During the years shown in the Table, the country was always a net importer but in 1911, 1913, 1918 and 1933 exports exceeded the imports.

Until the 1932-1933 depression, most of the lead imported by the United States came from Mexico in the form of ores, concentrates and alloys which were refined and later re-exported. At the beginning of the thirties the Mexican mines increased their refining plant, and metallic lead is now exported directly to the overseas markets.

As from 1940, United States imports of refined metal increased to such an extent that they now constitute the largest item of the country's foreign purchases, and at the same time United States exports have fallen to a very low value.

During the whole of this time there has been an import duty which has varied in the following manner:

/Table 39.

Table 39. Import Duty on Lead entering the United States

Period	In ore, concentrates, and bullion	Refined
1897-1912	1 1/2 cents/pound	2 1/8 cents/pound
1914-1932	3/4 cents/pound	25% ad valorem
1932-1942	1 1/2 cents/pound	2 1/8 cents/pound
1943-1947	3/4 cents/pound	1 1/16 cents/pound
1947-June 1949	free	free
July 1949	3/4 cents/pound	1 1/16 cents/pound
January 1951	1 1/2 cents/pound	2 1/8 cents/pound

As a result of these duties the price of lead on the United States market rose higher than that of the world market, thereby permitting some of the high-cost mines in that country to continue working at a profit, but even so, the United States lead mining industry has never taken full advantage of this protection, since the difference between the New York and London prices has usually been less than the amount of the duty.

Table 40 shows the percentage of net imports with respect to the balance available each year for domestic consumption (apparent consumption). It also shows the average quotations for lead in New York and the percentage of this value represented by customs duties with regard to both the lead content of the ores and the refined metal.

Table 40. Percentage of Virgin Lead Imported, over Total Supply and Ratio of Import Duty to Price

Year	Lead available (apparent consumption)	Percentage represented by net imports	Average price of lead in New York cents/pound	Duty on crude products		Duty on refined lead	
				Cents/ pound	% of average price	Cents/ pound	% of average price
1927	643,316	5.6	6,755	1.50	22.0	2,125	31.5
1928	624,673	6.2	6,305	1.50	23.7	2,125	33.7
1929	662,991	6.4	6,833	1.50	22.0	2,125	31.0
1936	367,676	1.2	4,710	1.50	32.0	2,125	45.0
1937	445,184	4.2	6,009	1.50	25.0	2,125	35.2
1938	359,611	4.2	4,739	1.50	32.0	2,125	45.0
1941	751,229	44.5	5,793	1.50	26.0	2,125	36.8
1945	623,161	43.2	6,500	0.75	11.5	1,063	16.4
1946	446,024	32.0	8,109	0.75	9.2	1,063	13.2
1947	539,376	35.5	14,673	0.75 a/	5.1	1,063 a/	7.3
1948	642,786	45.0	18,043	-	-	-	-
1949	714,888	48.7	15,364	0.75 a/	4.9	1,063	7.0

a/ Import duty in force for only part of the year.

/It may be

It may be seen from the Table that the relative importance of tariff protection had declined, partly because of the reduction in the tax itself and partly because of the increased price. At the same time, the percentage of net imports increased from 5 to 6 per cent of the total in the twenties, to between 30 and almost 50 per cent in the post-war period.

There was a reduction of 50 per cent in the duties as from 1942 as a result of the trade agreement with Mexico, and also because most of the potential exporters took advantage of the most-favoured nation clause. In June 1950 the Governments of both the United States and Mexico simultaneously abrogated the agreement, which therefore terminated on the 1st of January 1951, when the old duty of one and a half and two and one eighth cents per pound respectively was reintroduced. It is most probable that conversations will shortly begin regarding a new agreement but the present situation is that the United States miners are asking for increased protection whilst the Mexican Government wishes to see the duty reduced.

The policy of high prices on the United States domestic market, whether caused by heavy demand as at present, or by import duties as in the past, has permitted work to continue in many of the high-cost mines, which are in the majority. Unless some new deposit is discovered, it is unlikely that there will be any notable increase in the extraction of lead, in fact on the contrary, a declining trend may be seen.

The reserves of lead are actually the most critical amongst the industrial metals in the United States. In 1945 Pehrson and Shea calculated that these reserves would last for thirteen years at the 1935-1939 rate of extraction. This situation has probably since improved, as Pehrson only included ores commercially workable at the price of 6.5 cents per pound then ruling, but whereas in the case of copper, new deposits have been discovered, this is not so with lead, and for this reason, it may be assumed that the problem still exists.

The increase of the quoted price to more than three times the value mentioned above undoubtedly means that ores which had previously been neglected as un-economical can now be profitably worked.

It is obvious that the statement that the reserves will last for thirteen years does not mean that the whole lead mining industry will then simultaneously cease; many deposits will be exhausted before that date

/and others

and others will last for a much longer time, but it can definitely be said that there will be a considerable decline in annual production within a few years.

Investments which have been made since the war with the object of commencing work on new deposits of zinc, or of increasing extraction from those existing, especially in Arizona and the Eastern states [1/], will automatically increase the production of lead. In spite of the extent of these investments however, they will not be sufficient to reduce appreciably the need to import. Due to those made since the end of the war, United States lead production increased by 13,000 tons in 1949 and shows a further slight increase in 1950.

Supply and Consumption of Virgin Lead in the Sterling Area

Table 41 shows the production of lead in the countries of the Sterling Area divided into groups to facilitate analysis.

Table 41. Production of Virgin Lead in the Sterling Area

(In thousands of metric tons)

Year	Australia	South Africa, West Africa, Rhodesia and Nigeria	Other Countries	Total
1927	167.5	5.9 d/	73.1 a/	246.5
1928	158.8	4.7 d/	85.2 a/	248.5
1929	177.2	1.6 d/	92.4 a/	271.2
1936	227.3	9.6	90.8 a/	327.7
1937	249.9	14.6	91.0 a/	355.5
1938	278.7	15.6	92.4 a/	386.7
1941	263.9	0.4	82.3 a/	346.6
1945	157.8	1.7	3.0 b/	162.5
1946	176.3	8.4	2.6 b/	187.3
1947	189.2	29.0	3.0 b/	221.2
1948	207.0	38.6	10.5 c/	256.1
1949	203.4	46.1	2.8 b/	252.3

Source: Yearbooks of the American Bureau of Metal Statistics

a/ Burma and the United Kingdom
b/ India and the United Kingdom
c/ India, Burma and the United Kingdom
d/ Estimated.

1/ According to the Engineering and Mining Journal of July 1949 the principal investments are: the St. Joseph Lead Company in their Balmat and Edwards mines; Mine Hill and Sterling Hill in New York; in Antinsville, Virginia and in Belmerton, Pa; the American Zinc Company in Eastern Tennessee. In

/It may be

It may be seen that production, after reaching a maximum in 1936-1938, returned in 1947-1949 to almost the same figures as 1927-1929. This is due to an increase in Australia together with a steady increase in Africa, although the post-war extraction rate in the former country has never equalled that of the 'thirties. These increases, however, are offset by a market decline in Burma, the most important member of the group "other countries".

As may be seen from Table 42, consumption also reached its highest point in the period 1936-1938, and has fallen since the war to figures slightly lower than those of 1927-1929.

Table 42. Consumption and Balance of Lead Supplies in the Sterling Area

(Thousands of metric tons)

Year	Total Production	Consumption: United Kingdom	Consumption: Other Countries	Consumption: Total	Balance: + exportable - to be imported
1927	246.5	254.6	18.0	272.6	- 26.1
1928	248.5	279.2	12.0	291.2	- 42.7
1929	271.2	245.5	15.0	260.5	+ 10.7
1936	327.7	351.2	45.6	396.8	- 69.1
1937	355.5	347.1	50.3	397.4	- 41.9
1938	386.7	388.5	54.3	442.8	- 56.1
1941	346.6	-	-	-	-
1945	162.5	-	-	-	-
1946	187.3	195.6	63.0	258.6	- 71.3
1947	221.2	179.7	55.2	234.9	- 13.7
1948	256.1	190.0	61.1	251.1	+ 5.0
1949	252.3	159.5	65.6	225.1	+ 27.2

Source: Yearbooks of the American Bureau of Metal Statistics.

Arizona the Phelps Dodge Corporation at Bisbee; the American Smelting and Refining Company at Trench, Flux and Patagonia; the St. Anthony Mining and Development Company at Old Hat (San Manuel); the Shattuck Denn Mining Corporation in the Big Bug, Iron King, Banner and Seventy Nine Mines; the Eagle-Picher Mining and Smelting Company at Sahuarista and San Javier; the Magma Copper Company at Superior; the Coronado Copper and Zinc Company at Johnson District; the Athletic Mining Company at Aravaipa.

/The balance,

The balance, although varying in an irregular manner, shows a rising trend, mainly due to declining consumption in the United Kingdom since the war. The group of under-developed countries in the Commonwealth, on the other hand, shows a steady increase in consumption, but this is not sufficient to offset the above-mentioned decline. Both in the United Kingdom and the United States, the percentage of scrap used has increased, but this does not show in the tables, which include only virgin metal.

An attempt will be made later to establish the trend of lead consumption in the sterling area as a whole. but apart from this an appreciable increase in consumption may be expected, since the projects being developed in Australia, Rhodesia and South West Africa as part of the so-called "four-year plan" are amongst the largest at present being carried out in the whole world.

The recovery of Burma, which used to be a large exporter, depends mainly upon the return to normal of the political situation, upon which it would be unwise to attempt any forecast. In any case, it must be remembered that the maximum production in Burma was 74,687 metric tons in 1941 and that, after being negligible between 1943 and 1947, it rose again to 7,593 tons in 1948. However, the same reasons caused it to fall to almost nothing in 1949.

Australian production reached its highest point in 1941, with 266,000 metric tons, but in 1945 it fell to 160,800 tons, mainly due to a shortage of labour. Since then, production has shown an almost uninterrupted increase, rising to 186,000 tons in 1949. Probably the greatest single reserve of zinc and lead in the world is at Broken Hill, where extension projects are now in progress which will enable the 1941 maximum output to be surpassed in the course of the next few years.

In South West Africa the Tsumeb mine, which was shut down for many years, is now being developed; this mine used to be owned by the German company which operated the Otavi railway. The present investment of 8.8 million dollars is partly British capital, and the American Metal Company also has a considerable interest. The ore

/reserves contain

reserves contain 8.38 per cent copper, 20.9 per cent lead and 10.9 per cent zinc, lead production being 14,431 tons in 1947, 27,958 tons in 1948 and 35,248 tons in 1949. In the latter year the company carried out a diamond-drilling programme, and the favourable results obtained gave rise to a further investment of 2 million dollars, which will make it possible to double the 1949 output.

In Rhodesia, the Rhodesia Broken Hill mine is being developed. This mine, which had an annual output of only 2,000 tons during the war, is now producing 16,000 tons per year.

The Mpanda mine in Tanganyika is also being developed, and in the meantime the mine is being connected to the main central railway by the construction of a branch line 210 kilometres long, which was to be completed in 1950, whilst production should commence in the mine in 1951.

These developments lead to the expectation that the export capacity of the sterling area, which is at present small, will show an increase in the future, which will be even greater should the Burmese production regain its pre-war level.

Production and Consumption of Lead in Western Europe and Dependent Territories (Excluding the United Kingdom)

The production of lead in Western Europe and the dependent territories is shown in Table 43, and the consumption and balance in Table 44. It must be remembered that in both tables the German figures for 1927-29 and 1936-38 are for the whole country, whereas those for 1945-48 cover only the British and American zones, and those for 1949, the Federal German Republic. This explains the decline in production which appears in the table, since the 1949 extraction is only about 50 per cent of that shown for 1936-38. The decline in consumption to less than 25 per cent of its previous level, is certainly due to the fact that, apart from these same geographical reasons, there has been a decline in manufacturing output and a change in the pattern of consumption of lead in general. These same trends have also operated in the other industrial countries of Europe.

/Table 43.

Table 43. Production of Lead in Western Europe and Dependent Territories (excluding the United Kingdom)

(in thousands of metric tons)

Year	Germany	Italy	Spain	Remainder of Western Europe	African Possessions	Total
1927 i/	84.0 f/	23.8	139.0	105.1 f/	18.1 g/	370.0
1928 i/	87.0 f/	21.2	123.0	101.9 f/	16.9 g/	350.0
1929 i/	97.9 f/	22.7	133.3	95.6 f/	15.6 g/	365.1
1936 i/	63.5	30.2	42.0	23.5	20.0	179.2
1937 i/	75.0	35.2	27.0	27.8	32.7	197.7
1938 i/	96.0	39.5	32.0	18.0 e/	42.5	228.0
1941	98.2	39.9	33.7	14.8	28.8	215.4
1945	a/	2.5	26.2	25.6	21.4	..
1946	15.3 b/	13.6	38.4	31.7	24.7	123.7
1947	14.7 b/	23.8	30.8	30.8	39.1	139.2
1948	22.2 b/	30.0	27.3	35.3	45.8	160.6
1949	40.9 h/	35.0	29.5	40.3	54.1	199.8

Source: Yearbooks of the American Bureau of Metal Statistics

a/ Production unknown, but probably very small
b/ Bizonia
c/ Excluding Turkey and Yugoslavia
d/ Algeria, French Morocco, Tunis, Belgian Congo, and French Equatorial Africa
e/ The Austrian production, about 9.000 tons, is included with that of Germany
f/ Including lead obtained from zinc ores from Latin America and Newfoundland which were smelted in Belgium and Germany. These tonnages are not included in the production of the respective countries of origin
g/ Estimated
h/ Federal German Republic
i/ Amounts smelted in the respective countries, regardless of the origin of the ore.

The table shows a general downward trend in lead extraction, in spite of the increase in Italy, and, more especially, in the dependent territories. However, the tonnages in these groups are still too small to have any great effect on the general result. The groups showing a decline are Germany, Spain, and the "remainder of Europe", of which the Spanish deposits of the Real Compañía Asturiana de Arnao and Peñarroya in Cordoba are becoming exhausted, without yet being replaced by other new deposits which will be referred to later.

/In Germany

In Germany there are various reasons for the decline on production: a) the devastation caused by the war, which is by now almost completely rectified; b) the omission of the production of Eastern Germany from these statistics; and c) the exclusion of the statistics of the lead content of zinc ores imported for refining, which, as from the 'thirties, is credited to the country of origin of the ore (mainly Mexico and Newfoundland).

In the group called "The Remainder of Europe" the reasons for the decline compared to the 'twenties are the same as those given for Germany, and are particularly due to the method of accounting for the zinc ore refined in Belgium. On the other hand, when compared with the 'thirties, this group has succeeded in slightly increasing the amount extracted.

If, instead of comparing the production of the three periods 1927-1929, 1936-1938 and the post-war, one against the other, only the last named is considered, then a continuous increase is seen, particularly in the dependent territories. Amongst the efforts which have been made to achieve these results, the following may be mentioned:

In Greece, in the district of Laurium, near Athens, a selective flotation plant has been installed with a capacity of 200 tons per day, for silver, lead and zinc ores. The lead which is refined in the country is sufficient to meet its needs and also to leave a small exportable balance.

In Germany, after the ceding of the mining district of Upper Silesia to Poland (Stolberg mines), the Harz mines were enlarged to the extent that in 1949 they produced about 20,000 tons, or 40 per cent of the entire lead output of Western Germany.

In Italy, because of the progressive exhaustion of the great mines of Cerdeña, active efforts are being made to find new deposits of lead-zinc; the Cave di Predil mine, which will commence production in 1951, is one of these new discoveries. In the district of Bergamo a plant is being installed with an annual capacity of 12,000 tons of zinc, and this will also increase the extraction of lead.

In Spain, in spite of certain enlargements which have been made, production has declined compared with 1946, partly due to a shortage of hydro-electric power caused by very dry years. Amongst the new works

/is the

is the opening up of the Sierra Almagrera mine (Almería) which had been abandoned since the beginning of the century because of flooding. The whole of this district, which is very rich, has been drained, and modern extraction plant is being installed.

In Sweden, the capacity of the Laisvall mine, in the Lap mountains, was increased in 1949, and the results of this improvement will probably be seen in 1950. The smelter and thermo-electric refinery at Rönnskar have also been enlarged and improved.

Austrian production is also being extended, and from 3,000 tons in 1948 it rose to 4,300 tons in 1949.

In the dependent territories, the main increases in capacity, and investment, are as follows:

In Algeria, the Mesloula mine, by improving the extraction system, has increased its production to an extent which allows a much greater exploitation of reserves. The Ouarsenis mine is also improving its system of separating lead and zinc as a preliminary to increasing its extraction. The Zellidja company, which also owns mines in French Morocco, has been formed with United States capital, the Newmont Mining Corporation and the St. Joseph Lead Company, owning 9 per cent of the shares in Zellidja, and greater percentages in other associated companies. They are constructing and extraction plant with a daily capacity of 4,000 tons of ore. In 1949, the company produced 14,000 tons of lead, and expects to reach 60,000 in 1954, to which must be added some 65,000 tons of recoverable zinc. This company has received 3.6 million dollars of Marshall Plan funds, to be repaid later by means of shipments of concentrates to the United States.

In Tunis the Djebba mine, which had been closed since 1942, has been re-opened, and in the Ressas-Touireu mine a flotation plant is being installed which will produce 200 tons of lead per month. These, together with small projects in all the mines, should increase the lead production of Tunis from about 15,000 tons in 1949 to approximately 27,000 in 1952, with further subsequent increases.

As a result of these factors, a possible increase in consumption in some European countries, and an assured increase in extraction in Europe and the dependent territories, the European Economic Commission has

/estimated that

estimated that Western Europe including the United Kingdom, will need to import approximately 50,000 tons of lead in 1952-1953. As against this figure, it must be remembered that in 1949 the negative balance was 175,000 tons.

These forecasts are naturally based on the supposition that peace will continue, and without making reservation for extraordinary armament activity. It has been said that in the past lead has not been a metal with considerable armament applications, but is possible that in a highly mechanised war in the future its applications would increase considerably by virtue of its two principle uses in the United States today; batteries for motorised vehicles, and the manufacture of tetraethyl lead (for increasing the octane-rating of gasoline). As a co-metal of zinc, which certainly will be one of the critical raw materials if re-armament is speeded up, it is very probable that the extraction of lead will continue on a scale sufficient to permit its use as a partial replacement for other critical metals, good prices being assured by this same possibility.

The consumption of lead in Western Europe is shown in Table 44. In general, a declining trend is seen; comparing the 1947-1949 figures with those of 1936-1938 there is a fall of 17 per cent in the countries called "the remainder of Europe", 29 per cent in France and 85 per cent in Germany, although this appears greater because of the lack of data on Western Germany since the war.

Since the decline in consumption has been greater than that of production, the deficit which has to be made good by imports has been reduced, when compared with that of 1927, and more especially compared with 1936-1938.

/Table 44.

Table 44. Consumption and Balance of Foreign Trade of Virgin Lead in Western Europe and the Dependent Territories (excluding the United Kingdom)

(In thousands of metric tons)

Year	Germany	France	Remainder of Western Europe d/	Total Consumption	Total Production c/	Balance to be imported
1927	225.3	72.4	125.1	463.1	370.0	-93.1
1928	216.5	104.0	132.2	501.0	350.0	-151.0
1929	212.4	105.4	157.5	522.6	365.1	-157.5
1936	206.7	92.8	134.9	479.6	179.2	-300.4
1937	235.3	107.3	151.8	544.8	197.7	-347.1
1938	246.5	86.1	175.1	559.6	228.2	-331.4
1941					215.4	-
1945						
1946	16.3 a/	78.9	135.2	243.1	123.7	-119.4
1947	24.3 a/	79.8	133.8	262.8	139.2	-123.6
1948	34.9 c/a/	68.9	107.8	223.8	160.6	-63.2
1949	43.8 b/	53.2	141.0	269.3	199.8	-69.5

Source: Yearbook of the American Bureau of Metal Statistics

a/ Bizonia
b/ Federal German Republic
c/ Estimated
d/ Excluding Turkey and Yugoslavia
e/ From Table 43.

Production and Consumption of Lead in the Rest of the World

Of the countries and areas so far examined, it is necessary to add Japan and Eastern Europe as former net importers of lead, and Canada and Latin America as exporters. As Latin America will be studied in detail and since the others are only of secondary importance, Table 45 shows only the balance of lead trade for the countries already examined together with Latin America, Canada, Japan and Eastern Europe. 1/

1/ Since the war, information on European production and of Japanese consumption has been very slight, so that the corresponding figures in the Table are incomplete.

/Table 45.

Table 45. Balance of Trade and Production of Lead by Countries from Geographical Areas b/

(+ = exportable surplus; - = balance to be imported in thousands of metric tons)

	1927-29	1936-38	1946	1947	1948	1949
United States a/	- 34	- 51	- 185	- 323	- 337	- 159
Sterling Area	- 50	- 56	- 72	- 14	- 5	+ 27
Western Europe and Dependent Territories	- 70	- 326	- 119	- 124	- 63	- 69
Canada	+ 115	+ 192	+ 115	+ 140	+ 141	+ 117
Latin America	+ 235	+ 307	+ 166	+ 259	+ 249	+ 266
Eastern Europe	- 24	+ 12	..	..	..	..
Japan and Turkey	- 52	- 92	- 9	- 17	- 12	..

Source: Yearbooks of the American Bureau of Metal Statistics.

a/ Lead set aside for the stockpile is not included.

b/ The balances have been struck for each region separately, but in the total production does not appear to be the same as consumption for various reasons, amongst which may be mentioned: 1) variations in the stocks at the end of the periods; 2) it has been impossible to separate completely data relating to the consumption of certain quantities of scrap; 3) in the early periods it is possible that there was some duplication in the figures of lead content in zinc ores from Latin America and from Newfoundland which were refined in Europe; and finally, 4) no reduction has been made for metals set aside for the stockpile in the United States.

The most interesting conclusion from the Table, is that unless Western Europe renews its imports on the pre-war scale, it appears that exports from Canada and Latin America will depend to an increasing extent on the North American market. The danger to the stability of their industry which this involves will become evident, when it is remembered that 1947-1948 were years of considerable manufacturing output in the United States; that 1949 was a recession year and that, in spite of this, greater lead surplus and a fall in the market was only avoided by purchases for the stockpile, which should be considered accidental.

Modification in the Structure of Lead Consumption

The figures so far presented only refer to the consumption of virgin lead. The study of the structural changes which are continually taking place in its field of application demands the consideration of all lead consumed, including scrap. The proportion of secondary metal in the industrial countries has continued to increase, at least until 1939, the

/last year

last year in respect of which statistics are available, with the sole exception of cyclical variations in scrap, which were discussed in the general analysis.

Table 8 shows the proportion of scrap metal included in the total of lead consumed in the United States, without including chemical products which are recovered and copper alloys. It will be noted that the percentage of 23.4 reached in 1927-1929 period, rose to 31.9 per cent in 1936-1938, and to 42.5 per cent in 1947-1949 1/.

In the United Kingdom the proportion was almost identical to that of the United States, being 42.9 per cent in 1947-1949.

Under these conditions it is obvious that for the producer countries it is almost as interesting to study the trends of secondary lead production as it is to study consumption of the metal as a whole.

The increasing use of lead in batteries, especially for the automobile trade, undoubtedly contributes towards this increase in the proportion of recovered metal. For instance, in 1948 discarded batteries supplied 51 per cent of the scrap lead in the United States. In other countries, where there are less automobiles, this source of scrap may have much less relative importance. For lack of sufficient information regarding the consumption of scrap in the countries and the years under reviews, Table 46 shows the consumption of virgin lead per 100 dollars of manufactured goods at 1938 prices for the same countries which were studied in relation to the consumption of copper. In addition, a certain amount of information is given regarding total consumption, including scrap, in the United Kingdom and the United States.

1/ Arithmetic averages.

/Table 46.

Table 46. Consumption of Lead per 100 Dollars of Manufacturing Output at 1938 Prices (Kilograms per 100 Dollars)

Year	Total Consumption of Lead including Scrap a/		Consumption of Virgin Lead		
	United States	United Kingdom	United States	United Kingdom	Germany, Austria, Belgium, France and Sweden
1935	3.00	..	2.17	5.40	2.90
1936	2.97	..	2.30	5.19	2.73
1937	2.92	..	2.32	4.77	2.93
1938	2.98	..	2.18	5.81	2.94
Average	2.97	..	2.24	5.23	2.88
1947	2.97	4.40	1.85	2.47	1.88
1948	2.78	4.19	1.85	2.32	1.07
1949	2.31	3.80	1.54	2.29	1.29
Average	2.69	4.10	1.75	2.36	1.41
% Decline	9.4	..	22	55	51

Source: Consumption: Yearbooks of the American Bureau of Metal Statistics; industrial activity: European Steel Trends in the Setting of the World Markets.

a/ Only includes scrap as metallic lead, excluding chemical products recovered (for example, oxides from batteries) and copper alloys.

In the first place, the Table draws attention to the greater consumption in the United Kingdom for a given manufacturing output; an explanation for this will be sought later by analyzing the share of the various items in consumption.

It must also be remembered here that in Table 29, where similar information was presented with regard to copper, a similar tendency was shown.

Inversely, the consumption of virgin lead, which in the six Continental European countries selected was greater than in the United States in the 'thirties, has fallen to much lower figures. The explanation of this decline appears to be the slow industrial recovery of the countries devastated during the war, in which preference has been given to the manufacture of consumer goods.

It is not unlikely, therefore, that the United Kingdom consumption for each 100 dollars of manufactured goods (at constant prices) will decline slightly in the coming years, whereas it may almost certainly be

/be assumed

be assumed that there will be an increase in the six industrial countries of Europe, both movements having a trend towards the consumption rate in the United States. Taking 100 as the average use of lead for each 100 dollars of manufactured goods in the United States in 1947-1949, the United Kingdom gives a figure of 135 and the six European countries only 80.

On the basis of the opinion expressed in the previous paragraphs to the effect that European consumption will tend to assume values equal to those of the United States, the study of the factors deciding the decline in the consumption of lead in this country will have a very special interest, and consequently Table 47 has been prepared.

Table 47. Use of Lead in the United States

Uses	Thousands of Metric Tons			Percentage		
	1927-29	1936-38	1946-48	1927-29	1936-38	1946-48
White lead	111,500	73,330	41,550	12.4	13.1	4.3
Red lead and litharge a/	29,940	46,570	56,100	3.6	8.3	5.8
Cable covering	169,650	63,920	137,300	23.0	11.1	13.9
Building b/	84,640	36,600	62,100	10.2	6.5	6.4
Caulking	28,270	12,250	39,040	3.4	2.2	4.0
Cables, Building and Tubing	424,000	232,670	336,090	52.7	41.2	34.4
Storage Batteries	182,950	166,300	303,330	22.1	29.6	31.2
Automobiles	14,200	8,760	c/	1.7	1.6	c/
Tetra-ethyl lead	c/	c/	60,000	c/	c/	6.2
Automobiles	197,150	175,060	363,330	23.8	31.2	37.4
Terne plate	3,770	5,100	c/	0.5	0.9	c/
Foil	31,700	21,830	3,230	3.8	3.9	0.3
Bearing metal	29,030	12,250	37,070	3.5	2.2	3.8
Solder	32,960	17,840	54,280	4.0	3.2	5.6
Cast items	16,020	5,350	c/	2.0	1.0	c/
Mechanical Items	113,480	62,370	94,580	13.8	11.2	9.7
Railway Equipment	3,500	c/	c/	0.4	c/	c/
Naval Construction	180	c/	c/	..	c/	c/
Ammunition	34,700	31,200	34,600	4.2	5.6	3.6
Type metal	15,420	13,900	26,400	1.7	2.5	2.7
Other Uses	41,340	46,720	117,580	5.0	8.3	12.2
Various Uses	95,140	91,820	178,580	11.3	16.4	18.5
Total	829,770	561,920	975,580			

Source: Yearbooks of the American Bureau of Metal Statistics

a/ Does not include oxides used in batteries, which appear under the last item.
b/ Includes items in chemical factories.
c/ Included amongst unspecified uses.

/The grouping

The grouping of the items in the Table does not correspond to any separation made on compiling data, but has been established by combining various headings whose variations depend upon similar economic factors.

Comparing the periods 1936-1938 with 1946-1948, when the consumption of lead for each 100 dollars of manufactured goods in the United States fell by 10 per cent, it is found that the different groups experienced the following variations:

Cables, building and tubing	Decline of 14 per cent
Automobiles, gasoline and batteries	Increase of 20 per cent
Mechanical items	Decline of 13 per cent
Various uses	Increase of 11 per cent

However, if in the constructions group the lead used in the three types of paint, white lead, red lead and litharge are discounted, the decline of 14 per cent in consumption in this group becomes an increase of 22 per cent. The shortage of lead and its high price have necessitated the finding of substitutes for the pigments of this metal, for use in paints; amongst those selected are iron oxides, titanium and zinc, together with certain plastic materials.

In the same way, in the group of mechanical items, terne plate is no longer manufactured, having been replaced by galvanized sheeting or by black coated sheeting; in the alloys used in casting, lead has given place to zinc and considering only these two items, approximately 1.9 per cent of its previous uses have been discontinued. Finally, foil, which in 1936-1938 still represented 3.9 per cent of the total consumption, has fallen to 0.3 per cent and has almost certainly been replaced by aluminium, which now occupies the whole of this field. The use of lead for solder and as a component of bearing alloys has, on the other hand, increased by more than 70 per cent.

In spite of the fact that some items have shown this considerable fall, those which are not classified, the group of various applications, show an increase of 13 per cent, which confirms that the consumption of this metal is affected by invention which, as in the case of copper, causes constant changes in the field of application.

Finally, it is necessary to discuss separately uses for automobiles which, as may be seen, will undoubtedly have a considerable effect on

/future supplies.

future supplies. The small amount of lead used in the mechanical part of the vehicles has almost disappeared completely, so that it is no longer shown separately, but on the other hand, between 1936-1938 and 1947-1949 the consumption for the manufacture of batteries [1] increased by almost 150,000 metric tons per year.

However, it has been estimated that the equivalent of approximately 60 per cent of the amount of lead used annually in batteries returns to the market in the course of the same year in the form of scrap plates or oxides [2].

The increase of consumption to 150,000 tons for batteries, therefore, represents an increased availability of 100,000 tons of scrap and means that only an additional 50,000 tons per year of virgin metal are required to meet the consumption.

It is especially interesting to note that in 1946-1948 the use of lead for the manufacture of tetra-ethyl lead appears under the items for automobiles [3]. Lead used in this form of course disappears completely

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1/ For the sake of simplification, it has been assumed here that the whole of the lead-acid batteries are used in motorized vehicles.

2/ Yearbook of the American Bureau of Metal Statistics 1939, page 56.

3/ This refers to a lead composition which, when added in a certain proportion to gasoline, increases the octane-rating, or, in other words, reduces the time of the explosion of a mixture of air with this gasoline. The manufacture of gasoline with high octane-ratings has permitted the construction of higher speed motors, such as those used in civil aviation and more especially military aviation. In automobiles, it has allowed an increase in power for a given weight of engine, or the lightening of the engine for a given power. Although it is true that high octane-gasoline can be manufactured without the addition of tetra-ethyl lead, the latter process is much more economical at prices ruling today, and the possible changing of the characteristics of the gasoline by the addition of this compound has considerably increased the flexibility of the petroleum refineries for working in a satisfactory manner with crude oils of various compositions and origin.

/from the

from the market once the gasoline to which it has been added is consumed in aeroplanes, automobiles and other uses, and since the use of lead in the production of tetra-ethyl has shown a considerable increase in recent years, to the extent that in 1949 it represented 11.6 of the total consumption in the United States, it will be interesting to analyse the trend in its use in the group of the Table termed "automobiles". On the one hand, there is the increase of scrap caused by the greater use of batteries, and on the other hand, the definite elimination of a certain amount of lead from the market due to its incorporation in gasoline, and it becomes obvious that the effect of these opposing factors will profoundly influence the future of lead mining. Table 48 presents some figures regarding the use of lead in the group "automobiles" in the United States.

Table 48. Consumption of Lead in the United States in the Manufacturing of Batteries and Tetra-ethyl

(Thousands of metric tons or percentage)

Year	A Consumption as Tetra-ethyl		B	C	D	E Scrap	F
	% of total for the whole country	Thousands of metric tons	Consumption in batteries	Consumption as tetra-ethyl and batteries together		Thousands of metric tons in batteries (2/3 C)	% of total consumption in automobiles a/ E:D
1936	..	..	174	..		116	..
1937	..	..	175	..		117	..
1938	..	..	152	..		101	..
1939	4.5	27.2	180	207.2		120	58
1940	6.3	44.7	200	244.7		134	54
1941	4.8	45.3	223	268.3		148	55
1942	4.9	44.5	195	239.5		130	54
1943	4.9	55.0	233	288.0		155	54
1944	7.1	77.4	278	355.4		186	52
1945	7.6	69.0	268	337.0		179	53
1946	5.2	43.7	237	280.7		158	57
1947	5.2	60.5	346	406.5		230	57
1948	5.9	76.2	339	415.2		223	54
1949	11.7	92.5	255	347.5		170	49
1950	..	103.6					

Source: Yearbooks of the American Bureau of Metal Statistics

a/ This does not include small quantities of lead used in the mechanical portion of the vehicles.

/The rapid

The rapid increase in the use of lead in the manufacture of tetraethyl, may be seen from the Table and continued even in 1949, in spite of this being a year of contraction in the metals cycle. There has been an accumulative average rate of increase of 29 per cent between 1946-1949, and if the war period is taken into account, then the accumulative increase for 1939-1949 is 14.1 per cent. Turning to the consumption of lead in batteries, it is interesting to note that the average annual accumulative increase, comparing 1936-1938 with 1947-1949, was 5.9 per cent, and that the manufacturing output of the country increased between 1936-1938 and 1947-1949 by 5 per cent per year, that is to say, in exactly the same ratio as the consumption of lead in batteries.

Should the post war rate of increase continue, consumption of tetraethyl will be doubled in three years, whereas should the long-term trend of the period 1939-1949 prove valid (a rise of 14.1 per cent per annum), consumption will be doubled in six years.

At the same time, the items where consumption of lead is declining are already unimportant: in 1946-1948, according to Table 47, these were: paints 10.1; constructions 6.4; terne plate and foil 0.3; casting less than 1.0, that is to say, a total of 17.8 of the entire consumption. It may therefore be argued that even for purely civilian output, total consumption of lead in the United States will increase faster than manufacturing output, at least until such time as some new and more economical method is found for increasing the octane rating of gasoline without using this metal.

The present trend has an even greater importance for the supply of virgin lead since, because of the destruction of large quantities through its combustion with gasoline, the proportion of scrap flowing into the market will be decreased.

The greater consumption (including scrap) in the United Kingdom compared with the United States per 100 dollars of manufactures, which is seen in Table 46, may be partly explained by the comparison of the uses of lead by items in both countries, shown in Table 49.

/Table 49.

Table 49. Distribution of the Uses of Lead in the United Kingdom and in the United States

(Percentage of the total including scrap)

Uses	United States 1947-1949	United Kingdom 1947	1948	1949
Paints and pigments	10.1	16.0	15.0	14.3
Cable	13.9	30.0	33.8	37.0
Building	6.4	27.2 a/	24.5 a/	21.3 a/
Caulking	4.0	..	..	..
Total Constructions	34.4	73.2	73.3	73.6
Batteries b/	31.2	14.2	13.5	14.2
Tetraethyl	6.2	..	..	..
Total Automobiles	37.4	14.2	13.5	14.2
Terne plate				
Foil and collapsible tubes	0.3	0.7	0.7	0.7
Solder	5.6	3.3	3.1	3.0
Alloys	3.8	4.0 c/	3.9 c/	3.6 c/
Total Mechanical Items	9.7	8.0	7.7	7.3
Ammunitions	3.6	0.7	1.1	1.2
Type metal	2.7	..	..	..
Miscellaneous Uses	12.2	3.9	4.4	3.7
Various Uses	18.5	4.6	5.5	4.9

Source: United States: Yearbook of the American Bureau of Metal Statistics; United Kingdom: 1947 British Ministry of Supply, 1948 Publications of and on The British Bureau of Non-Ferrous Metal Statistics.

a/ Mainly lead sheet and piping.
b/ Plates and oxides.
c/ Includes metal.

According to these figures, the excess of United Kingdom consumption over that of the United States, to which reference was made in the study of Table 46, is chiefly due to a greater use in pigments, protection of cables, and sheets and piping for construction. These three items will most probably decrease shortly, which justifies the assumption that the consumption rate of the United Kingdom per 100 dollars of manufactured goods should tend to approach that of the United States. Furthermore, the use of lead for the manufacture of tetraethyl is not shown here, so that the part played by scrap in the supply will almost certainly continue to increase in the coming years.

/Summary of

Summary of Trends of Consumption

The analysis so far made allows the following probable conclusions to be summarized: 1) the United States, which consumed 681 million tons of virgin lead in 1948 will in all probability increase its consumption in the future, partly due to the increase in population, which was 1.77 per cent in 1949, and partly due to the increase in manufacturing output which, following the trend of the first half of the century, should increase by 1.35 per cent per year. It is probable that total consumption of lead in the coming years will increase more rapidly than manufacturing output, and that the amount of scrap returning to the market will decrease, which gives an increased stimulus to the virgin metal. The percentages given correspond to the average trend and may vary in either direction. The study of the reactions of lead to the above-mentioned variations is outside the scope of this work, but it may be said that these variations have not greatly exceeded those of manufacturing output;

2) The six most industrialised countries of Europe and the United Kingdom together consumed 414,000 tons in 1948. Here there are two trends: that of the United Kingdom towards a slight reduction in the consumption of lead for a given manufacturing output, and that of the Continental countries towards a partial reversion to their previous consumption. It is probable that these two trends will not continue and that consumption in the future will rise in relation to the population and the manufacturing output, at least for some years. If this occurs, an increase may be expected of about 2.6 per cent per year in the consumption of virgin lead in this group of countries, in which case 0.6 per cent of this rise will be due to the increase in the population;

3) In 1948, the under-developed countries, without taking into account Eastern Europe, consumed approximately 170,000 tons of virgin metal. These show the greatest rate of increase of population and probably of manufacturing output also, but as their demand is still very small, these increases do not greatly affect the metal market.

As a consequence of the foregoing, it can be taken that, in the next few years, the consumption of lead will depend upon the United States market to a much greater extent than in the past.

/Production

Production of Lead in Latin America

Table 50 shows the tonnages of fine lead content in the ores and the concentrates exported from Latin America, by countries, plus the bullion and refined lead which they have produced [1].

Table 50. Lead Production in Latin America
(metric tons, percentage and thousands of metric tons)

Year	Argentina	Bolivia d/ a/	Chile e/	Peru	Mexico c/	% Mexico	Total
1936	6,841	14,532	189	30,448	215,724	80	267.5
1937	15,646	18,289	648	42,038	237,075	76	313.6
1938	23,700	13,169	921	58,044	282,369	75	378.2
1941	20,200	6,067	28	45,000	155,249	68	226.5
1945	18,325	9,508	53	53,398	205,315	72	286.6
1946	18,054	8,434	47	44,297	140,143	67	211.0
1947	20,762	11,310	462	54,542	223,135	72	310.2
1948	21,665	25,606	5,122	48,297	193,316	66	294.0
1949	19,826	26,311	2,859	53,316d/	220,763	68	323.1
1950	...	...	...	...	246,600 b/	...	...

Sources: a/ Banco Central de Bolivia
b/ Engineering and Mining Journal
c/ Boletín de Minas y Petróleo
d/ Exports
e/ Chilean Statistics.

Mexico is the largest producer in Latin America, generally occupying the second place in the world after the United States, although in the years of low Mexican production, which are relatively frequent, Australia takes the second place and Mexico the third. The Table shows that output since the war has not regained the average pre-war values; and as the production of Argentina, Bolivia, Chile and Peru, has increased in comparison with 1936-1938, this means that the Mexican percentage of the

1/ The figures in the Table are not complete, the production of certain small foundries producing pigs for local consumption having been excluded for, among others, Bolivia, Brazil, Chile and Mexico.

/total

total has also decreased 1/.

Production in Argentina and Peru now appears to be stabilized, whist in Bolivia and Chile it appears to be on the increase, but since the total figures in respect of both these are still very low, these increases are of very slight value. In spite of the slight decline in the joint production of Latin America, these countries have a greater share in the world total, as may be seen from Table 51, according to which the percentage rose from an average of 19 per cent in 1936-1938, to 25.5 per cent in 1946-1948. This is due to the declines in extraction in other areas, mainly Europe, which have been seen in the corresponding tables.

1/ These observations should be accepted with certain reservations, as there are considerable discrepancies regarding the volume of Mexican lead production. In the Table given below, the official Mexican figures for certain years are given together with those of the Yearbook of the American Bureau of Metal Statistics, after computing the analyses and statements made by the countries which have imported lead and concentrates from Mexico.

1 Year	2 Mexican figures a/	3 Figures from American Bureau of Metal Statistics	4 Difference 2 - 3
1935	184,193	184,193	...
1936	215,724	215,724	...
1937	237,075	218,133	+ 18,942
1938	282,369	282,369	...
1939	219,506	220,000	- 494
1940	196,253	196,254	...
1941	155,259	155,260	...
1942	197,019	194,140	+ 2,879
1943	219,126	189,876	+ 29,250
1944	185,282	179,114	+ 6,168
1945	205,315	204,913	+ 402
1946	140,143	169,276	- 29,133
1947	223,135	196,480	+ 26,655
1948	193,316	197,497	- 4,181
1949	220,763	233,681	- 12,948

a/ Dirección General de Industrias Extractivas.

The differences between the two series fortunately are not sufficient to invalidate the general conclusions which have been mentioned, but prevent a clear analysis of events in certain years.

/Table 51.

Table 51. Latin America's Share in World Production of Lead (excluding Russia)

(in thousands of tons and percentages)

Year	World	Latin America
1936	1,670	16.1
1937	1,772	17.8
1938	1,619	23.4
1941	1,581	14.4
1945	1,077	28.5
1946	1,053	20.0
1947	1,171	26.5
1948	1,142	25.8
1949	1,329	24.3

Source: World production: from the Yearbooks of the American Bureau of Metal Statistics. Latin American production: from the official sources shown for Table 50.

Table 52 shows the average prices of refined lead per pound, placed New York, production in tons of the Latin American group of countries, and the value of this production, placed New York, had it all been in the form of refined bars.

Table 52. Production and Value of Latin American Lead, after Refining, placed New York

Year	Total production of fine lead in thousands of metric tons	Average price of refined lead, placed New York, in cents/pound	Value of Latin American lead, placed New York, in millions of dollars
1936	267.5	4,710	26.7
1937	313.6	6,009	41.3
1938	378.2	4,739	39.7
1941	226.5	5,793	28.8
1945	286.6	6,500	41.2
1946	211.0	8,109	37.7
1947	310.2	14,673	100.0
1948	294.0	18,043	117.0
1949	323.1	15,364	113.0

Source: Yearbooks of the American Bureau of Metal Statistics
a/ Engineering and Mining Journal.

/It may

It may be seen from the Table that the total value of lead production has risen from approximately 40 million dollars in 1937-1938 to more than 100 millions. As the quantum of production since the war has never regained the 1938 level, this increase is entirely due to the price rise which has been more rapid than that of any other metal.

Obviously, only a part of the total value benefits the economy of Latin America, since deductions must be made to cover ocean freight, insurance, sales expenses, amortization of imported machinery, spares, other elements of production, and often refining also. Where, as in many cases, the industry is financed with foreign capital, it is also necessary to deduct the company's profit and service on loans.

Investments in Lead Mining in Latin America

Table 50, on page 96 shows Latin American lead production for 1936-1938, 1941, and 1945-1949, from which it may be seen that the major producers, which, in order of importance are Mexico, Peru and Argentina, have not succeeded in repeating the 1938 extraction in any of the succeeding years, whilst Bolivia and Chile have increased their production. A concise summary of the events relating to lead mining in these countries is given below:

Argentina

The Compañía Minera Aguilar S.A., which was formed in the 'thirties, financed by the St. Joseph Lead Company, owns the Tres Cruces mine at Jujuy, which produces almost the whole of the lead ore of Argentina. The company owns a smelter and refining plant, at the river port of Vilelas, in the Chaco, which has an annual capacity of 18,000 tons of pig lead. This plant smelts and refines, in general, ores and concentrates, both from Argentina and imported from Bolivia.

The theoretical capacity for extraction of ore is over 30,000 tons per annum, but this figure has never been achieved in recent years, due to transportation difficulties, both in bringing down the concentrates, and in taking wood and other supplies up to the mine. For this reason also, part of the production of concentrates has been directly exported, and only a small part goes to the smelter in Puerto Vilelas, which on the other hand, has facilities for receiveing supplementary quantities of ore from Bolivia.

/Under these

Under these circumstances, until the transport problem is solved, there is no point in increasing lead production from the mine. The company is at the same time investing heavily in a factory at Borghi, on the Río Paraná to produce 40,000 tons of sulphuric acid, making use of the sulphur obtained from the roasting of the sulphides. They are also constructing a plant at Comodoro Rivadavia for the thermo-electric refining of zinc which will use surplus petroleum gas as fuel, and which will have an annual production of 15,000 tons of slab zinc.

In the outskirts of Buenos Aires there are some low capacity lead smelters and refineries, such as that at Mercedes on the Río Paraná. These process secondary lead, together with surplus concentrates from Aguilar, ores from the small Argentina mines, and concentrates from the mine at Aysén in Chile. These plants operate mainly for the Argentina domestic market, and details of their production are not known.

Bolivia

The extraction from the mine at Huanchaca, which in 1941 produced almost the whole of the 6,000 tons of lead extracted in the country, has gradually diminished, barely reaching 3,270 tons in 1949, although at the same time the production of zinc concentrates from this mine has increased considerably.

Since the price of lead commenced to rise in 1947, the Banco Minero de Bolivia has financed a very large number of small producers and some of this assistance was used for the supply of machinery for a certain extent of mechanisation in these mines large enough to justify this step. The result of this policy has been an increase in the Bolivian lead industry to an extent which may be seen from the following Table:

Table 54. Production of Lead in Bolivia by Groups

(In metric tons)

Year	Huanchaca	Various	Banco Minero		Total
			Tons	Percentage	
1945	4,230	2,846	2,432	26	9,508
1946	3,700	1,901	2,833	33	8,434
1947	3,300	4,054	3,956	35	11,310
1948	5,060	4,362	16,184	63	25,606
1949	3,270	6,187	16,854	64	26,311

Source: Banco Minero de Bolivia (Annual Reports) and Yearbook of the American Bureau of Metal Statistics.

/In March

In March 1949, lead prices on the New York market fell from 18 to 12 cents per pound, this lower price being maintained with slight variations until September 1950. This price fall considerably reduced the guarantees of private individuals covering the corresponding credits with the Banco Minero, placing this government credit organisation in a temporarily delicate situation. Fortunately the bank did not change its policy and the subsequent rise in price satisfactorily solved this problem. In the course of five years, the small lead mines of Bolivia increased the extraction of fine metal contained in the concentrates by nearly 600 per cent. There is no information available regarding the producers of the 6,187 tons which were shown in 1949 under the heading of "Various Producers", but the small figures show that even should this have been the output of a single one of the so called medium mines it must have been made with comparatively small investment.

Brazil

The Plumbum S.A. owns a smelter and lead refining plant in Panelas (Paraná) which mainly works with concentrates imported from Bolivia. In the state of Sao Paulo there is another small refinery, government owned, which works ores from Sao Paulo and Minas Gerais as well as imported concentrates.

These plants are producing for the Brazilian domestic market and no information is available as to the tonnage which they have refined nor the origin of the raw material used, just as in the case of the small refineries and smelters of Buenos Aires.

Chile

Lead is very scarce in the enormous mineral area of Chile. The tonnages produced yearly for export are shown in Table 50 and there is no information on the production of the small smelters and refineries which work for the domestic market.

The Compañía Minera Aysén has recently been formed, which owns a deposit in the Aysén province in the south of Chile, on the Lago Buenos Aires, with ore of an average grade of 40 per cent of lead, 14 per cent of zinc and 400 to 500 grammes of silver per ton.

The high grade of the ore justifies its exploitation in spite of transportation difficulties. At present, supplies for the mine are sent by sea to Puerto Ibáñez and are there transhipped into lighters or small steam river boats to Puerto Aisén, whence they are carried by truck some 400 kilometres over the road which passes through Argentina to the port of

/Chile Chico

Chile Chico on the Lago Buenos Aires, and it is finally taken across this lake in lighters to the mine.

The ores and concentrates which have been exported up to date are taken across the Lago Buenos Aires to Chile Chico and from there, by truck about 100 kilometres to Las Heras and finally 80 kilometres by railway to the Argentine port of Deseado, whence they are shipped by sea to Buenos Aires (Mercedes) or to overseas countries.

The Company owns an extraction plant with a capacity of 40 tons per day in which they are at present carrying out flotation of lead ore and concentrating it to 67 per cent, together with 4 to 5 per cent of zinc and 800 grammes of silver per ton. This small plant is being modified in order to increase the recovery of lead and separate the zinc concentrates.

In addition high grade lead ore is bein extracted by hand but this does not pass through the extraction plant. The total capacity of the plant is approximately 800 to 1,000 tons of material, of which 67 per cent is lead, each month.

The production of fine lead has been:

1948	794 tons
1949	763 tons

Including the towing barge and other vessels for the Lago Buenos Aires, the Company has invested one million dollars in the development of this mine up to date, the whole of which has been contributed by Chilean capitalists.

In addition to the modification of the extraction plant previously mentioned, a hydro-electric plant is being constructed with a capacity of 300 kilowatts and a second small boat is being built for the lake. A plan is also being studied for the installation of a smelter and lead refinery with the object of supplying the Chilean market. Apart from this Company, the Corporación de Fomento together with the Caja de Crédito Minero has a plan for a smelter and lead refinery, which will probably be in the north, near Paipote. The purpose of this plant would be to treat the few lead ores which are at present being worked, together with any which may be extracted in the future, the capacity being approximately 1,600 tons per annum.

Guatemala

The Compañía de Guatemala has commenced the exploitation of a deposit of lead and zinc with open workings at Alta Verapaz, some 20 kilometres east of Coban. The plant was completed in 1949 and commenced to produce metal in a smelter with a daily capacity of 50 tons. The product of this furnace is shipped to the United States for refining. The Minerales Nacionales have constructed a modern flotation plant in the

/south of the

south of the country with a daily capacity of 50 tons of concentrates, which, once dehydrated, are sent to the United States for smelting and refining.

No data is available at present regarding the tonnages extracted from these two mines.

Mexico

The capacity for the production of lead in Mexico appears considerably higher than the figures for extraction during the recent years. In general it is maintained that two independent factors have operated to keep the production, in practice, within the figures given in Table 50 and these are: 1) transportation difficulties, both for the ores and concentrates and also for the productive elements, especially wood, fuel and provisions, and 2) strikes and stoppages caused by labour troubles.

With regard to the first point, the Administración de los Ferrocarriles Nacionales made a serious effort in 1950 to solve these difficulties and the producers expressed the opinion that the situation has improved considerably when compared with the end of 1949, a period during which movements within the yards of the plant were impeded by stocks of concentrates and ores ready for shipment, which it had not been possible to despatch.

So far as labour troubles are concerned, in spite of the fact that 1950 was the year when the majority of the collective contracts expired, there have been very few stoppages. One of the few exceptions is that of Fresnillo, controlled by the Nacional Financiera, which was stopped for three months during the first half year, although it is possible that use was made of this time to effect repairs. Fresnillo produced 20,886 tons of fine lead in 1949.

Table 55 shows the annual productions of the most important mines whose extraction is registered by the American Bureau of Metal Statistics.

/Table 55.

Table 55. Production of Lead in Mexico by Groups of Producers

(In metric tons)

Year	American Metal Co. Torreon Chihuahua	Fresnillo a/	Howe Sound Co. a/	San Francisco a/	Sta. María de la Paz and Annexes a/	Various (obtained by calculating the difference) c/	Total b/
1936	70,789	15,331	56,090	26,891	..	21,258	215,724
1937	85,322	14,691	56,803	32,094	..	48,165	237,075
1938	79,637	15,055	53,170	33,393	..	101,014	282,369
1941	60,252	15,475	52,761	23,775	-	2,986	155,249
1945	63,661	20,755	12,055	33,814	2,825	72,205	205,315
1946	49,123	18,274	8,672	27,823	2,087	32,164	140,143
1947	52,157	21,862	9,267	26,370	2,106	111,373	223,135
1948	57,403	20,284	13,580	24,630	1,933	75,486	193,316
1949	76,272	20,886	12,325	32,768	2,593	75,919	220,763

Source: a/ Yearbooks of the American Bureau of Metal Statistics; b/ Dirección General de Industrias Extractivas; c) these figures are obtained by calculation of the difference and may not be exact due to discrepancies shown at end of page 97.

As mentioned in note c/, the tonnage shown for the group "Various", which has been obtained by calculating the difference between the total value and the remaining figures, is probably incorrect due to the discrepancy between total figures supplied by the two sources from which they were obtained. With this explanation, if an average is struck between the values before and after the war it may be seen that there has been a certain amount of increase of production in this group and that on the other hand there has been a decrease in the output of those which previously were the big deposits.

An anaylsis of the figures shows that the productive capacity of the American Metal Company in Torreon, Chihuahua, has remained constant, since production for the year 1949 is very similar to that of the 'thirties, and the same is seen in the case of San Francisco.

Fresnillo, lately controlled by the Nacional Financiera, shows an increase of 33 per cent in spite of the strike in 1949, and finally the small plant of Santa María de la Paz is new. Within this Table the greatest influence in the problem of Mexican production has been the decline in output of the group of mines owned by Howe Sound Company, which

/is due to

is due to parcial exhaustion, and the extraction of zinc from this group shows a similar trend. The increases in Fresnillo, Santa María de la Paz and the group "Various" does not compensate for this decline.

Explorations made by the American Smelting and Refining Company in the San Antonio mine in Taxco in 1946 revealed the existence of an important reserve of silver-lead-zinc ore. In 1949 a selective flotation plant with a daily capacity of 800 tons was completed at a cost of one million dollars and this plant will also treat ores from the new district of La Concha, which was later discovered in Taxco Guerrero. This is the most important event in lead mining in Mexico and the new production will more than replace the deficiencies which have been noted in some ores which are becoming exhausted.

Amongst the smaller investments may be mentioned that of 300 thousand dollars by the Mazapi Copper Company as the first stage in the installation of a smelting furnace for lead, which should be working by March 1951, and which will considerably relieve the transportation problem. The same company plans to invest a further 200 thousand dollars in 1951 in various additional works.

The large quantities of lead offered and the low prevailing prices in the world markets between March 1949 and the second half of 1950 caused the main producers, the American Smelting and Refining Company and the Compañía Minera de Peñoles, to reduce production by 12 per cent, but in October 1950 these companies recommenced working at maximum capacity.

This voluntary reduction is probably the only negative factor affecting the production of lead in Mexico in 1950.

Over a long period, a favourable factor will be the United States demand, which will probably increase more rapidly than the expansion of lead mining in the Sterling Area, which is Mexico's principal competitor. On the other hand an unfavourable factor will be the opinion apparently held by most United States entrepreneurs that the taxes on mining in Mexico are excessive. It must be remembered that the deposits of lead and zinc, however great they are individually, are becoming exhausted and it is necessary that investments be made in new mines if the production quota is to be maintained, and even more necessary if it is to be increased.

/Peru

Peru

Table 56 shows an analysis of the production of lead in Peru by groups of mines, with the tonnages refined in Cerro de Pasco separated from the remainder of the production.

Table 56. Production of Lead in Peru by Groups of Mines

(In metric tons)

Year	Cerro de Pasco concentrates (own and purchased)	Huarón	Various obtained by calculating the difference	Totals	Refined Lead (Cerro de Pasco group in percentage)
1936	8,889	21,559		30,448	29.2
1937	19,053	22,985		42,038	45.3
1938	26,005	32,039		58,044	44.8
1941	32,798	6,883	10,366	50,047 a/	65.0
1945	39,994	10,144	3,260	53,398	74.9
1946	36,383	7,775	139	44,297	82.1
1947	32,116	6,400	16,026	54,542	58.9
1948	34,782	6,977	6,538	48,297	72.0
1949	35,986	8,340	21,233	65,559	55.0

Source: a/ Annual Report of the Industria Minera del Peru, and Yearbooks of the American Bureau of Metal Statistics.

The tonnages shown in the column "Cerro de Pasco" correspond almost entirely to refined lead of 99.9 purity and the remainder to concentrates for export. Amongst these Huarón, one of the greatest producers, has been separated as from 1941.

Cerro de Pasco produced ore in its own mines and also buys from third parties. In 1947, for example, the tonnages attributed to that Company were obtained as follows:

Cerro de Pasco Corporation	18,471
Volcan Mines Company	6,364
Minas Cercapuquio	3,286
Negociación Minera E. Fernandini	2,351
Castrovirreyna Metal Mines Company	758
Negociación Minera Lizandro Proaño	454
Empresa Explotadora de Vinchos	337
Mateo Saljuf	95
	32,116

The theoretical refining capacity of Cerro de Pasco has been estimated at 40,000 tons per annum, which was achieved in 1945. During

/the other

the other years the smelter has worked at a figure varying between 80 and 90 per cent of capacity.

The high prices ruling since 1947 have caused a revival in lead mining, resulting in an output even greater than that of 1938, and the increase has been shared between a number of medium-sized mines, amongst which the Compañía Minera Atacocha is the most important. The opening up of these mines has been almost entirely financed by Peruvian capital, and the Banco Minero del Peru has given financial assistance and has installed certain selective flotation plants, such as that of Sacramancha, which obtain their ore from the small producers in the area. In view of the favourable price of lead in recent years the trends towards financing and opening up of lead mines should continue in the next few years.

Apart from the investment in a copper refinery, which was mentioned in the relevant chapter, Cerro de Pasco is also increasing its capacity for the production of lead and zinc, with an investment plan of almost 30 million dollars in seven years, of which 20.8 millions will be lent by the Export Import Bank. The project includes the construction of an adequate flotation plant and a thermo-electric zinc refinery which will be constructed by stages. The first stage of 10 thousand tons per annum (35 tons per day) will come into operation in 1951 and the final stage, which will bring output up to 65 thousand tons per annum, will be operating in 1957. In addition to increasing the present plant at Malpaso the hydro-electric plant of 60 thousand kilowatts is being constructed in Paucartambo. The reserves of lead and zinc in the deposits owned by Cerro de Pasco are very considerable and will last for many years, whilst the proven deposits of copper and silver will begin to be exhausted within some seven to ten years.

The production of lead from the mines owned by the Company will therefore commence to rise, as from 1951, above the present figure, which varies between 20 and 25 thousand tons per annum.

Summary of Latin American Activities

Summarising, the following are the important projects which are being or have been carried out in Latin America with foreign capital; the main object is the production of zinc but the extraction of lead will also be

/increased:

increased:

30 million dollars in Cerro de Pasco in Peru, to be invested between 1950 and 1957.

3 to 4 million dollars in Guatemala in two new mines which have already commenced production.

1 1/2 million dollars in Mexico in an extraction plant at Texaco Guerrero, and in the old copper mines of Masapil.

Domestic capital being invested by the various countries includes the following projects, which are shown in dollars:

4 millions in Argentina for the Aguilar mines.

1 million in Chile in the Aysén mine.

In addition to these plans, very successful investments are being made in a number of smaller projects which have not been greatly published, in Bolivia, Brazil, Mexico and Peru.

As a result of these projects and of the high prices of the metal, the extraction of lead in these countries will reach the highest totals yet registered. Mexico is probably an exception since in this country the total losses in production caused by exhaustion of some of the old mines has not been replaced by the opening up of new ones.

However, no matter how encouraging the results of this effort may be, there is no doubt that the increase in lead extraction will be greater in the Sterling Area because of the so called four-year plan which is being developed in Australia, Southwest Africa (Tanganyika) and Southern Rhodesia, and the same may be said of the French dependant territories, Algeria, Morocco, French Equatorial Africa and Tunis, whose production will increase considerably in the next few years. The expansion and new plants in this group of countries, and also in the Belgian Congo, are, as already stated, being financed with the assistance of private United States firms and Marshall Plan funds.

As occurred in the case of copper, it seems that this will cause a reduction in the share of Latin American mining in world production. There is, however, the difference that this fact probably will not prejudice the economic development of the countries so much as would the failure to make use of these natural resources which, if they are not exploited now, may remain for many years without any advantage being

/taken of

taken of them. The reserves of lead in the United States, where the market has shown the greatest increase, are so exhausted that it is almost impossible that they will meet even the reduced consumption during cyclical downswings, and at the same time, the variations in the demand for lead caused by the cyclical variations are considerably less than those of copper.

PRODUCTION OF ZINC

Introduction

At the beginning of the chapter on lead a short explanation was given on the form in which lead and zinc ores are found, which is generally in mixtures of the two. This chapter will briefly review the development of the separation processes, and it will be shown that the smelting of zinc presents difficulties which have resulted in its concentration being undertaken only in a few countries or regions.

In spite of the specialized nature of the work the processes used are still relatively inefficient, and some 10 to 12 per cent of metallic content is lost in the smelting and refining of ores and concentrates. This fact leads to a certain amount of confusion in statistics and studies of the trade in zinc ores and concentrates; apart from sources which still show bulk weight, there are some which show the fine metal content given by analysis and lastly there are others which deduct metallurgical losses, and this latter is, of course, the metal really paid for by the importing countries.

Supply and Consumption of Some Important Regions

a) United States. As in the case of the majority of the industrial metals, the United States is at the same time the greatest producer and the greatest consumer of zinc in the world. Table 57 shows domestic production, imports by types, overall exports, and the balances remaining for apparent consumption.

/Table 57.

Table 57. Zinc: Supply of Zinc in the United States

(in metric tons)

Year	Production in the United States	Imported as ores or concentrates	Imported in ingots	Total e/	Exported b/	Apparent balance consumed
1927	559,695 d/	8,630	54	568,379	91,043	477,336
1928	564,785 d/	9,072 c/	2	573,991	39,865	534,126
1929	576,277 d/	13,073	205	589,699	17,442	572,257
1936	531,349 d/	156	10,634	542,191	1,783	540,318
1937	597,904 d/	7,993	35,741	641,701	2,456	639,245
1938	464,039 d/	16,859	6,791	487,747	2,393	485,354
1941	679,606 a/	262,364	31,347	973,444	83,652	889,792
1945	557,345 a/	346,295	88,103	992,071	7,356	984,715
1946	521,488 a/	246,809	95,022	863,389	43,170	820,219
1947	578,347 a/	270,308	65,601	914,256	98,264	815,992
1948	571,528 a/	239,698	84,626	895,888	60,463	835,425
1949	529,697 a/	218,525	115,145	863,382	53,884	809,498

Source: Yearbook of the American Bureau of Metal Statistics.

a/ Calculated as recoverable.
b/ Not including rolled products.
c/ Estimated.
d/ Slab produced from American ore, plus zinc dust, plus oxides, plus lithophone, plus sulphates.
e/ Including small amounts imported in the form of zinc dust.

Although the fact does not appear in the table because of the years shown therein, it must be recorded that the United States ceased to be a net exporter of zinc in 1935, and became a net importer. It may be seen from the figures that this was due to increased consumption, since production remained more or less constant during the whole period with the exception of the war years, for example 1941, when it was increased to assist armament production.

/Table 58.

Table 58. Zinc: Import Duties on Zinc in the United States

	In Concentrates a/	In Ingots
1909 Law	1.000 cents/pound	1.375 cents/pound
1913 Law	10% ad valorem	15% ad valorem
1922 Law	1.500 cents/pound	1.750 cents/pound
1930 Law	1.500 cents/pound	1.750 cents/pound
Treaty with Canada 1939	1.200 cents/pound	1.400 cents/pound
Treaty with Mexico 1943	0.750 cents/pound	0.875 cents/pound
1947 Law applicable until 30 June 1949	Duty free	Duty free
International Conference in Paris, June 1948	0.750 cents/pound	0.875 cents/pound

Source: Bureau of Mines

a/ At various times natural ores of grades lower than 25 per cent have been duty free or have paid less than the concentrates.

Most producer countries have taken advantage of the trade agreement with Mexico because of the favoured-nation clause, but it was decided by both parties on 23 June 1950 that this would expire on 31 December of that year. In any case the fact is unimportant, since the United States contribution to the International Trade Organisation was to make permanent the 50 per cent reduction in tariffs.

The import tax has allowed a higher domestic price to be maintained during the period when zinc was quoted at a price too low to cover the cost of United States production. A number of marginal mines in the United States, which could not profitably sell at world prices, have been enabled to continue producing by virtue of this tax. In any case, with the considerable price increase since the war United States production has been able to maintain approximately the same level without protection, the tax having been suspended in 1947.

However, the additional zinc requirements for manufacturing output, the defence programme, and the accumulation planned for the stockpile cannot be met from United States production even though the price may be increased in an attempt to make it profitable to work many low grade or deep deposits. It will be remembered that during World War II this price increase was achieved by means of subsidies.

/On the other hand,

On the other hand, it is publicly admitted that, on the whole, lead and zinc mining in the United States has not reached the degree of mechanical efficiency of the copper industry, and substantial increases could be obtained both in output and productivity by means of adequate investment in many existing mines. Any such plans would naturally be in addition to those mentioned at the foot of page 77 on the subject of the expansion of lead mining in the United States, since all of these would be mainly designed to increase the extraction of zinc.

b) Consumption and Production in the Sterling Area

Table 59 is similar to Table 58, except that it shows zinc production in the Sterling Area.

Table 59. Zinc: Production of Zinc in the Sterling Area

(in thousands of tons)

Year	Australia	Burma	Africa	Total
1927	156.1	23.7	-	179.8
1928	160.6	28.0	-	188.6
1929	117.7	25.5	-	143.2
1936	161.4	38.2	-	199.6
1937	160.2	36.7	14.2	211.1
1938	176.1	36.0 a/	10.3	222.4
1941	198.7	28.1	13.7	240.5
1945	116.9	-	15.4	132.3
1946	135.8	-	17.4	153.2
1947	144.7	-	21.5	166.2
1948	150.9	-	31.7	182.6
1949	152.9	-	33.5	186.4

Source: Yearbooks of the American Bureau of Metal Statistics

a/ According to analysis.

In common with mining in almost the whole world, the highest quantities were extracted during the war. Australia, in particular, has never been able to repeat these figures, but great efforts are being made to increase production again, as is shown in the chapter on lead. Africa, and especially Rhodesia shows a high rate of increase which will continue to rise in the coming years. Burma has been unable to return to its previous production, mainly due to the almost continuous political disturbances since the war. In any case, should political stability again

/be established

be established in this country, the sterling area will probably become a net exporter.

Table 60 shows the consumption of this area and the balance of the zinc trade.

Table 60. Zinc: Consumption of Zinc in the Sterling Area and Balances.

(in thousands of tons)

Year	Total Production	Consumption					Balance to be imported
		United Kingdom	India	Africa	Australia and New Zealand	Total	
1927	179.8	177.7	6.5	1.5	11.0	196.7	- 16.9
1928	188.6	184.1	8.2	2.0	15.0	209.3	- 20.7
1929	143.2	190.2	8.1	2.0	17.4	217.7	- 74.5
1936	199.6	222.2	21.3	2.5	27.9	273.9	- 74.3
1937	211.1	231.2	24.5	3.0	29.0	288.0	- 76.9
1938	222.4	211.7	21.5	4.0	30.5	257.7	- 45.3
1941	240.5	-	-	-	-	-	-
1945	132.3	-	-	-	-	-	-
1946	153.2	219.5	27.2	3.6	36.0	286.3	- 133.1
1947	166.2	226.8	30.6	4.5	44.9	306.8	- 140.6
1948	182.6	226.8	28.6	6.4	41.6	303.4	- 120.8
1949	186.4	201.9	26.0	6.4	45.5	279.8	- 93.4

Source: Yearbooks of the American Bureau of Metal Statistics.

The table shows a different trend in the United Kingdom, compared with the increase experienced in all the under-developed countries of the Sterling Area. These used an average of 13.3 thousand tons per year in 1927-29, as against 78.2 thousand in 1947-49. In the first of these three-year periods this figure represented 6.4 per cent of the entire consumption of the sterling area, and 26 per cent in 1947-49.

The sterling area has shown a consistent deficit in its supply of zinc, and this has increased since the war although, as has been stated, active efforts are being made to produce a larger quantity. On the other hand there is a strong tendency in the industrialized countries towards reduction of the consumption of zinc for each 100 dollars of manufacturing output at constant prices, so that it should be quite

/possible

possible even without the assistance of Burma, for the Sterling Area to become a net exporter of zinc in the course of the next few years.

c) Consumption and Production in Western Europe

Table 61 shows the production of zinc in Western Europe excluding the United Kingdom and Yugoslavia.

Table 61. Zinc: Production of Zinc in Western Europe, excluding the United Kingdom and Yugoslavia.

(Production in thousands of metric tons)

Year	Italy	Spain	Germany	Remainder of Europe	African Possessions	Total
1927	88.8	52.9	94.0	31.1	54.3	321.1
1928	72.4	54.0	91.0	33.5	38.3	289.2
1929	75.5	50.0	106.4	48.3	33.8	314.0
1936	56.5	36.0	120.0	40.6	9.4	262.5
1937	70.0	20.0	147.3	44.0	12.4	293.7
1938	83.7	44.0	157.6	41.5	8.0	334.8
1941	77.7	42.0	228.3	40.5	26.3 b/	414.8
1945	11.8	30.0	-	35.4	29.2	106.4
1946	27.5	37.6	22.1 a/	47.9	43.4	178.5
1947	60.2	40.4	22.1 a/	49.9	52.1	224.7
1948	79.4	46.9	28.8 a/	50.4	69.5	275.0
1949	62.0	50.5	57.2 c/	57.0	69.5	299.6

Source: Yearbook of the American Bureau of Metal Statistics.

a/ Only Bizonia
b/ Including Indochina
c/ Federal German Republic

A decline may be noted in Italian and Spanish production after the World War and the Civil War respectively, although in recent years a trend can be seen towards regaining the 1927-29 figures. In Germany there is a considerable falling off in comparison with the pre-war period. This is partly due to war devastation, from which the country is rapidly recovering, but to a much greater extent it is due to the fact that the tonnages extracted in Silesia and Saxony, both in Eastern Germany, are not included. So long as the two parts of the country remain separated, the East will have an excess of production and the West a deficit which will compel both of them to resort to international trade.

Production has increased in the remainder of Europe as a whole, and this also applies, to a far greater extent to the dependent territories

/in Africa,

in Africa, so much so, that this offsets the loss of production from Indochina, which, as in the case of Burma, is due to the prevailing political situation.

Table 62 shows the consumption and production of zinc in Western Europe, excluding Yugoslavia and the United Kingdom.

Table 62. Zinc: Consumption of Zinc in Western Europe Excluding Yugoslavia and the United Kingdom

(Consumption in thousands of metric tons)

Year	Belgium	France	Germany	Remainder	Total	Production as per Table 61	Balance to be imported
1927	112.3	114.2	199.9	46.1 b/	472.5	321.1	- 151.4
1928	117.9	125.7	204.3	64.7 b/	512.6	289.2	- 223.4
1929	133.2	113.7	200.2	75.6 b/	522.7	314.0	- 208.0
1936	110.0	85.2	209.0	82.0	486.2	262.5	- 223.7
1937	100.0	91.9	233.8	94.5	520.2	293.7	- 226.5
1938	102.0	89.2	269.4	92.7	553.3	334.8	- 218.5
1941	-	-	-	-	-	414.8	-
1945	-	-	-	-	-	106.4	-
1946	42.4	80.6	16.5 a/	90.5	230.0	178.5	- 51.5
1947	49.3	18.6	20.7 a/	110.9	279.5	224.5	- 55.0
1948	38.7	91.6	45.1 a/	118.1	293.5	275.0	- 18.5
1949	32.8	108.6	98.5 c/	119.1	359.0	299.6	- 59.4

Source: Yearbook of the American Bureau of Metal Statistics.

a/ Only Bizonia
b/ Estimated
c/ Federal German Republic

A considerable decline in consumption in Western Europe may be seen from the table. This must undoubtedly be attributed, 1) to the lower manufacturing output in Germany and Italy, both of which used to be heavy consumers, and 2) to the fact that part of the zinc processed in Belgium and Germany was exported to countries in Eastern Europe. 1/ France on the

1/ Here it must be remembered that metal is "consumed" in the country where it is processed, without making any adjustment for the subsequent export of laminated products, etc.

/other hand

other hand has already exceeded the 1935-38 consumption level and the same has also occurred in the remaining countries of this group.

d) Japan

Neither in the chapter on lead nor in this chapter on zinc has any reference been made to Japan, which in the 'thirties was a substantial importer of both metals, and used to buy considerable quantities, especially from Mexico.

The explanation for this lies in the fact that even before the war it was not known to what use the metals were put in that country, and at present, due to the very low manufacturing output, consumption is small.

As the industrial reconstruction of Japan proceeds, the country will undoubtedly need greater quantities of lead and zinc, although it is impossible to state for the moment whether imports similar to those of 1935-38 will be made.

e) Consumption and Supply of the Western Hemisphere

Table 63 shows the consumption and production of zinc ores in the Western Hemisphere.1/

1/ This table, like those covering zinc in the other parts of the world, is only intended to give an idea of the trends of consumption and production by countries and groups. It is not sufficiently accurate to permit the calculation of balances, since the following factors give rise to possible errors: (a) production figures have been taken in some cases on the basis of zinc contained in the ores and concentrates according to analysis, and in others the recoverable zinc has been calculated, and finally some have been taken directly from the production of the smelters; (b) the consumption figures do not include ore used for direct production of zinc dust or chemical products; and (c) in some countries it has not been possible to separate zinc dust and chemical products from mining production.

/Table 63.

Table 63. Zinc: Consumption and Supply of Zinc in the Western Hemisphere

(in thousands of metric tons)

Year	Production				Consumption b/				Exportable Balances
	United States a/	Canada & Newfoundland	Latin America	Total	United States	Canada & Newfoundland	Latin America	Total	
1927	504.9	77.0	152.3	734.2	498.7	13.0	9.1c/	510.7	223.5
1928	509.9	98.0	169.7	777.6	525.8	16.3	12.8c/	554.9	222.7
1929	519.8	128.4	184.3	832.5	540.9	17.3	15.0c/	573.2	259.3
1936	474.6	190.5	175.4	840.5	520.7	18.1	10.5	549.3	291.2
1937	534.9	191.9	194.2	921.0	551.7	16.9	16.0	584.6	336.4
1938	414.6	224.0	206.9	845.5	374.8	13.6	14.0	402.4	443.1
1941	679.6	287.2	217.4	1.184.2	-	-	-	-	-
1945	557.3	286.0	306.8	1,150.1	-	-	-	-	-
1946	521.5	262.9	234.1	1,018.5	723.3	41.9	17.5	782.7	235.8
1947	578.3	228.6	285.8	1,092.7	704.7	46.4	21.2	772.3	320.4
1948	571.5	251.6	271.2	1,094.3	728.3	42.3	22.4	793.0	301.3
1949	529.7	263.7	288.1	1,081.5	637.6	41.4	30.0c/	709.0	372.5

Source: Yearbook of the American Bureau of Metal Statistics.

a/ Production of slab, since no data are available regarding the consumption of zinc dust and chemical products.
b/ Consumption of slab, exclusive of zinc dust and chemical products.
c/ Estimated.

It may be seen that in the period between 1927-29 and 1946-49, production has remained more or less constant in the United States, and that in Latin America it has increased less rapidly than in Newfoundland and Canada. In this latter country part of the zinc is associated with copper. Consequently, the corresponding tonnage varies more in accordance with the copper cycle than with that of zinc. Since the war, however, the copper market has developed more or less in line with that of zinc. From a short-term point of view, on the other hand, this association of the two metals has caused the producers to take the line most favourable to them each time that it has been attempted to form a cartel to regularize the production of either.

Consumption has increased less than production for the hemisphere as a whole, so that the exportable balance has increased in the course of the years.

/The 1949 consumption

The 1949 consumption in the United States was less than that of 1948, and is shown in the table as an increase of the exportable surplus. In practice, this excess tonnage was partly used to bring up to a normal level the stocks in the various distribution channels which had fallen too low in 1948. The remainder, approximately 90.000 tons, was set aside for the stockpile. Apart from this, purchases for the stockpile have not been deducted from the balance calculated in the table for the hemisphere.

In the corresponding section consumption trends will be analyzed. Plans for the increase of productive capacity are of necessity the same as those found in process for increasing the production of lead.

With the possible exception of Mexico, United States and Canada, production in the hemisphere tends to increase.

f) Trends of the International Trade in Zinc

Table 64 shows the balance of international trade in zinc and the countries or groups which have been previously studied are shown separately. Since the production figures which are used as a basis refer to recoverable zinc crediting it to the countries where the ore originated without taking into account the additional complication of refining they do not reflect all the movements of the metal in its various stages of preparation.

Table 64. Trade Balances of Zinc by Areas

(Production in thousands of metric tons. + Exportable Surplus
- Balance to be Imported)

Country or Area	1936-38	1946	1947	1948	1949
United States	- 8	- 202	- 126	- 157	- 108
Canada	+ 186	+ 221	+ 182	+ 209	+ 222
Latin America	+ 179	+ 217	+ 265	+ 249	+ 258
United Kingdom	- 222	- 220	- 227	- 227	- 202
Remainder of Sterling Area	+ 160	+ 86	+ 86	+ 106	+ 109
Western Europe	- 233	- 95	- 107	- 88	- 129
Dependent Territories	+ 10	+ 43	+ 52	+ 70	+ 70
Japan	- 40	+ 21	+ 30	+ 34	+ 45
Eastern Europe a/	+ 20	- 24	- 53	- 23	..

Source: Yearbook of the American Bureau of Metal Statistics.

a/ Does not include Russia or Yugoslavia; since the war includes only zinc sent from the Western World and there is no information regarding extraction.

/The outstanding fact

The outstanding fact in the Western Hemisphere is the United States trend towards increased imports, and also that Latin America, up to now, is tending to export greater quantities. Canada shows a similar although sharper trend.

The dependence of the Sterling Area upon imports has increased, but, as stated in the relevant section, this is due to the failure of Burma to regain its pre-war export level. It is also most probable that increases planned in Africa and Australia will more than compensate for this defection on the part of Burma.

It will be noted that the need to import has decreased in Western Europe and its dependent territories, which is mainly due to the decline in European consumption, and to a lesser degree at the moment, to the rising production of the dependent territories, and both these factors should show an increase in the next few years. Later, an attempt will be made to decide whether the present position will be maintained or whether international trade will be expanded.

Japan has been shown together with Eastern Europe. In both cases, the only post-war imports included are those originating from the Western World. So far as can be seen from available data, Japan, which used to be a net importer, has become an exporter, and Eastern Europe which used to export to Western Europe has, since the war, imported from the West the quantities of zinc shown in the table.

g) Changes and Trends in the Structure of Zinc Consumption

As shown on page 21 in referring to Table 8, the part played by scrap in supplying metallic zinc to the United States has remained more or less constant since the twenties and in any case this only represents a very small percentage of the whole. The figures referring to virgin metallic zinc, and the totals, have varied in a similar manner, and the trends shown by one are equally valid for the other in that country. This is probably true for the other countries, which considerably simplifies analysis. Table 65 shows the consumption of virgin zinc per 100 dollars of manufacturing output at 1938 prices, for the United States, the United Kingdom, and the six countries of Western Continental Europe which have already been studied with regard to copper and lead, that is to say, Germany, Austria, Belgium, France, Italy and Sweden.

/Table 65.

Table 65. Consumption of Virgin Zinc in Kilogrammes per 100 dollars of Manufacturing Output at 1938 Prices.

Year	United States	United Kingdom	Average for: Germany, Austria, Belgium, France, Italy and Sweden
1935	2.66	3.28	3.37
1936	2.71	3.28	3.12
1937	2.63	3.18	3.09
1938	2.25	3.15	3.28
Average	2.56	3.225	3.215
1947	1.96	3.13	2.27
1948	1.99	2.89	1.98
1949	1.86	2.33	2.17
Average	1.937	2.780	2.140
Decline	24.3%	14. %	33 %

Sources: Metals Consumption: Yearbooks of the American Bureau of Metal Statistics.
Manufacturing output: Economic Commission for Europe. European Steel Trends in the Setting of World Markets.

The outstanding feature shown by the table is a reduction of the rate of consumption of zinc in the eight countries, although this reduction is not the same in all cases, and an attempt will be made later to determine the possible causes of this decline. It is first necessary to record that the consumption shown for the United States is not quite comparable with that of other countries, since it does not include the consumption of zinc oxide or zinc dust, which in the case of the United Kingdom constitutes approximately 20 per cent of the total, including scrap. Since no comparable data are available for the three groups, it may be safely assumed that (a) the zinc oxide and zinc dust are consumed in more or less the same proportion in the six countries of Continental Europe as in the United Kingdom; (b) the percentages of total consumption of these two in both groups of countries are equally aplicable to the consumption of virgin metal. Granted this point, it may be taken that the average rate of consumption for the period 1947-49 was 14 per cent greater in the United Kingdom than in the United States, where in turn it was 13 per cent higher than that of the continental group. On the other hand the average rate of consumption for the previous period shown in the table, 1935-38, is effectively the same in all three groups, once the same adjustments have been made.

It therefore seems reasonable to assume that there will be a relative decline in the consumption of the United Kingdom, and an increase in that

/of the continental

of the continental countries, so that both will approach the United States consumption. It is therefore essential to know the consumption trend in this latter country in order to make any forecast regarding the future demand for zinc for civilian production in the world.

Unfortunately, no detailed information is available on the division of employment of zinc in the United States, classified by industries or consumer products, but only data showing the form in which it is used. In spite of this, Table 66 has been compiled to show the grammes of zinc used for each 100 dollars of manufacture and from this some conclusions may be drawn regarding the trend.

Table 66. Estimated Consumption of Slab Zinc in the United States.a/

(Grammes per hundred dollars of manufacturing output at 1938 prices)

Purpose	1935	1936	1937	1938	1947	1948	1949
Galvanizing	1,089	1,134	1,098	1,080	903	910	925
Brass and Bronze	689	776	726	555	281	269	224
Rolled Zinc b/	315	260	249	250	177	189	147
Zinc Base Alloys c/	310	338	378	261	540	579	524
Other Purposes	234	226	167	164	69	65	47
Totals	2,637	2,734	2,618	2,310	1,970	2,012	1,867

	1936/38	1947/49	Percentage Difference d/
Galvanizing	1,104	913	- 17.4
Brass and Bronze	686	258	- 62
Rolled Zinc b/	253	170	- 33
Zinc Base Alloys c/	326	548	+ 68
Other Purposes	186	61	- 67
Totals	2,555	1,950	- 23.5

Sources: Consumption of zinc: Yearbooks of the American Bureau of Metal Statistics; Economic Commission for Europe, European Steel Trends in the Setting of World Markets.

a/ Excluding zinc oxide and zinc dust;
b/ Sheets, tubes, bars and wire;
c/ Die castings;
d/ Difference between the averages of 1936/38 and 1947/49.

The variations in average consumption before and since the war give a very clear picture of the trends. In order to form some idea as to whether the downward trends will continue, the figures for 1947 may be compared with those for 1948. The figures for 1949 give no assistance in this respect, since that was a year of recession and reductions appear

/which are simply

which are simply due to the greater movement (caused by cyclical variations) in metal consumption compared with the manufacturing output.

Consequently: a) there is a decline of 17.4 per cent in the use of galvanized zinc in the post-war period, but this fall seems to have been arrested since 1948 and 1949 show a small increase when compared with 1947. It seems very probable that a greater use of aluminium caused the modification in the industrial structure which produced this decline; b) a strong trend may be noted towards a reduction in the use of alloys of zinc and copper, known as brass, which are incorrectly called "bronze" in many Latin American countries. The decline represented, on the average, 62 per cent between the two periods and the trend evidently continues, as is proved by the decreasing use in 1947-48 and 1949. It seems probable that these alloys have been replaced by: 1) die-cast zinc; 2) aluminium; 3) plastics; and, finally, 4) stainless steel; c) a decline of 33 per cent is also shown in the consumption of rolled materials, but this trend now appears to have ceased, as is shown by the greater use in 1948 compared with 1947. Rolled zinc has moreover been partly replaced by aluminium and stainless steel; d) there is an increase of 68 per cent in the use of zinc die-castings. This is probably due to the fact that items which were formerly cast either with alloys containing copper, zinc and tin, or antimonial are now made of zinc base alloys, and this application of it seems to be increasing; e) finally, a decline of 67 per cent may be seen in unspecified uses of zinc and although this appears to be continuing, no attempt will be made at analysis here, partly because only very small quantities are involved and partly because it combines various uses which represent even smaller tonnages.

From the foregoing it will be seen that the trend of the consumption rate of zinc in the United States will probably cease to decline (at least whilst there are no technological changes); moreover it may even start to rise slowly.

In the case of the United Kingdom, statistics similar to those employed for Table 66 are available, as from 1942, prepared by the British Ministry of Supply. It is interesting to compare these figures for the post-war period with the averages for the United States, and this comparison is shown in Table 67.

/Table 67

Table 67. Zinc Consumption of the United Kingdom.

(In grammes per 100 dollars of manufacturing output at 1939 prices)

Purpose	1947	1948	1949	1947/49	United States 1947/49
Galvanizing	1,040	1,030	1,030	1,033	913
Brass a/	1,490	1,200	970	1,220	258
Rolled Zinc b/	360	341	290	330	170
Zinc alloy for die-casting	500	360	305	388	548
Miscellaneous uses	172	156	147	158	61
Totals	3,562	3,087	2,742	3,129	1,950
Zinc oxide and zinc dust	800	747	580	709	
Final Total	4,362	3,834	3,322	3,838	

Source: Consumption of Metals: Yearbooks of the American Bureau of Metal Statistics.
Manufacturing Output: According to Economic Commission for Europe, European Steel Trends in the Setting of the World Markets.

a/ Mainly brass and other copper alloys containing zinc.
b/ Sheets, tubes and bars.

From figures in Table 65, in which only the consumption of virgin zinc is analysed, it may be appreciated that in the United Kingdom, as in the United States, there has been a downward trend in the consumption rate ever since the 'thirties. The last table shows that the trend, referring now to total consumption, including scrap, extends to the post-war period. In order to understand the development of consumption it must be remembered that in the United Kingdom there was no decline in manufacturing output in 1949, although a special effort was possibly made to reduce consumption because of the dollar shortage.

The consumption of zinc for galvanizing in the United Kingdom appears to have become stabilized since the war at a level similar to that of the United States. Its use for die-casting is considerably less than in the latter country and shows no tendency to rise during this period, although this situation may change later. Consumption in copper alloys, on the other hand, appears disproportionately high, although a strong downward trend may be noted which may be expected to continue in the course of the coming years. The downward trend which is seen in the years 1947-49 in the use of zinc in the remaining items, laminations and other unspecified uses, for a given

uses, for a given manufacturing output, will probably continue in the next few years.

In spite of the relatively short period under review, it is possible to estimate that the decline will continue in the United Kingdom to the point where the consumption rate will be close to that of the United States. This same conclusion was reached earlier during an examination of the world trends of the consumption rate, which was made in Table 65. It was also stated at that time that in all probability it would rise slightly in the course of the coming years in the six countries of Continental Europe and would also approach the consumption level of the United States. Since the consumption of zinc (per 100 dollars of manufactured goods) seems to have reached its minimum and commenced to rise once again, a general increase in world consumption of the metal may be expected in the next few years.

The foregoing study only analyses what has been termed here the "consumption rate", that is to say, the quantity of metal used for a given amount of manufacturing output at constant prices.[1/]

Consequently, the total consumption of zinc in any country depends upon the consumption rate, the volume of manufacturing output per inhabitant and the size of the population.

It has been shown in the chapters on copper and lead that once the economic position of Europe has been stabilized by means of the plans at present being carried out, which should be completed by 1952-53, it is possible that the combination of the two deciding factors - increase of population and of the manufacturing output per capita - will increase more rapidly in the United States than in Europe.[2/] Once this period of economic readjustment (and manufacturing output) in Europe ends and while the population of the United States continues to increase at the same rate as in recent years, a greater consumption of zinc may be expected in this latter country than in Europe. As stated regarding the other metals,

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1/ That which corresponds to a given proportion of the physical volume of the total of manufacturing output in the countries.

2/ The rate of increase of the combination of these two factors is greater in the under-developed countries, but their total consumption is so small that this is of no importance.

/the consequence of

the consequence of this will be that zinc will depend to a greater extent on the United States market in the future, with all the consequent advantages and disadvantages. Among the advantages, the most important is the availability of dollars and among the disadvantages is the greater extent of the cyclical variations in the United States with corresponding variations in the demand for the metal.[1/]

The greater stability shown in the consumption of zinc during the cycles and the shortage of reserves of zinc ore in the United States which do not allow this country to increase its self-sufficiency, point to a lesser variation in the United States demand for imported zinc during the cyclical variations than may be expected in the case of copper, the projected production of which may meet the country's needs during the recessions. However, the prevailing decline in the consumption rate in the United Kingdom, together with the projects for the increase of production in Australia and British Africa, lead to the expectation that the Sterling Area will in future compete with Latin America for the United States market.

The projects at present being developed in British, French and Belgian Africa and Australasia, have a joint scope greater than those of Latin America, and their completion will reduce the share of the latter in world production as compared with the war period. Even so, it appears probable that Latin America's future share will always be greater than it was in the 'thirties.

The last two World Wars show that zinc has a considerable use for armaments and when there is great rearmament activity added to a large manufacturing output for civilian consumption, as there is at present, the world production of zinc will not be sufficient to meet the entire demand.

h) Production of Zinc in Latin America.

Table 68 shows the tonnage of zinc produced in Latin America in ores, concentrates and refined metal.[2/]

1/ Up to date, consumption of zinc has varied during the cycles more in relation to manufacturing output than has copper, but it is possible that changes in the structure of consumption which caused the increase of its use in die-casting will tend, in future, to alter this relationship to the détriment of the stability of the zinc market.

2/ These figures are not strictly comparable since, depending upon the source, on some occasions they show zinc according to chemical analysis and in others the actual metallurgical recovery. On the average, this recovery is at present only about 88 per cent of the figure given by analysis and this is the figure which has been used to make the necessary conversions in preparing some of the tables in this chapter.

/It will be noted

Table 68. Zinc: Production of Zinc in Latin America.

Year	Argentina	Bolivia	Peru	Mexico	Mexican percentage	Totals
1927	-	5,600 a/	10,300 a/	136,478	90	152,378
1928	-	2,500 a/	5,500 a/	161,747	95	169,747
1929	-	1,300 a/	8,900 a/	174,050	94	184,250
1936	3,100 a/	10,900 a/	11,239 b/	150,251	86	175,490
1937	5,400 a/	10,100 a/	18,263 b/	160,415	83	194,178
1938	12,200 a/	8,012 a/	14,532 b/	172,215	84	206,959
1941	31,000 a/	8,628 b/	22,810 b/	154,996	71	217,434
1945	13,134 b/	20,975 b/	62,737 b/	209,940	68	306,786
1946	14,724 b/	19,189 b/	60,672 b/	139,535	60	234,120
1947	16,230 b/	14,606 b/	59,194 b/	195,814	68	285,844
1948	12,189 b/	21,124 a/	58,842 b/	179,029	66	271,184
1949	10,920 b/	14,196 a/	71,427 b/	191,582	66	288,125

Source: Yearbooks of the American Bureau of Metal Statistics, excepting Peru from 1936-47, which was taken from the Anuarios Mineros del Peru, and Mexico 1927-48, which was taken from the figures of the Dirección de Industrias Extractivas de México.

a/ Not calculated by analysis but as recoverable zinc.
b/ Zinc calculated by analysis without taking into account metallurgical losses.

It will be noted that all countries show an upward trend even though there have been variations between one year and another. Some of these appear to be due to the greater relative price increase of lead for which reason preference was given to the extraction of this metal at the expense of the loss of small quantities of zinc. Peru, which achieved its highest production in 1949, is an exception.

In this table, 1945 is the year in which the largest quantity was mined in Latin America, which in that year also produced its greatest percentage of the world total. This may be seen from Table 69 which shows that this share has since then declined, from 21.6 to 17.9 per cent, partly due to the increase in world production and partly to the slight decline in Latin America.

/Table 69.

Table 69. Percentage Share of Latin America in World Production of Zinc, Excluding Russia.

Year	World (thousands of metric tons)	Latin America (thousands of metric tons)	Latin American percentage of world total
1927	1,514	152.3	10.0
1928	1,467	169.7	11.6
1929	1,514	184.3	12.2
1936	1,479	175.4	11.9
1937	1,645	194.2	11.8
1938	1,535	206.9	13.5
1941	1,900	217.4	11.4
1945	1,420	306.8	21.6
1946	1,397	234.1	16.8
1947	1,489	285.8	19.2
1948	1,555	271.2	17.4
1949	1,608	288.1	17.9

Source: World Production from the Yearbooks of the American Bureau of Metal Statistics, and Latin American Production from Table 68.

Latin America's share of world supply is much greater at present than it was in 1927-29 and 1936-38 and, as shown earlier, it is probable that the amount extracted will continue to increase and that even if this share should decline it will never fall to the percentages of some of the earlier three-year periods which have been compared in this study.

Finally, the economic importance of the Latin American zinc industry becomes evident from the figures in Table 70.

Table 70. Zinc: Production of Zinc in Latin America and its Value when Refined: placed St. Louis.

Year	Total Production of Refined Zinc (thousands of tons)	Average Price of Refined Zinc (in cents per lb.)	Estimate of Metallurgical Recovery (thousands of tons)	Value of Latin American Zinc, placed New York (thousands of dollars)
1936	175.4	4,901	156.1	16,869
1937	194.2	6,519	172.7	24,823
1938	206.9	4,610	184.5	18,754
1941	217.4	7,474	195.0	32,136
1945	306.8	8,290	270.0	49,116
1946	234.1	8,736	206.0	39,636
1947	285.8	10,800	251.5	58,227
1948	271.2	13,589	241.7	72,422
1949	288.1	12,144	255.3	68,361

Source: Prices from the Engineering and Mining Journal; tonnages from Table 68.

/This table shows

This table shows tonnages produced according to the figures given in Table 68, together with an estimation of the probable metallurgical recovery, and also the average annual zinc prices in the St. Louis market, which is the centre for quotations on this metal in the United States. From these, the nominal value of the total production in dollars has been calculated, refined and placed St. Louis.

This joint nominal value has risen from an annual average of 20 million dollars in 1936-38 to 70 million in 1949, partly due to greater extraction but mainly to better prices. The cost of smelting and refining zinc ore is one of the highest amongst the various metals and it also has greater metallurgical losses which have already been deducted from the figures in the table. Consequently, countries which do no refining but only export the ore in bulk obtain a smaller percentage of the nominal value of zinc than of the majority of other ores and this explains the trend towards local refining, which is made obvious in the succeeding section. The expansion of zinc mining at present taking place in Latin America is entirely in deposits where the zinc is mixed with lead, which have already been described in the corresponding section of the chapter on that metal. However, in view of the difference in foreign exchange receipts to the countries concerned depending upon whether the metal is refined in the country of origin or exported in the form of concentrates, the Latin American zinc refining industry will now be analysed together with investments and plans for its increase which are at present in progress.

i) The Refining of Zinc in Latin America.

It was stated in the introduction that the smelting and refining of zinc involves special technical problems and for this reason, as distinct from the case of lead, this operation is only undertaken in a very few well defined world centres.

Of the Latin American countries, only Mexico has a zinc smelting industry directed towards export, which has been in existence since the late 'twenties. Peru has a large zinc refinery under construction, the first stage of which, with an annual capacity of 20,000 tons, may be in operation in 1951-52, the remainder being gradually completed so that in 1957 it will have a final output of 270,000 tons per annum.

In view of the technical difficulties involved, the fact that there are plants designed to supply the domestic market in the respective

/countries is a

countries is a demonstration of the progress they have achieved in industrialisation, as far as this may be appreciated from the consumption of zinc. The following list gives some details regarding zinc refining establishments in the area, although some of these plants have not worked steadily.

A. Existing Plants

Argentina. In 1947 an electrolytic zinc refinery inaugurated at the port of Uriburo on the river Paraná, with an annual capacity of 3,000 tons.

A small experimental electrolytic refinery was opened in Rio Tercero in the Province of Cordoba in 1948. This is owned by Fabricaciones Militares Argentinos and has an annual capacity of 200 tons

Brazil. The Companhia Brasileira de Zinc has an electrolytic plant at Utinga near Sao Paulo, which has operated sporadically since 1942, having an annual capacity of 300 tons

Mexico. In Nueva Rosita, state of Coahuila, there is a thermic plant belonging to the American Smelting and Refining Company (ASRCO) which has been operating since 1925-28, producing for export, with an annual capacity of 49,500 tons

Peru. The Compañía Cerro de Pasco has a pilot plant in Oroya, which has produced the following quantities of electrolytic zinc: approximately 1,100 metric tons in 1947, 1,350 in 1948 and 1,200 in 1949, from which may be assumed a maximum annual capacity of 1,350 tons.

Total of existing capacity in 1950: 54,350 tons.

B. Plants under Construction.

Argentina. At Comodoro Rivadavia an electro-thermo refinery is being constructed by the Compañía Minera Aguila S.A., which should be in operation in 1951, with an annual capacity of refined zinc of 15,000 tons

/Peru.

Peru. The Cerro de Pasco Mining Corporation is constructing a thermo-electric plant by stages at Oroya. The first stage will probably begin production at the end of 1950 with a capacity of	22,000 tons
the remaining stages, which will be finished in 1956-57, have a final additional annual capacity of	48,000 tons
Total capacity of plants under construction:	85,000 tons

C. Projected Plants.

Chile. The Corporación de Fomento de la Producción is endeavouring to obtain financial aid from one of the international credit institutions with the object of building jointly with the Compañía Minera Bellavista, S.A., an electrolytic plant in Huachipato capable of producing 3,600 tons per annum of sulphuric acid together with refined zinc to a total of	2,000 tons
Total of projected plants:	2,000

The effective Latin American capacity for the production of zinc at the end of 1950, therefore, was 54,350 tons per annum, which will be increased by 37,000 tons in 1951-52, whilst plants under construction or projected should add a further 50,000 tons per annum.

CHAPTER VI. RECENT DEVELOPMENTS AND TRENDS IN TIN MINING IN LATIN AMERICA

Introduction

The pattern of world production and consumption of tin differs in certain fundamental aspects from that of the other non-ferrous industrial metals which have been so far studied. These differences suggest a method of approach distinct from that followed in the analysis of copper, lead and zinc. The chief variations are:

a) Latin American production is concentrated almost entirely in Bolivia, where approximately 97 per cent of the metal is extracted (content in ores or concentrates). The market fluctuations are of considerable importance to that country, since tin production in 1949 represented 72 per cent of its total income of foreign exchange.

b) As in the case of the other metals, the United States is the greatest consumer, but in this case there is the difference that no tin ore is extracted there.

c) The production, sales and stocks in many countries have been regulated since 1931 by a cartel in which the chief producer countries have been represented. As a result of this artificial intervention, prices have been maintained at a higher level than would have been the case in a free market, and a consequence of this has been an increase in the productive capacity in some areas wishing to take advantage of these prices. In others, taxes have been increased and, finally, some mines have not exerted themselves to increase productivity and reduce costs.

d) The greater part of world consumption is in the United States and Western Europe (including the United Kingdom), whilst the greatest proportion of tin production is in the Far East. Consequently, any event which impedes, or threatens to impede, the normal development

/of supply from

of supply from the Far East has profound repercussions on the tin market. For example, the present extremely high prices are partly due to speculation caused by the fear that this production may be interrupted, and the pressure on the market is increased by United States purchases for the stockpile.

e) The extraordinary prices which occasionally result from these conditions, added to the general uncertainty created by them, constitute the incentives which resulted in the policy of high prices maintained during the 'thirties, for which reason it was endeavoured to substitute other metals for tin in many of its applications.

f) During World War II the responsibility for supplying the Western countries with tin fell exclusively upon Bolivia, Nigeria and the Belgian Congo, where production could not be increased sufficiently to meet the entire need. In view of these circumstances, the governments imposed strict rationing which limited the fields of application and also gave users every possible assistance for reducing consumption and finding substitutes.

g) These factors have caused such a sharp reduction in tin consumption for civilian use that the International Tin Study Group, an official organisation formed by the governments of the main producer and consumer countries, has estimated that even without new investments production will exceed civil consumer needs for some years.

This clearly shows that economic factors have only an indirect bearing on the trends and developments affecting the tin market, whereas on the other hand, these are more directly affected by other factors, such as the cartels governing production and trade, and the official control of consumption. For this reason, a certain amount of space will be devoted to these so-called "political" factors.

Ratio Between World Consumption and Production of Tin

Table 71 compares world production and consumption of tin at different periods.

/Table 71.

Table 71. World Production and Consumption of Tin

(In metric tons)

Period	Production	Consumption	Balance
1927-29	179,289	171,060	+ 8,229
1932-34	103,428	121,987	- 18,559
1936-38	185,081	165,506	+ 19,476
1941	242,824	172,110	+ 70,714
1945	91,948	99,273	- 7,325
1946	90,424	110,048	- 20,624
1947	116,332	139,090	- 22,758
1948	155,346	140,716	+ 14,630
1949	162,488	140,000	+ 22,488
1950	168,351	156,800 a/	+ 11,500a/

Source: International Tin Study Group.

a/ Estimated on the basis of 10 months.

Since the beginning of the century, omitting the period of inflation of the First World War, the price of tin showed a steady increase up to the end of the 'twenties. For example, the average prices per pound, placed New York, in United States currency, over 5-year periods were as follows:

1900-04	27,902	cents	per	pound
1905-09	33,707	"	"	"
1910-14	40,211	"	"	"
1920-24	50,882	"	"	"
1925-29	56,623	"	"	"

These increases were greater than those of other industrial metals during the same period. As shown in Chart 2, the prices of aluminium and copper fell between 1900-04 and 1920-24, whilst those of zinc rose by 30 per cent, those of lead by 60 per cent, and those of tin by 80 per cent approximately.

In the 'twenties the increase in price was especially great, as a result of which production increased more rapidly than consumption, and in 1930 there were stocks estimated at 60,000 metric tons. A group of the chief producer countries, together covering 90 per cent of the total extraction, formed a cartel known as the International Tin Committee, with headquarters at The Hague, for the purpose of liquidating these stocks. This Committee fixed export quotas for the member countries

/and by this means

and by this means succeeded in reducing the surplus stocks to about 20,000 tons by 1935. This control of supply by the Committee was such that, in addition to its primary objective, it allowed the relatively high prices to be maintained; in the 5-year period 1935-39 the price was 48.784 cents per pound in New York.

This situation encouraged a number of countries which were not members of this Committee to organise new production and to increase that already existing, and at the end of the 'thirties, the percentage of extraction from the countries affiliated to the cartel fell from 90 to 85 per cent of the total. In 1940, on the threshold of the war in the East and in view of the fact that Malaya, Nigeria, Siam and China were producing more than 60 per cent of the world's tin, the cartel, in order to form stockpiles, allowed producers to increase extraction. In 1941 production reached its record of 242,000 tons, 70,000 tons greater than the consumption, which also reached very high levels.

During the war, production in the East became negligible and even these small tonnages were not accessible to the Allied countries. Bolivia, Nigeria and the Belgian Congo increased their joint extraction to some 90,000 tons per annum, of which, in 1945, 43,000 tons were produced by Bolivia. These 90,000 tons, plus the quantities taken from the stockpile, constituted the total available supply for the Allied countries during the period 1942-45. It is therefore not strange that all the governments concerned, and especially that of the United States, did their utmost to reduce the use of tin to a minimum and also to assist in the search for substitutes.

After the war, production was impossible in the mines of the Far East due to the devastation which had occurred, and reconstruction and reorganisation had to be undertaken. At the same time, the majority of the plants in Bolivia and Africa had encountered difficulties in obtaining spares and equipment and had therefore concentrated their efforts rather on production than on adequate development of the deposits. For both these reasons the production of tin during 1946-47 was less than the consumption, and the United States retained controls on its use until 1949, when they were gradually lifted, between February and the end of the year.

/Production increased

Production increased more rapidly in the post-war period because of the rehabilitation of the mines in the East, whilst consumption, still restricted by controls, tended to become stable at around 140,000 tons. The consumption of tin did not increase greatly with the re-establishment of the free market, probably due to the fact that at that time there had been a decline in manufacturing output in the United States as a result of the contraction of 1949.

The International Tin Committee, to which reference has been made, ceased to exist in 1941. In 1946 the Government of the United Kingdom formed a new organisation, the International Tin Study Group, which at a meeting in June 1949 produced the following forecast regarding the probable production and consumption of tin in the future.

Table 72. Forecast of World Consumption and Production of Tin

(In long tons)

Year	Production a/	World consumption for commercial uses b/	Balance
1949	170,000	138,000	+ 32,000
1950	190,000	158,000	+ 32,000
1951	205,000	162,000	+ 43,000

Source: International Tin Study Group.

a/ Based on the assumption that there will be no considerable change in social, economic or political conditions in the producer countries.

b/ Based on the assumption that full manufacturing output will be maintained in the consumer countries.

Comparing these figures with the production and consumption shown in Table 71, a small difference is seen in 1949. This may be attributed to the fact that, whilst production was some 8,000 tons lower than that forecast, consumption was higher by some 2,000 tons, and in 1950 the discrepancy was greater, as will be seen later. Such a surplus of production would, in the past, have caused a considerably greater crisis than that which occurred in the market when the price dropped to 0.743 dollars in February 1950 from 1.03 dollars per pound placed New York, where it had remained between January and

/September 1949.

September 1949. The reason for this relatively small decline may be found in the fact that tin supplies exceeding the needs of commercial consumption were bought for the United States stockpile. It was originally announced that this would consist of more than 200,000 tons, but it appears that this quantity has not yet been reached. Prices remained at more or less 77 cents until June 1950, but after the invasion of Korea at the beginning of 1951 they rose to more than 1.80 dollars per pound, finally remaining steady at around 1.50 dollars.

The military events in the Far East have revived interest in the stockpiling of tin, but without this the production planned for the mines could certainly not be maintained indefinitely without causing a violent fall in prices and a complete readjustment of the industry. In view of the fact that Bolivia, which is of most interest to this study, figures amongst the highest-cost producers, it will be interesting to analyse the tin market position together with its long-term trends. For this purpose military factors will be neglected for the moment, only taking into account commercial and economic influences.

The disequilibrium between supply and demand in 1949-50 was caused, in the first place, by the reduction in virgin tin consumption compared with the pre-war figures and, in the second, by the increase of productive capacities of some countries, which was already obvious in 1925-29. The decline in consumption not attributable to the cycle may have been caused by:

a) the prices being too high;
b) restrictions on supply due to World War II.
c) technological progress in the consumer countries due to the factors enumerated earlier.

The increases in production have been entirely due to the following reasons:

d) that the high prices maintained by the Committee with the intention of permitting remunerative operation by producers who had the highest costs, provided an incentive for increasing capacity by those whose costs were lower, and
e) the interest of the United Kingdom and the United States in forming a stockpile in 1940-41.

/The quantity of

The quantity of tin contained in manufactured items is generally very small, so that the price of this metal exercises only a minor effect on their final cost. For this reason, while higher tin prices do not greatly influence the search for substitutes, they do provide a strong incentive to the miners for increasing their productive capacity. An attempt will be made to analyse this situation in the sections which follow.

Table 73 shows world tin production for those years which have been analysed as regards the other metals of interest to this study. The main producer areas have been shown separately in a manner which indicates the most important trends:

Table 73. Price of Tin in New York and Annual Extraction of the Main Producer Areas

Year	Price in New York	Production in long tons					
		World	Bolivia	Malaya Indonesia and Siam	Nigeria	Belgian Congo	Other producers
1929	45,155	192,600	46,338	114,178	10,734	1,011	20,339
1936-39	48,350	180,250	25,421	106,665	9,565	8,427	30,172
1941	52,018	246,000	42,199	144,427	12,155	16,190	31,029
1942-45	52,000	112,400	40,276	27,682	12,204	17,018	15,220
1948	99,250	151,500	37,336	79,668	9,236	12,859	12,401
1949	99,336	161,700	34,117	91,692	8,823	13,760	13,308
1950	95,620	165,700	31,213	98,064	8,258	14,558	13,607

Source: International Tin Study Group.

The tin cartel allowed Bolivia a quota equal to 25 per cent of its average production, based upon the high extraction record of 46,338 long tons in that country in 1929, and this was also used as a basis for the first distribution of quotas amongst the associated producers.[1/]

1/ In the previous section entitled "Ratio Between World Consumption and Production of Tin", a concise outline is given of the formation of the cartel and of the influence which it had on stocks and prices of both world production and that of some determined areas. In order to avoid repetitions in this study, the analysis here is confined to the influence of the limitations of the cartel, and the prices and the trends resulting from the military situation, that is to say, those events which were not analysed in detail in the first part. The two parts complement each other and must therefore be considered together.

/In the period

In the period 1936-39, Nigeria, Malaya, Indonesia and Thailand (Siam) kept their productions within the quota allotted to them by the cartel. Bolivia, however, was unable to produce the total of its quota, principally due, according to the Bolivian Government's explanation, to an acute shortage of manpower, which was attributed to the interrupted entry of workers into the mines as a result of the Chaco war, and its consequences. In the Belgian Congo, which only joined the cartel in 1934, production had meanwhile been increased from about 1,000 tons per year in 1929 to an average of more than 8,000 in 1936-39. Finally, producers not associated with the cartel increased their production from some 20,000 tons in 1929 to some 30,000 in 1936-39.

In 1940-41, when the aim was to produce the largest possible quantity of tin, Bolivia increased its extraction, although without reaching the 1929 figures, whilst the other associates of the cartel produced tonnages considerably greater than those of that base year. During the war, the responsibility for supplying the Allies with tin, in order to diminish as much as possible the draining of the stockpiles, fell almost exclusively upon Bolivia, Nigeria and the Belgian Congo. In spite of these circumstances and of the stimulus of subsidies offered by the United States Government, Bolivia's average production in 1942-45 was 5 per cent less than that of 1941, and 15 per cent below that of 1929.

In the world as a whole, both production and consumption in 1941 reached their highest levels, the former exceeding the latter by 70,000 tons, or say about 40 per cent. The total world extraction for 1941 was 246,000 long tons, whilst that of 1929, which had been taken as the basis for the formation of the cartel, was 192,600. This difference of 53,400 tons was divided as follows:

a) Malaya, Indonesia and Siam: an increase of 30,249 tons, that is 26 per cent.
b) Nigeria: an increase of 1,421 tons, that is 13 per cent.
c) Belgian Congo: an increase of 15,179 tons, that is 1,500 per cent.
d) Remaining producers jointly: an increase of 10,690 tons, that is 53 per cent.
e) Bolivia: a reduction of 4,139 tons, that is 9 per cent.

/This general increase

This general increase in productive capacity could not have been achieved without adequate preparation even in Malaya, Indonesia and Siam, where such expansion is easier since they are mainly washings whose extraction can be increased by the simple addition of more machines, always assuming that more tin-bearing areas have been proven. This increase, therefore, shows the extent to which the high prices constitute an incentive for preparing better extraction facilities, and also the sacrifice for some countries entailed by the limitation of their output to the quotas indicated by the Committee.

In this analysis, the failure of Bolivian production to react to the stimulating effect of the high prices, and the great demand, is very noticeable. The reason for this is probably the formation of the mines, which are almost entirely lodes, in contrast to the alluvial deposits of the Far East. In Bolivia, in order to extract from any pre-determined section of the mine, apart from machinery capable of extracting and processing the ore, considerable preparation is necessary in the form of underground gangways for access and ventilation, etcetera,[1] which often take many years to construct.

After the war, as long as the high prices of around one dollar per pound were maintained, each of the producer areas proposed a reversion to the production figures of 1941. As already stated, the tonnage at that time was excessive when compared with the demand and would now be even more so, because the consumption rate has declined considerably, as will be seen later.

The decline in prices in 1949 had a discouraging effect on many marginal producers, who could not profitably produce at the figure of approximately 74 cents per pound, the minimum for that period. On the other hand, the rise in price at the beginning of 1951 to more than 1.50 dollars per pound is also inexpedient because it may result in a new rise in productive capacity and, with this, increase the disequilibrium between civil consumption and potential production.

1/ An idea of the size of investment necessary to increase the production in Bolivia may be obtained from a statement made by a high official of the Compañía Aramayo in La Razón of La Paz, on the 22 October 1950: That the Company had projected an immediate investment of 1,500,000 dollars in order to double the existing production (2,176 tons in 1949). This means, therefore, an investment of approximately 700 dollars per ton of tin produced in the year. This figure presumably covers only a part of the capital necessary for a new mine, since in the case of an extension there are many items which do not need to be increased.

/This situation of

This situation of the tin market will cause greater instability in the event of any cyclical contraction, once the present emergency has passed, which will in turn affect the high-cost producers to a much greater extent than those with low costs. Amongst these high-cost producers, a comparatively small reduction in price will result in some of the most important sections of the mining industry becoming marginal. On the other hand, such price reductions have never so far stimulated the market, thereby causing an increase in consumption, but they have considerably affected the economy of the producer areas because of the closing down of many mines. At the same time, in those countries where costs are high, the stimulus for increasing the capacity of production acts to a lesser degree and more slowly than in those where the costs are low. Each of these cyclical variations of the metal has therefore reduced the share of the high-cost producers in the total production.

It may therefore be stated that the high prices of tin have a favourable short-term effect for high-cost countries, amongst which Bolivia and Nigeria are usually included, but over a longer period the results are unfavourable, since they make the situation more unstable.[1/]

It is not possible, within the scope of this study, to give a systematic demonstration of the manner in which high prices have discouraged increases in productive capacity. In order to do this it would be necessary to show at the same time the increase in productivity in various areas which, in the course of years, varies the profit obtained in those areas for a given selling price. The existence of a large potential productive capacity shown by the events of 1940-41 indicates that the 1930 prices were high for many producers and provided an incentive for developing mining beyond the needs of consumption.

1/ This would presumably not be true if, during periods of high prices, investments are made which increase productivity and bring higher-cost production nearer to the level of low-cost production.

/These high prices,

These high prices, however, have been partly caused by the equally high extraction costs of some of the countries which were members of the Committee. A summary of the variations of some of the factors determining the costs, therefore, seems to be required in order to permit a better appreciation of the developments and trends in the tin market.

Comparison of Some Factors which Determine the Cost of Tin in Various Countries

One of the many factors which determine the costs of extraction is the productivity per man-hour. This productivity has varied in different countries in the course of years, with a tendency to deteriorate in proportion to the reduction in the grade of ore being worked, and on the other hand it has improved because of investments which have bettered the technique or reduced the manpower necessary. A superficial idea of the position of Bolivia as regards labour productivity in tin extraction may be seen from the figures in Table 74, which shows the various countries in 1948-49.

Table 74. Productivity of the Tin Mining Industry in Various Countries

Year	Country	Tons of tin in concentrates	Average number of workmen per year	Tons of tin per workman per year
1949	Malaya	54,910	47,107	1.170
1949	Indonesia	28,965	22,782	1.270
1948	Belgian Congo	13,760	47,618	0.290
1949 a/	Nigeria	9,060	52,451	0.173
1948	Bolivia - total c/	37,336	41,995	0.890
	Bolivia - large and small mines b/	35,180	33,239	1.060
	Bolivia - small mines b/	2,156	8,576	0.253

Source: International Tin Study Group.

a/ The figures for the fourth quarter of 1949 have been averaged to an annual basis.

b/ It has been assumed that the total sales by the Banco Minero were obtained from the so-called small mining and that the large plant did not take in the ores on a toll basis from this source.

c/ A document which the Bolivian Government circulated amongst members of the International Tin Study Group at their meeting in Paris in March 1950, stated that the number of workers in the large and medium mines had been obtained from the number insured under the social security scheme, whilst that of the workmen in small mining had to be estimated for lack of official statistical information.

/The table shows

The table shows that the productivity per worker over the whole of the tin mining industry of Bolivia is lower than in Indonesia and Malaya, and higher than in the Belgian Congo and Nigeria. In small mining, which produced 6 per cent of the total in 1948, is discounted from Bolivian production, the productivity per man-year in the large and medium mines rises to more than one ton, or say figures approximating those of Malaya.[1/]

The productivity per man-year, however, is not a precise indication of costs in the various countries. These are determined by so many different factors, and information which has been published concerning them is so sporadic, that all that can be done is to attempt to throw a little light on this situation by combining and analysing the information which is available.[2/]

One of the reasons most frequently given in explanation of the rise of costs which has affected almost all countries and all types of producers, is the progressive impoverishment of the average grade of ore being worked. There is little official information on this point, but some idea of its extent may be obtained from the figures shown in Table 75.

1/ The small mining, in spite of the inefficiency which shows in these comparisons, receives very special attention from the Government through the Banco Minero, which allows credit and all kinds of other facilities. The justification for this policy is that most of these mines are owned by small indigenous proprietors whose main means of existence is agriculture and who augment their meagre resources by mining. The production of this mining, in turn, represents an increase in the income of foreign exchange to the Government, in addition to the payment of export duties. In this way, therefore, in spite of the deficiencies of this system of production, the workmen produce more benefit to the community than if they limited their activities to the cultivation of their small farms.

2/ The main source of information for this study has been the various publications of the International Tin Study Group.

/Table 75.

Table 75. Analysis of the Ores which Have Been Worked

Year	A Nigeria lbs. a/	B Indonesia lbs. a/	Bolivia Producer C % b/	Bolivia Producer D % d/
1929	..	1.01	3.94	..
1939	1.62	0.84	3.08 c/	..
1941	0.85	..	2.83	..
1943	0.93	..	2.47	..
1945	0.84	..	2.46	3.26
1947	0.69	..	2.55	2.95
1948	0.71	0.86	2.26	2.34

Source: International Tin Study Group, A Statement on the Position and Prospects of the Tin Industry, November 1950.

a/ Pounds of fine tin per cubic yard of ore processed.

b/ Average percentage of tin arriving at the extraction plant after having been selected.

c/ Figures for 1938.

d/ The same as b), but the mathematical average of the analyses of the various mines.

The lowering of the grade of ore has been greater in Nigeria and Bolivia,[1] both of which are considered to be high-cost producers, than in Indonesia, where it has only fallen by about 15 per cent in the last twenty years, but has remained constant during the 'forties, although it is true that extraction was negligible during the war in the East.

Under these conditions, the fact that the large and medium mining industry in Bolivia have been able to maintain the same production in 1948[2] as in 1940 is a clear indication that investments must have been made, or better technique introduced in order to achieve these results. Table 76 shows the yearly figures from 1940 to 1948.

1/ The two Bolivian producers shown in the table jointly produce more than 50 per cent of the total extraction of the country.

2/ The total tonnage of tin extracted in those years being almost the same.

/Table 76.

Table 76. Productivity of Tin Mining in Bolivia 1940-1948

Year	Large and medium mining			Production of tin per workman-year in small mining	Joint production of tin per workman-year
	Tonnage produced	Average number of workers	Production of tin per workman-year		
1940	35,327	33,595	1.050	0.297	0.860
1941	39,703	41,259	0.964	0.298	0.818
1942	35,690	47,234	0.756	0.297	0.660
1943	37,311	52,937	0.706	0.343	0.632
1944	35,605	48,731	0.732	0.355	0.653
1945	39,404	43,466	0.910	0.337	0.778
1946	34,779	34,659	1.000	0.279	0.800
1947	29,813	31,440	0.955	0.340	0.772
1948	35,180	33,239	1.060	0.253	0.890

Sources: International Tin Study Group, Statistical Bulletin, July 1950, and the series of Boletines Estadísticos of the Banco Central in Bolivia.

It has frequently been stated that the difficulties experienced by Bolivia with regard to the present cost of its tin are due to the fact that only the best reserves were worked during the war, so as to increase the extraction of metal. Judging from the official figures shown in Tables 75 and 76, and by combining these, it would appear that this is not completely true, but rather that production was increased by employing more workers in a manner which was therefore less efficient. This of course does not apply in the case of the small mining, which seems to have increased its productivity. However, since the number of workers employed therein is only estimated, and their production as a whole is small, even if productivity were increased, it is of no great importance.

It must be remembered that productivity results from many factors: the quality of the ore, as already mentioned; its accessibility; investments in machinery; the organisation of the company, etcetera, and it will therefore be interesting to compare available information on its development in the various countries. Table 74 shows conditions in 1948-49 in the most important countries; Table 76 shows the development in Bolivia between 1940 and 1948. The following table shows the figures for Bolivia in certain years and compares them with the development of productivity in certain other countries.

/Table 77.

Table 77. Average Productivity in the Extraction of Tin

(Kilogrammes of fine tin in concentrates per worker and per year)

Year	Nigeria	Belgian Congo	Malaya	Indonesia	Bolivia
1929	295	..	735	793	..
1932	296	..	753	..	..
1939	307	242	735	1.347	..
1941	263	283	1.038	..	818
1943	179	218	..	..	632
1945	188	262	..	..	778
1947	180	302	697	..	772
1948	177	290	971	1.307	899
1949			1.170	1.270	

Source: International Tin Study Group, Statistical Bulletin, January 1950, and A Statement on the Position and the Prospects of the Tin Industry, November 1950.

Unfortunately it has not been possible to obtain information on Bolivia for the years before 1940, except for those figures given in a study made by the Commission appointed by the Bolivian Government in October 1935.[1/] From this report it may be seen that total tin production in 1935 was 27,602 metric tons and that 20,229 workmen were employed in large and medium mining during that year. Dividing the total tonnage by the number of workers (excluding those employed in small mining) gives the figure of 1,364. The total production in 1948, on the same basis as before, was 37,336 tons and a total number of 33,239 workmen were employed in large and medium mining, which by again dividing the tonnage by the number of workers, gives the figure of 1,125, that is to say 17 per cent less than in 1935. The reduction of 17 per cent between these two periods must bear an approximate relation to the fall in productivity, assuming that the proportion of the production coming from the small mines remained more or less the same during the two periods. For lack of more precise information, these figures will be considered to be representative of the whole, for the reasons given below.

1/ A Decree dated 10 October 1935 appointed this Commission, consisting of Señores Santiago Schultze, Leoncio Suaznabar and Alberto Gränier, in order to investigate the tin mining situation.

/In Bolivia

In Bolivia it may be estimated that the decline in productivity occurred between 1930 and 1935, because in the latter year it was approximately the same as that in 1948. Since the total production remained at a low level for many years after the 1929 maximum and rose again in 1940, although even then it did not reach the 1929 figure, it must be concluded that investments during the 'thirties, if any, were very small. On the other hand, however, there was considerable investment during the 'forties in order to improve productivity.

Amongst the other countries shown in the table it appears that investments must have been made in Nigeria at the end of the 'thirties, and furthermore, the temporary increase in production during the war must certainly have been due partly to investments made during the 'forties, and partly to employment of a greater number of workers. In the Belgian Congo it may be stated that this mining commenced operation through investments during the 'thirties, continuing until 1945, the year in which its record extraction was achieved. These investments, however, did not greatly improve productivity. Considerable investments were made in Malaya and in Indonesia in the 'thirties, as may be seen from Table 77, permitting at all times the maximum extraction authorised under the terms of the cartel. Once these/restrictions were lifted, immediately before the war, a very high output was achieved, together with equally high productivity. Finally, investments made in both these countries since the war with the object of re-establishing the production, will at the same time help to maintain a very high rate of productivity per man, although, as will be seen later, the 1950 extraction was less than had been forecast.

The foregoing leads to the following conclusions: that the prices ruling in the 'thirties, combined with the costs, average grades of ore, taxes, etcetera, did not give a sufficient profit in Nigeria and Bolivia to induce the investors to enlarge or improve their mines except towards the end of the period; and that on the other hand satisfactory results were obtained by the industry in the Belgian Congo, Malaya and Indonesia.

/At the same time,

At the same time, the same combination of factors in the post-war period gave satisfactory results for Bolivia as well as Malaya and Indonesia, in all of which considerable investments were made, as can be seen from the improved results, at least until prices fell.

The position during recent months has been excluded from this section, because the increased activity in the armament industry has caused an increase in the prices of almost all metals and merchandise. Studying the price of tin, which rose approximately 100 per cent between 1936-38 and 1948, it will be found that the increase only very slightly exceeded the rise in the wholesale price index in the United States. In the producer countries, on the other hand, the majority of the factors which determine the cost increased in greater proportion. Table 78 shows, as an example, some figures related to wage rates in Bolivia.

Table 78. Increase in Rates of Pay and in Social Service Expenses of Large Tin Mining in Bolivia

Year	Cost of wages in dollars		Indices 1940 = 100			
	Per lb. of fine tin a/ d/ e/	Per working day a/ c/	Daily wages dollars a/ c/	Wages in Bls. a/ d/	Wages per lb. of fine metal a/ d/ e/	Cost of living (food) in La Paz
1940	0.067	0.94	100	100	100	100
1941	0.088	1.025	109	122	131	141
1942	0.138	1.10	117	138	206	172
1943	0.169	1.54	164	181	252	180
1944	0.199	1.71	182	198	297	205
1945	0.209	2.22	236	257	313	226
1946	0.200	2.52	268	292	297	283
1947	0.259	3.04	324	364	387	326
1948	0.304	3.64	386	422	452	345
1949				452		368

Sources: Documented presented by the Bolivian Government at the meeting of the International Tin Study Group, in Paris, in March 1950. Cost of living index from the United Nations Monthly Bulletin of Statistics.

a/ Including social laws.
b/ Excluding social laws.
c/ Including price differentials of the company store.
d/ Excluding price differentials of the company store.
e/ Average values depending upon productivity.

/The cost of

The cost of labour expressed in dollars per pound is almost four times as great in 1948 as it was in 1940. In fact, from an index of 100 it rose to 386, which represents a rise from 13.4 per cent of the price of tin in New York in 1940 to 32.2 per cent in 1948, or say from 6.7 to 30.4 cents per pound. The outlay included in this figure consists of wages paid directly in cash, cheap food purchasing facilities and contributions under social laws. It would seem that the workmen have only benefited from a part of this considerable increase, and to make this clear it is necessary to know the true wage, for which reason the wages index will be adjusted in accordance with the cost of living index. There are two cost of living indices in La Paz, one which refers to the cost of living in general and the other only to the cost of food, both of which are of course in Bolivian currency. To decide the pertinent La Paz index for the prices in the mining settlements, would constitute a very considerable study in itself, and consequently lies beyond the scope of the present work. Both calculations will therefore be made, and the figure most favourable to the worker will be used. The conversion of wages shown in dollars into Bolivian currency will be made at the official rate of exchange, which presumably must have been used in the original conversion, since the wages were paid in Bolivian currency.

The official rate of exchange was 38.68 bolivianos to the dollar in 1940, and 42 in 1948. Calculated on this basis, therefore, the index of wages per pound of tin, which was 386 expressed in dollars, becomes 419 in Bolivian currency,[1/] and adjusting this value in accordance with the index for food costs in La Paz, the 1948 index of real wages becomes 122 (1940 = 100), and if the adjustment is made using the general cost of living index instead of the index of food costs, the figure rises to 135.

1/ This series has been used because it is the only one which includes payments for all the various reasons. In the first and last years, 1940 and 1948, the comparison is undoubtedly correct, but the intermediate figures are affected by the variations in productivity.

/It will therefore

It will therefore be seen that real wages have probably risen by 22 per cent according to the index of food costs, which appears to be the pertinent one, as in the mining camps, houses, fuel and light are generally supplied free, and in the case of the general index, which is more favourable to the worker, these would have risen by 35 per cent. Compared with this, the wage expressed in dollars has increased to 386. Part of the difference between these increases is undoubtedly due to the universal inflation, and part to the fact that foreign exchange receipts resulting from tin mining were converted at a very low rate, which in a similar case (that of Chile, according to the Economic Survey of Latin America 1949) has been considered as an indirect tax.

It appears that the income from this indirect tax has been partly used to benefit the national treasury, by selling the foreign exchange at a higher price, and partly to maintain artificially low prices for certain essential articles. From the point of view of this study, the use made of this difference is not so important as the amount which it represents per pound of tin.

As a basis for an estimate of the value of this tax, it is necessary to make some conjectures. In the case of Chilean copper mining it was taken that the tax represented the difference between the export exchange rate for copper and that granted to the remaining items. In Bolivia this free exchange, when it was in force, involved so few transactions that it bore little relation to the general economic situation of the country. For this reason, therefore, in order to appreciate the degree of inflation, and as merchandise exported and paid for in dollars is involved, it seems reasonable to use the cost of living index (food) in the United States as a basis for comparison. Between 1940 and 1948 this index rose from 100 to 218. On the other hand, in Bolivia, the corresponding index, converted into dollars, has risen to 318.

If wages in this country had increased in line with world prices, then adding the increase in real wages, the cost of wages per pound of tin in 1948 must have been 6.7 x 135 x 218 = 19.7 cents; and the

/amount of the

amount of the indirect tax calculated by the same method is 30.4 - 19.7 = 10.7 cents per pound.[1/] This figure is given as a provisional approximation and may change with a detailed investigation of the variations of costs, prices and validity of the indices in the mining camps. The difficulties met in the case of Bolivia, in attempting to show the importance of wage variations on the increase of costs, shows that the reproduction of the following figures covering increase in other countries is of no great assistance: Index 1940 = 100; in Malaya, the wages in the mud-pump mines rose to 376 and in the dredging mines to 284; in Indonesia the increase was from 100 in 1940 to more than 600 in 1948.

For Bolivia and the Belgian Congo, a breakdown of the main items of costs affecting the price of tin in 1948 is available. These figures are shown in Table 79.

1/ It must be remembered that if Bolivian wages are adjusted by using the index of food costs in La Paz, instead of the general index, the increase in real wages will only be 22 per cent. For this increase to agree with the trend of prices in the United States, a rise in wages of 6.7 x 1.22 x 2.18 = 17.8 cents would have been sufficient, in which case the tax becomes even greater than the given figure of 10.7 cents. The calculation made in the text uses the changed indices to provide a greater safety margin in the figure.

/Table 79.

Table 79. Distribution of the Price of Tin in 1948

(Percentages)

	Belgian Congo[a]		Bolivia[b]	
	Partial costs	Totals	Partial costs	Totals
Production Costs				
Production costs in the mine (without amortisation)	49.0		..	
Transportation, insurance, smelting and sales expenses	8.0		..	
General administration	2.0	59.0	..	57.44[c]
Cost of production		59.0		57.44
Participation by the State				
Export duties and other direct taxes on tin	..		19.60	
Income tax on profits derived from tin	..		1.52	
Indirect tax resulting from the rate of exchange applied to tin	..	16.50	11.30[d]	32.42
Participation of the State		16.50		32.42
Participation of Capital				
Amortisation depletion and re-investments	16.0		2.54	
Participation of the Directorate	1.0		—	
Net dividends	7.5	24.5	7.60	10.14
Participation of Capital		24.5		10.14

Source: International Tin Study Group.

a/ Average results of companies operating in the Belgian Congo where there is no "small mining".

b/ Average total production of the country, including medium and small mining.

c/ 10.7 cents per pound discounted, as estimated to represent an indirect tax due to the fixing of the rate of exchange. This figure is only partial, since in other expenses in Bolivia there may have been similar charges.

d/ The tax of 10.7 cents referred to in c/ represented 11.3 per cent of the price of 94.6 cents.

/The table shows

The table shows that the actual costs of production are very similar in the two countries. The lower productivity of the Belgian Congo is partly counter-balanced by lower wages and partly by the fact that some 10,000 tons per annum are smelted within the Colony, thereby reducing transportation costs, etcetera.

The distribution of the remainder of the price shows that direct or indirect taxation in the Congo is only half of that in Bolivia, whereas here the participation of capital is only equal to 41 per cent of that in the Congo.

This difference leads to the question of capital invested in the industry in the two countries. Unfortunately it is very difficult to establish a figure in the case of companies which have made investments at different times over a long period, during which currencies have been devalued and their purchasing power has been decreasing.

The taxation authorities in the Congo have established a formula which allows approximate correction of the prices in order to obtain a comparative value for any given time. For example, on the 31 December 1948 the total capital of the tin companies was 2,200 million Belgian francs, approximately equivalent to 50 million dollars. At the end of 1947 the large and medium tin mining of Bolivia had a declared capital of nearly 61 million dollars, but there is no indication as to a) the part of this sum that has been amortised, b) the part relating to investments which it has been necessary to abandon (whether because of exhaustion of the ores or because equipment became obsolete), nor the portion corresponding to that part of the industry which is actually working efficiently. Consequently it is not possible to make a comparison of the capital invested in the two countries.

As 1948 production was three times greater in Bolivia than in the Belgian Congo, it will be seen that for the percentage of the profit on investments to have been the same, it would have been necessary for the value of the mining installations in Bolivia to be 150 million dollars. As this does not seem probable, there is an indication that the profit distributed was somewhat greater in Bolivia.

/The table also

The table also shows very clearly the ratio existing between world prices and the costs of these two producers. In both cases a fall in price of approximately 8 per cent, as compared with 1948, would have been sufficient to cause most of the industry to show no profit. Should this happen, the first mines to close down in both countries would have been those with the highest costs and the remainder would continue to operate at a reduced profit. Confronted by this crisis, the governments would have to choose between reduction of taxes and a complete stoppage, with the consequent loss of foreign exchange and of the means of livelihood of large sections of the population.

Such a reduction of taxes was precisely the course followed by the Bolivian Government during the contraction at the beginning of 1950, when the price fell from 1.03 to 0.74 dollars per pound. Actually, the dollar rate of exchange was modified so that indirect taxation was reduced, thereby allowing a large part of the mining industry to continue working at a profit at this price of 0.74 dollars per pound. In the case of the Congo, the smaller percentage covered by taxes seems at first sight to reduce the possibilities of this method, but in bad years it is always possible temporarily to suspend re-investments and amortisation which, in that country, represent a more important part of the price than they do in Bolivia.

Analysing the events published by the International Tin Study Group, and especially the reports presented by some of the producing countries belonging to this Group, two categories may be given: high[1/] and low cost. The distribution into either group would be more or less as shown in the following table:

1/ Mines which need a price of around 1 dollar per pound in 1948 in order to work at a profit are considered to be high cost, whilst those of low cost could probably work at a price of 60 cents.

/Table 80.

Table 80. Classification of Tin Production in 1948 into High Cost and Low Cost

Producing country	Method of extraction	Tons extracted in 1948 High cost	Low cost
Nigeria	Alluvial	9,236	—
Belgian Congo	Alluvial	12,859	—
Bolivia	Lodes	37,336	—
Other countries a/	Various	17,192	—
Malaya	Alluvial with dredges	—	30,923
"	Alluvial with mud-pumps	13,892	—
Indonesia	Dredges and mud-pumps	—	30,562
Totals		90,516	61,485
Percentage of world production		approx. 60%	40%

Source: Various publications by the International Tin Study Group.

a/ In Indonesia there is a small percentage of mud-pumps working at high cost. These have not been shown separately since they are offset by tonnages of low cost which may be produced in Thailand.

The world consumption in 1948, restricted by the retention of war-time controls, was 159,900 long tons. Consequently, as may be seen from the table, the low cost producers could not by themselves produce the amounts of tin needed in the world. Amongst them Indonesia, which still has not regained its complete pre-war productive capacity, is rather a special case since nearly 80 per cent of its tin production comes from mines owned and controlled by the Government, and it does not seem very probable that any strong policy of price reduction will be followed. The fact is that tin mining is an exhaustive industry and the proven reserves in the alluvial soil of the washings is limited. Once one of these is exhausted, exploitation must be commenced in another, and this needs investment. The alluvial reserves of Indonesia will last for only some 15 years, and before that time it will be necessary to have organised a sufficient number of mines similar to those of Bolivia, and this requires investment. The capital for any such projects will be difficult to find if, in the meantime, a policy of low prices and low profits has been continued. Some of the low cost producers will be even less inclined to lower their prices, as their experience since the beginning of the century is that a reduction does not help consumption during the short periods

/when it is possible

when it is possible to keep them low, nor does it help to relieve unemployment in the industrial countries. For this reason, and because of the serious effects caused by crises of price (and production) in the mining countries, all of which depend to a high degree on their income from tin,[1/] it is most probable that once the present emergency and period of extraordinary prices has passed, a new association will be formed by the producer and consumer countries to establish prices and reasonable production quotas.

This association should preferably be at government level, because only governments are likely to study these problems on a plane of mutual solidarity and social responsibility, which would ensure fair treatment for the tin producing countries, whose economies are so vulnerable.

Tin Consumption

In the foregoing sections it has been shown that the production of tin is at present greater than the consumption. The International Tin Study Group maintains very complete statistics, conducting and publishing studies which give up-to-date pictures of the variations of production and consumption of the metal, country by country. Reproduction here of these figures has therefore no greater object than to attempt to relate the present trend in tin consumption to the manufacturing output of the main producer centres of the world. The purpose of this is to maintain a certain homogeneity with the studies referring to the other metals, and above all permit some conclusion regarding the future position, when the danger of an interruption of supplies from the Far East has passed.

Table 81 shows some figures relating to the consumption of virgin tin in the world.

1/ The inter-dependence between the prosperity of the tin industry and the economy of the country is undoubtedly more direct in Bolivia than in any other country.

/Table 81.

Table 81. Consumption of Virgin Tin in Some Areas of the World

(In thousands of long tons)

Year	World	United States	United Kingdom	Western Europe excluding the United Kingdom
1927	150.9			
1928	170.6			
1929	183.6			
1936	155.5	68.2	21.9	31.8
1937	189.5	72.9	26.0	36.5
1938	150.5	48.1	18.3	39.4
1941	173.0	103.0	30.0	10.0
1945	103.0	55.6	16.4	11.5
1946	109.0	54.6	25.6	13.2
1947	135.1	59.2	27.4	20.4
1948	139.9	59.9	25.2	24.9
1949	118.9	50.1	20.8	22.6
1950			22.9	

Source: International Tin Study Group: 1949 Statistical Yearbook and Statistical Bulletin February 1951.

It may be seen from the table that, compared with the 'thirties, consumption has fallen in each of these areas, but the reduction has been even greater in the group of countries not shown in the table, as their percentage of the total has decreased. Probably the virtual cessation of tin deliveries to Eastern Europe by the member countries of the International Committee may be partly responsible for this decline. It should be noted that, whereas an appreciable increase in manufacturing output since the war as compared with the earlier period, caused greater consumption of the remaining basic metals, this was not the case with tin, and that, on the contrary, there was a reduction in the amount of virgin tin consumed in the United States.

In order to decide the manner in which the structure of tin consumption is varying, that is to say, the share of the different items in the total demand, the case of the United States will be considered first. In this country, as in the rest of the world, virgin

/tin is mostly

tin is mostly used for the manufacture of tinplate. Only a very small proportion of tin used for coating tinplate returns to the market in the form of scrap. During the war there was a certain amount of scrap available because for purely patriotic motives, and for no economic reason, collections were made of food cans and similar articles. Once the emergency had passed, however, the situation returned to normal, that is to say, tin used for this purpose is generally permanently lost, and the manufacture of tinplate almost exclusively uses virgin metal. No appreciable error will therefore occur if it is assumed here that in the United States tinplate is exclusively manufactured from virgin tin, and that with this use the metal disappears permanently.

It is therefore advisable to make a distinction between two groups of tin and to compare the variations of each of these with the volume of manufacturing output. The first is that used for the manufacture of tinplate, and consists entirely of virgin metal, while the second is that used for remaining applications, to which all the scrap is added. Table 82 shows the variations in consumption in these two groups.

Table 82. Consumption of Virgin Tin and Scrap in the United States

(In long tons and percentages)

Year	Consumption of virgin tin			Scrap	Virgin metal plus scrap	
	Total	In tin-plate	Tinplate percentages		Employed in various uses	General total
1935	55,928	27,290	49	15,245	43,883	71,173
1936	68,232	33,750	49	14,818	49,300	83,050
1937	72,928	39,221	47	17,202	50.909	90,130
1938	48,115	23,545	48	11,658	36,229	59,774
1939	66,583	36,640	55	15,845	45.788	82,428
1940	72,324	38,764	53	24,830	58,390	97,154
1941	103,086	44,854	43	31,609	89,841	134,695
1942	56,288	28,522	50	29,399	57.165	85,687
1943	46,253	21,684	47	34,077	58,646	80.330
1944	59,156	24,968	42	30,813	65,001	89,969
1945	55,642	26,080	47	27,941	57,503	83,583
1946	54,627	26,127	48	26,316	54,816	80,943
1947	59,166	31,481	53	24,103	55,700	87,181
1948	59,863	32,175	54	26,349	58,234	90.409
1949	50,120	30,919	62	21,209	40,410	71,329
1950 a/	70,716	37,080	53	28,788	62,424	99.504

Sources: Publications by the International Tin Study Group, United States Bureau of Mines and Metal Statistics of the American Metal Market.

a/ Estimated on the basis of the figures for the first six months of the year.

/The table shows

The table shows that the total consumption of virgin tin has decreased since the war (by 6,400 tons per annum, which is some 10 per cent of the average 1935-39 compared with 1945-49); the quantity used for the manufacture of tinplate has also decreased (by 2,700 tons, or 8.4 per cent), and lastly the same has occurred in the case of virgin tin for unspecified uses (in which there was a fall of 3,700 tons or 12.2 per cent).

At the same time, the tin derived from scrap, and which returns to the market, has increased by 10,000 tons per annum, so that the total amount of the metal employed in unspecified uses has shown an average increase of 6,300 tons, or 14 per cent. These figures show the importance which scrap returns are acquiring in certain sectors of consumption, precisely in those where the demand has increased, and which are at the same time the only producers of this secondary metal.

During the same periods, the average total production of tinplate in the United States has increased from 1,974,000 tons in 1935-39 to 2,930,000, or 48 per cent. Tin consumption has not increased in the same proportion, due to the fact that at the beginning of the war, with the object of economising in tin and at the same time reducing the tinplate costs, electrolytic manufacture of tinplate was begun in the United States and has spread rapidly. This method, which replaces the old system of tinning by immersion of the sheets in a bath of melted tin, consists in depositing a layer of tin on a sheet of iron by means of an electrolytic process. This new system reduces by approximately 33 per cent the amount which was formerly used in the immersion process. More and more of this type of plant has been constructed, until in 1948 approximately 51 per cent of the tinplate manufactured in the United States was made by the electrolytic process, and in 1950 this had risen to 62.3 per cent.

In the early stages, the electrolytic deposit was not perfect and pin-holes remained in the protective layer of tin. During the war this defect was overcome by the use of varnishes designed to protect the foods, but since then the technique has improved slightly and in order to eliminate this defect completely, a slightly thicker layer

/of tin may be

of tin may be used, which is still much lighter than that deposited by immersion. A precaution which is taken in the United States to ensure protection of the canned food against these defects in tinning was the issue of regulations laying down which products might use electrolytic tinplate and which must use immersion tinplate, and this ensured greater safety even though it did not assist economies in the use of the tin reserves.

Some details of the production of tinplate in the United States are shown in Table 83.

Table 83. Ratio between Consumption of Tinplate in the United States, Manufacturing Output in Dollars in 1938 and Consumption of Tin per Ton of Tinplate

Year	Consumption of tinplate, thousands of long tons	Manufacturing output in 1938, in millions of dollars	Consumption of tinplate, kilos per 100 dollars of manufacturing output	Average consumption of tin, kilos per ton of tinplate
1935	1,692	16,300	10.4	16.2
1936	2,096	19,280	10.8	16.2
1937	2,418	21,200	11.4	16.2
1938	1,430	16,650	8.6	16.7
1946	2,346	32,200	7.3	11.2
1947	3,271	36,300	9.0	9.7
1948	3,416	36,800	9.3	9.4
1949	3,296	34,200	9.7	9.4
1950	3,830 a/	38,500	10.0 a/	8.2 a/

Sources: For manufacturing output, Economic Commission for Europe, European Steel Trends in the Setting of the World Markets; for the production of tinplate and consumption of tin, various publications of the International Tin Study Group.

a/ Estimated from the figures for the first ten months of the year.

In 1950 United States production of tinplate reached its highest figure, exceeding by 24 per cent the previous record in 1948. On the other hand, as may be seen from the estimations in Table 82, the consumption of tin for this application was far below the maximum, due to the continuing increase in the proportion of electrolytic tinplate produced in that country.

/The consumption rate

The consumption rate of tinplate fell slightly in the post-war period compared with 1935-38, the mathematical averages of 10.3 kilogrammes per 100 dollars in that period comparing with 9.5 in 1947-50. The trend towards the recovery of the consumption rate in the post-war period even including the years of economic contraction such as 1949, shows that it has not yet been possible to meet the potential demand, possibly due to the shortage of capacity for manufacture of steel sheet.

It may therefore be stated that the consumption rate of tinplate tends to increase more rapidly than manufacturing output (at constant prices).

In other sections of this study it has been stated that the combination of the increase in population with that in manufacturing output per capita, that is to say the total increase of manufacturing output, in the United States, will be approximately 3.15 per cent per annum in the next few years.

According to this earlier hypothesis, therefore, the increase in the consumption of tinplate in the next few years should show this same average[1/] increase of 3.15 per cent per year, that is to say, in direct ratio to manufacturing output. The consumption of tin in the future, in 1960 for example, should take up various levels in accordance with the following alternatives: a) that all tinplate manufactured in 1960 is made by the electrolytic process, which would give the lowest consumption rate of tin; b) that it is not possible to substitute electrolytic tinplate for immersion tinplate entirely, and for this reason some of the existing plants remain in operation. In this case only the additional capacity needed by new consumption would be produced by electrolysis: c) that various intermediate solutions are adopted.

In both the cases defined in the previous paragraph the total consumption of tinplate, which was estimated at 3,830,000 tons in 1950, will probably be approximately 5,228,000 in 1960. Under the first alternative, whereby all the tinplate would be electrolytic, the use

1/ Average trend, disregarding cyclic variations.

/of tin, which

of tin, which was 37,080 tons (estimated) in 1950, would fall to 28,300 tons. On the other hand, with the second alternative, that is to say maintaining the present tonnage of immersion tinplate produced in the United States, the total consumption of tin in this item would rise to 44,600 tons in 1960.

In addition to this ample margin of possible variations, there are other uncertain factors which in the above enumeration were called "various intermediate solutions". These might be, for instance: 1) that the immersion plants are replaced as they depreciate; 2) that the abandonment of the immersion plants is speeded up, but that a new type of tinplate is produced with an electrolytic layer thicker than that which was determined by the shortage of tin during the war. Finally, there is a further factor which cannot be ignored, which is even more unfavourable to the consumption of tin, and that is a patent for electrolytic tinning which allows control of the thickness of the protecting layer on each side of the sheet of steel, making it possible to manufacture a tinplate with a very thin layer on one side (which would be the outside of the container with no other object than to avoid atmospheric oxidisation) and a thicker layer on the other side (which would be in contact with the contents and could be of the same thickness as the present electrolytic layer). The inventors maintain that this new system of manufacture provides sufficient economy in the use of tin to justify its installation in plants which are at present using the electrolytic process.

Whatever may be the trend of the variation in the consumption of tinplate, no increase in the use of tin for this item may be expected; even should there be an increase, this would probably not be more than 20 per cent in the next few years. Of course, if there are temporary additions to the productive capacity of tinplate during the peaks of the cycles, the consumption of tinplate, and of tin, might be much more than this 20 per cent, which is only the average trend.

In the remainder of the world the substitution of the new electrolytic process for the immersion process has not greatly advanced.[1]

1/ An electrolytic plant for the manufacture of tinplate was opened in the United Kingdom in 1948, with an annual capacity of 63,000 tons, and it has been in production ever since that date.

/Some of the

Some of the industrial countries show a considerable decline in the manufacture of tinplate because of the increased production in the so-called under-developed areas. Table 84 illustrates this situation with figures, grouping together some of the important producer areas.

Table 84. Production of Tinplate in Various Areas and in the World, Excluding Russia and the United States

(In long tons)

Year	World, excluding Russia and U.S.	Canada	Latin America	India & Japan	United Kingdom	Germany a/	Rest of Western Europe
1936	1,473,163	14,000	—	193,919	814,800	235,690	214,754
1937	1,717,599	19,000	—	220,612	957,800	263,011	257,176
1938	1,382,600	26,418	—	217,733	612,500	242.719	283,230
1946	712,097	131,779	—	30,814	439,000	33,120	77,384
1947	837,068	135,219	2,522	46,756	553,200	—	99,371
1948	949,652	140,226	9,627	65,906	610,100	—	123,793
1949	1,233,572	161,539	28,159	93,096	620,100	155,000	175,678
1950	1,477,491	216,720	42,000	98,931	664,800	203,616	251,424

Source: Various publications of the International Tin Study Group.

a/ Bizonia in 1946, and the Federal Republic of Western Germany as from 1949.

The table shows that production in 1949-50 had still not regained the 1937 level, but if the manufacture of tinplate in these countries, and in these years, is added to the increase in exports from the United States of 200,000 tons per annum, the amount available in 1950 will be seen to have been approximately the same as in 1937. However, since the total manufacturing output of this group was greater in 1949 than 1947, it may be said that here, as in the United States, there has been a decline in the consumption rate. To complete the similarity of these two cases, there is also a strong movement towards increasing the production of tinplate, which must also have been slowed by the destruction of the industry in Germany and Japan, added to an appreciable reduction in the United Kingdom.

/Since the consumption

Since the consumption of tin for this item in this group was approximately 27,000 tons in the best year (1937) and approximately 17,000 in 1948, it is doubtful if it will be more than 36,000 tons in 1960, especially if the electrolytic process continues to expand.

Providing, therefore, that between the present time and 1953 this industry is not deprived of its tin, as might occur for military reasons, the total consumption, including that of the United States, may rise from some 60,000 tons in 1950 to 67,000 tons in 1953, and at the most to some 76,000 tons in 1960.

The remainder of the virgin tin used in the United States is diluted with scrap. Table 85 shows the ratio between this consumption and manufacturing output, at constant prices.

Table 85. Ratio between the Consumption of Tin for Uses Other than Tinplate, Manufacturing Output of the United States, and the Proportion of Scrap which is Added to this Metal

Year	Consumption of tin for uses other than tinplate, in long tons	Manufacturing output in 1938, in millions of dollars	Consumption of tin in Kgs. per 100 dollars of manufacturing output	Percentage of scrap included in the tin consumed in these uses
1935	43,883	16,300	0.270	35
1936	49,300	19,280	0.255	30
1937	50,909	21,200	0.240	34
1938	36,229	16,650	0.217	32
1946	54,816	32,200	0.170	48
1947	55,700	36,300	0.154	43
1948	58,234	36,800	0.158	45
1949	40,410	34,200	0.118	52
1950 a/	62,424	38,500 b/	0.163	46

Sources: Industrial activity, Economic Commission for Europe, European Steel Trends in the Setting of the World Markets; consumption of tin, from various publications of the International Tin Study Group, and production of secondary tin from the United States Bureau of Mines.

a/ Estimated on the basis of the first six months.

b/ Estimated on the basis of the index of manufacturing output.

/The rate of

The rate of tin consumption has declined in an appreciable manner since the war compared with the pre-war period, although this trend appears to have ceased in 1950. In this connection it must be remembered that during the first ten months of this year, precisely those which have been used as a basis for the estimation of world consumption, the United States was enjoying complete freedom in the use of this metal for the first time since 1942. It is possible that this may be responsible for the slight increase in the consumption rate, or perhaps this might be attributed to changes in the structure of industrial production caused by the beginning of a new and considerable armament activity.

Before going on to examine the variations in the participation of various items in the consumption of tin, it is worth noting that since the war, in addition to a reduction in the total consumption rate, an increase appears in the proportion of scrap, which has the effect of reducing the consumption of virgin tin.

Table 86 shows the distribution of the uses of tin (omitting tinplate) according to the manner of its application. These figures have been given in percentages for the following years: 1937, the peak of the economic cycle which followed the great depression; 1941 which showed the maximum consumption of the metal, and in which year a considerable armament activity was added to the high levels of manufacturing output for civilian use; 1944, a year which marked one of the peaks of activity during the war and in which all the restrictions covering the use of this metal during the emergency were in force; 1948, peak of the first stage of post-war recovery, with a high level of manufacturing output, and, in spite of this, with limitations still imposed on the use of tin.

/Table 86.

Table 86. Consumption of Tin in the United States by Finished Products (Omitting Tinplate and Terneplate)

(Long tons and percentages)

Form of application of tin	1937	1941	1944	1948
Total consumption (tons)	49,512	87,795	64,261	57,587
Solder	40.29	32.09	21.09	37.67
Babbitt metal	13.70	12.10	13.90	11.30
Bronze and brass	13.10	26.42	51.40	38.70
Collapsible tubes	7.20	5.08	0.82	1.14
Tinning	5.35	4.70	4.88	4.92
Foil	2.95	4.87	0.50	0.50
Chemicals other than oxide	3.03	1.11	0.45	0.40
Pipe and tubing	2.61	1.51	0.41	0.55
Tin oxide	2.35	1.70	—	—
Type metal	2.75	2.07	2.11	2.46
Galvanising	2.00	1.10	—	—
Bar tin	1.67	2.43	1.96	—
Miscellaneous alloys	1.00	0.70	1.75	—
White metal	0.80	2.92	0.15	—
Miscellaneous	1.20	1.20	0.58	2.36

Sources: International Tin Study Group, 1949 Statistical Yearbook, page 93.

The table shows very clearly the extent of the modification in the structure of consumption caused by the restrictions imposed during the war. Whether these modifications will become permanent or whether the metal will again commence to be used in some of the applications which were prohibited, will not be known until some years after the restoration of full liberty of use. Only then will it be certain that industry has achieved a feeling of security and has had time to change its methods and tooling. There is no object, therefore, in analysing the trends ruling during 1950, once the figures are published in detail, since the unrestricted consumption only lasted some ten months, and of these three or four passed under the threat of a new general conflict in the Far East.

This therefore justifies the provisional acceptance of the hypothesis that, discounting armament activity, the rate of tin consumption for these uses in the United States will increase in

/direct proportion

direct proportion to the industrial output which, as has been shown on a previous occasion, has an average upward trend of 3.15 per cent per annum.

It must be stated that the future of consumption in these applications is not so simple as it has been made to appear in this chapter. At times the price increases during the last half of 1950 have been interpreted not only as speculation based upon the danger of the interruption of supplies from the East, but also as a result of a real demand for tin, whose consumption has been greater than the forecasts made by the International Tin Study Group, as a result of the reappearance of some items of use which had been abandoned because of the restrictions during the period of the controls.

The future consumption trends for tin applications other than tinplate are so uncertain, that any analysis of the present position of these particular uses is necessarily limited. However, the figures in Table 87, which indicate the apparent consumption in the various items, allow certain conclusions to be drawn.

Table 87. Index Numbers of the Apparent Consumption of Virgin Tin for Uses Other than the Tinning of Tinplate, in Various Areas

Year	United Kingdom	United States	Remainder of the world, excepting Russia and Eastern Europe a/
1935	91	85	[illegible]
1936	83	103	106
1937	100	100	100
1938	78	73	85
1946	144	85	107
1947	146	82	74
1948	124	82	89
1949	91	57	70
1950	103	100	
1937 (tons)	12,671	33,707	48,529

Source: Various publications of the International Tin Study Group.

a/ Calculated by subtracting tin used in the manufacture of tinplate at a rate of 16.3 kilogrammes per ton from the apparent total consumption.

/Bearing in mind

Bearing in mind that during the post-war period manufacturing output did not rise in any of these countries to the same extent as in the United States, an examination of the table shows clearly that it is in this country that the consumption rate of tin for the uses mentioned has declined in the greatest proportion. In view of the delay in adopting technical innovations in Europe, it may be assumed that there is a trend in this continent towards a reduction in the consumption rate, bringing it nearer to that of the United States.

On the other hand, as soon as there is a greater amount of tin available and complete liberty in its use, it is possible that some forms of consumption may reappear which have been suppressed for several years, both in the United States and in Europe, and with this may come a trend towards a return to the values of the 'thirties.

It is necessary to add a further factor which tends to increase the use of metals: this is the reconstruction of the industrial capacity of some countries devastated during the late war, principally Germany, Austria, Italy and Japan. To this is added the increase in manufacturing output which necessarily resulted from the plans and projects in Europe carried out by the governments and by the Economic Commission for Latin America.

Assessment of Surplus Productive Capacity

The foregoing analysis shows the close relationship which exists, at least on a short-term basis, between the consumption of tin and manufacturing output; and since this latter depends upon the cycle, it is impossible to make any valid forecast on the consumption of metal without reference to the corresponding economic situation. In the next few years, so long as there is considerable manufacturing output for civilian use, together with an increase in the armament industry, there is no doubt that the total manufacturing output will be one corresponding to a moment of expansion in the cycle, and therefore tin consumption will be high, always assuming that supplies from the Far East are not interrupted and that no considerable restrictions are imposed upon its use for civilian purposes.

/Changes in manufacturing

Changes in manufacturing output cause considerable variation in the demand for the metal, and in order to meet this without interruption during the whole cycle, there are two opposing solutions (apart from intermediate solutions made up of a combination of these two): a) to have a sufficient productive capacity to supply the whole world during the peaks of the cycles and to work to only a part of this capacity during the contractions, or b) to produce tin equivalent to the average consumption and accumulate the surpluses produced during the recessions in an anti-cyclic stock.

The second of these solutions was put into practice under the name of "buffer stock" in June 1938 and, in addition to solving satisfactorily the problems of stoppages caused by the recession of 1938, it was also an excellent commercial proposition by virtue of the increase in price of the metal at the time when it was sold.

Since the old cartel was dissolved in 1941, no new body has been formed which will organise a similar reserve, probably because all surpluses which have appeared on the market (which were shown in Table 71) have been bought for the United States stockpile. Consequently, there have been no quantities of tin worthy of mention accumulated by private individuals or firms to meet the increasing demand of the next few years. It is quite possible that this fact played an important part in the increased prices quoted since October 1950.

The consumption forecast made in 1948 by the Tin Study Group, apparently did not take into consideration cyclical variations, but only the reconstruction programmes in Europe. Therefore it is remarkable that the actual consumption in 1950 was only 1 per cent less than the forecast (which appears in table 72); on the other hand, however, production has been well below the estimated figure. Table 88 compares these forecasts with the actual production in the principal areas.

/Table 88.

Table 88. Tin Production in Concentrates in 1950, with the Forecast of the International Tin Study Group

(Metric tons and percentages)

Country or group	Forecast	Actual production	Difference - Deficit	Difference + Surplus
Bolivia	38,000	31,712	- 16.5%	—
Malaya	65,000	58,660	- 9.8	—
Indonesia	45,000	32,641	- 27.5	—
Congo	15,700	14,790	- 5.8	—
Nigeria	8,000	8,390	—	+ 4.9
Other producers	18,300	21,807	—	+ 19.2
Totals	190,000	168,350	- 11.4%	—

Sources: Minería, La Paz, July 1949, page 34, and International Tin Study Group, Statistical Bulletin, February 1951, page 6.

These figures, together with the conclusions derived from Table 71, show that the situation with regard to the surplus of productive capacity of tin has been greatly overestimated by the International Tin Study Group. This may have been due to excessive optimism on the part of the producers regarding the speed with which they hoped to complete the rehabilitation of the mines, or possibly because the fall in price of tin at the beginning of 1950, to 0.74 dollars per fine pound, made production marginal in many mines, and therefore there was no incentive for investments. The explanation of the precise cause of this backwardness in production has only a theoretical interest in view of the figures to which quotations have risen.

There is no doubt that with the prices ruling at the present time considerable investments are being made throughout the world to increase tin mining, and therefore the incentive of a remunerative price which may have been missing during the first half of 1950, now exists to a considerable degree. If the armament activities which have been added to those of civilian consumption disappear from the buying market, the consumption of tin will probably only rise very slowly. These two facts, an excess of investments and a slow rate of increase of consumption, will tend to produce later on, once the

/emergency has passed,

emergency has passed, the situation of over-production which was feared a year ago by the International Tin Study Group. This trend will be aggravated by the following factors: a) the shortage of tin which is being felt at present, and b) the United States intention to continue to increase the stockpile. The way in which this shortage will affect future consumption will be the high price and restrictions, which together will increase the incentive to seek substitutes or methods of economising in tin.

An increase in productive capacity anywhere, but particularly in the Western Hemisphere or in Africa, will therefore, so long as the present emergency lasts, constitute an effective contribution to the maintenance of the tin market for civilian consumption. Should there be a future reduction in consumption because purchases are no longer made for armaments, and should an excess of productive capacity appear, it will be necessary to compare any such excess with the cyclical variations of demand. It is possible that in the future, once armament buying ceases, any such amplifications will make the over-production situation which has been foreseen even more serious, as stated in the preceding paragraph. Nevertheless, any disadvantages resulting from this are very small, as such enlargements would in any case have been necessary in the future. Tin is a wasting asset, and a great number of the individual deposits have a very short life. Therefore, should the rate of investment be interrupted, the natural exhaustion of these mines one after another will automatically eliminate any surplus capacity in the course of a few years.

Should the price fall below certain limits, investments will undoubtedly cease. As shown in various parts of this study, the detrimental effect on the producer countries during recessions which affect both the price and the amount of production is so out of proportion to the effect of these same reductions on the consumers, that this part of the adjustment could certainly be negotiated later by means of an agreement between the governments. Consequently, both the increase in investments and in the production of tin at the present time seem to be of general advantage to the economic future

/of the metal.

of the metal. During a period of considerable economic activity these alleviate the disadvantages caused by the lack of production or of insufficient stocks to cover the world demand.

Production of Tin in Latin America

Table 89 shows Latin American production of tin in bars and concentrates.

Table 89. Latin American Production of Tin in Bars and Concentrates

(In metric tons of tin content in ores and concentrates)

Year	Argentina	Bolivia	Brazil	Mexico	Peru	Total	Bolivia's percentage of the total
1937	1,869	25,424	—	380	73	27,746	91.6
1938	1,869	25,777	—	254	103	28,003	92.0
1939	1,720	27,650	—	295	47	29,712	93.0
1945	990	43,170	124	177	55	44,516	97.1
1946	938	38,223	273	266	31	39,731	96.5
1947	530	33,799	276	175	30a/	34,810	97.4
1948	277	37,933	244a/	185	30a/	38,669	98.5
1949	305a/	34,662	244a/	541	36a/	35,788	96.8
1950	305a/	31,712	244a/	490a/	73a/	32,824	96.7

Source: International Tin Study Group.

a/ Estimates of the International Tin Study Group.

As Bolivia produces approximately 97 per cent of the total output of tin from Latin America, this study will only consider the developments and trends in production in this country, omitting the small quantities extracted in others. This is even more justified because tin represented 72 per cent of Bolivian exports in 1949, whilst in Argentina, Mexico and Peru the figures are of no importance within the totals.

Developments and Trends Related to the Production of Tin in Bolivia

Tin concentrates from Bolivia go to the following destinations: a) The production of the Patiño group, which represents nearly 50 per cent of the exports, is delivered to the smelter of Williams Harvey and Company, of London, in accordance with an agreement signed in 1940, subsequently modified with the consent of the British Ministry of Supply, and remaining in force until 1950. Thirty per cent of the

/production must be

production must be used within the Sterling Area and the remaining 70 per cent is paid for in pounds sterling convertible into dollars. The prices have been fixed periodically and in general have been in accordance with those paid by the Texas Smelter, which is owned by the Government of the United States. Immediately after the devaluation of the pound in 1949, the price was increased accordingly;

b) Since 1941 the remaining tin producers of Bolivia have a contract to sell their production to the Reconstruction Finance Corporation, to be smelted in Texas. This contract, which expired in December 1949, was renewed in August 1950, valid until the end of the year. It fixes a basic price 4 cents per pound lower than the price of Straits tin sold in New York during the preceding month. From this basic price it is necessary to subtract the costs of smelting which have a rising scale as the grade of tin declines in each consignment of concentrates, plus certain small additional charges.

As the prices which the Patiño group obtain in London are substantially the same as those received by producers who sell to the smelter in Texas, it may be said that the amounts received by the producer are as follows:

The average quotation of Straits tin in New York, during the preceding month, less:[1/]

a) The 4 cents per pound depreciation in accordance with the contract;
b) The costs of smelting and other small expenses varying according to the grade of the concentrates;
c) The cost of ocean freight and insurance;
d) The cost of railroad transport to the Pacific ports, which vary between 640 and 1,100 kilometres.
e) Commissions overseas and the taxes on export and production in Bolivia.

A Decree was issued on the 7 June 1939 which for the first time obliged the Bolivian ore exporters to sell the whole of their available foreign exchange at the official rate. This decree laid down that foreign exchange thus obtained by the Banco Central should be

1/ b), c) and d) of the following are known as "conversion expenses".

/distributed into

distributed into various parts, amongst which was the formation of a reserve of 2.5 per cent of the product to meet price variations, whilst others were for purchases of supplies, both for production and for the mining camps and foodstores, smelting charges, depletion, salaries of foreign employees, dividends and profits which had to be paid abroad, etcetera.

Since at the time that this Decree was issued the Banco Central was unable to assume the virtual management of the export trade of Bolivia, a temporary measure was adopted which remained in force with very slight modifications until the Decrees of 8 April and 11 August 1950. Reference to these two decrees will be made later. It was ruled that as each lot was exported, the customs would prepare an estimate of the smelting and transportation charges in accordance with a formula laid down in the Decree, and would deliver to the exporter a Bill of Charges for this amount. On presentation of the export documents, the customs would also require from the exporter a draft for foreign exchange covering the difference between the selling price abroad and the amount of the Bill of Charges.

Thirty days after the date of this draft, the exporters were obliged to change an equivalent sum of foreign exchange into Bolivian currency at the official rate. The Banco Central opened a register of the Bills of Charges, debiting their value to the producer. When the producer delivered the vouchers covering the expenses, the corresponding discharge was made and also the transfer of any difference in foreign exchange, which could remain in the hands of the producer.

These regulations were not complied with because of various subsequent modifications. In practice, at the end of 1949, the producers were delivering at the time of exporting, foreign exchange at the official rate of 42 bolivianos to the dollar, which, according to the grade of tin in the ore, varied between 28 and 60 per cent of its New York value. They retained the amount corresponding to smelting and transportation charges, depreciation of equipment, depletion, supplies imported for production and for the camps, profits, salaries, and commissions abroad. The eventual balance of foreign

/exchange which

exchange which remained after these payments and services, and which the exporters remitted to Bolivia, was liquidated at the special exchange rate of 55.50 bolivianos per dollar; after the fall in prices in September 1949, special regulations permitted liquidations to be made at the rate of 115 bolivianos per dollar. Apart from the natural disinclination of the industrialists to have their businesses completely controlled by the Government to the extent established by the Decree of 1939, the fact that it was very roughly compiled must also have contributed towards non-compliance. In fact, many of the items covering distribution of the foreign exchange and also some of the tax regulations which it contained, were drawn up from generalised percentages for the whole industry and were based on simple assumptions and not on sound and concrete facts. There were so many cases where investigation proved the impossibility of complying with several regulations that, in order to avoid irregularities and injustices, no attempt was made to enforce them.

The fall in the price of tin between September 1949 and February 1950 from 1.03 dollars per pound to 0.74 dollars, added to the continued increase in the cost of living, so reduced the producers' profit margin that many of them probably could not then operate without a loss. In view of this situation, a decree was issued on 8 April 1950, which fixed a new official rate of exchange of 60 bolivianos instead of 42 for the conversion of provisional deliveries of foreign exchange resulting from the export of tin. It was estimated that this new exchange would allow remunerative working of all the mines in operation at the prices then ruling, which were approximately 0.74 dollars per pound of Straits tin placed New York.

On the other hand, the same Decree required the delivery of the whole of the foreign exchange to the Banco Central which, upon application by the producers, allowed them the necessary amount to pay smelting and transportation charges, depreciation, funds for reserves against depletion, imports of supplies for the camps, and profits, although the amount of these last was regulated. The

/industrialists, although

industrialists, although they accepted the new rate of exchange, objected to handing over the whole of the foreign exchange, giving as their main reason for this objection, probable delays in the granting of import permits.

In spite of this opposition, and in view of the increase in the tin price in the meantime, a further decree was issued on 11 August of the same year insisting upon the handing over of all foreign exchange to the Banco Central, and adding a new regulation to the effect that the full value of tin exports should be delivered to the Banco Central by the producers, to be exchanged at the official rate of 60 bolivianos per dollar. However, insofar as the use of foreign exchange thus obtained by the Bank was concerned, and in order to calculate the amount of foreign currency which the industrialists could apply for, the following changes were made: a) of the part up to 0.75 dollars per pound, the Banco Central would deliver to the exporter by means of a detailed permit, the necessary foreign exchange to meet the smelting and transportation charges, dividends, interests on foreign loans, depreciation of equipment, depletion, salaries of foreign employees,[1] and sales expenses. The remainder would be sold to meet the country's normal requirements and obligations; b) The Bank would divide the excess over 0.75 dollars per pound into three parts in varying proportions, scaled according to the price of tin. The first part would be used to supplement the foreign exchange available to meet the normal needs of the country; the second part would be set aside for the formation of reserves which would help to stabilise the currency or to be used for investments for productive purposes, and the third for a special reserve which would be invested by the exporters, either in the tin mining industry itself or in other industrial activities using domestic raw materials, of which the Government approved.

The increase in manufacturing output in the United States, resulting in greater consumption of tin, added to fears of a possible

1/ According to lists accepted by a special committee.

/extension of the

extension of the conflict in the East, caused the price of tin to rise to 1.80 dollars per pound in March 1951. In order to take advantage of the favourable opportunity thus offered to Bolivia, the Government, together with the principal producers, studied a plan under which the producers undertook to increase their extraction and the Government to extenuate some of the rulings of the decree of 11 August.

These negotiations resulted in various decrees, the most important of which was that of 30 October 1950 which refers only to the procedure for exports of tin from the large mining industry. This shows the spirit which inspired the redistribution of the value of the ores exported, after the attempts to increase government participation which were contained in the decrees of April and August, mentioned earlier. A series of later decrees adapted the new methods to the whole mining industry.

This decree separates 18 per cent of the official value of the tin which is the estimated extent of the so-called "realisation expenses",[1] which must be paid in foreign currency. The exporter must account in Bolivia only for the remaining 82 per cent. He must sell foreign exchange to the Banco Central to a value varying between 58 and 60 per cent of the official price, according to the current quotation for the metal, and must account for the expenditure of the remainder, that is between 22 and 24 per cent. He may spend this difference, subject to the approval of the Banco Central, in importing means of production, supplies for the camps, paying interest on foreign debts, remittances of profits, and reserves for depletion and for depreciation of equipment. As the amount of profit which may be remitted abroad has been limited by the Decree, this contains a number of regulations covering the investment of those profits which may accumulate in Bolivia. The distribution changes in proportion to the various possible values of the metal.

1/ These expenses comprise costs of smelting, plus additional small surcharges which are variable according to the grade and purity of the concentrates, shipping expenses, insurance and the cost of railroad transport to the Pacific ports.

/Of these investments.

Of these investments, some are destined to improve the living conditions of the workers, whilst others go to assist in the economic development of the country, being invested in such new industries as the Government may approve.

On the other hand, the companies constituting Bolivia's large mining, which during the first ten months of 1950 produced (measured by exports) at an annual rate of 22,116 metric tons of fine tin, undertook to increase the production within three months to an annual rate of 24,000 tons, and within six months to 26,250, both rates as from 30 October.