BUREAU OF MINERAL RESOURCES.

MINERAL ECONOMICS SECTION.

ECONOMIC REVIEW OF COPPER

by

J. A. DUNN, (Mineral Economist)

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PART I - THE WORLD COPPER POSITION.

INTRODUCTION.

Until recent years the consumption of copper in Australia had not been greatly different from the domestic mine output. Production attained a high peak during the war, but there has since been a serious drop. Although this drop is temporary, it has unfortunately coincided with a period of severe dollar shortage and of rapidly expanding demand for the metal. As a consequence it has been apparent for some time that two important problems face the metal industry in this country, now and for an indefinite number of years in the future - (a) to what extent Australian production of copper can be expected to meet local consumption, and (b) in what manner imports of copper can be made available from soft currency areas rather than from hard currency sources. It is with the idea of clarifying the position that this note has been prepared.

To place the Australian picture in proper perspective it must be viewed against the background of the world's copper position and accordingly this note has been divided into two parts - the World position, and the Australian position.

WORLD PRODUCTION.

Table 1 shows the production of copper in various countries during a representative pre-war year and in post-war years. It will be noted that of a world production around 2,200,000 tons annually (excluding Russia where the production is probably of the order of 200,000 tons) about 1,500,000 tons are of American origin. If production in the Belgian Congo be included then 1,650,000 tons emanate from hard currency areas, and the total production of soft currency countries is only 500,000 - 550,000 tons.

During 1948 and 1949, production throughout the world, except in America, Germany and Japan has been practically at capacity. The total world capacity from mine through smelter to refinery, is about 2,500,000 tons annually, a figure which was attained and even slightly exceeded during the war years 1941 and 1942. Smelters in Germany and Japan have been considerably rehabilitated since the war, but capacity output from these plants will depend on imported ores. The principal unused capacity has been in the United States, with some in Canada and Chile - reduction in output in America was partly due to strikes, and partly due to fall in price in the second quarter of 1949. According to E.C.A., the only soft currency country in which any great increase in output is likely is Northern Rhodesia, where an additional capacity of 100,000 tons annually is possible.

WORLD RESOURCES.

A note which the writer prepared in 1941 is as true today as then, and is quoted:

> The principal copper mining regions are United States, Chile, Northern Rhodesia, Canada, Belgian Congo and U.S.S.R. In these principal countries (excluding U.S.S.R) if the reserve

Table 1 - WORLD SMELTER PRODUCTION OF COPPER - LONG TONS.

(Copper in Copper Ores in Parenthesis.)

	1938.	1946.	1947.	1948.
Canada	212,326	149,043	177,155	189,583
	(255,022)	(164,257)	(201,662)	(216,020)
United States (a)	502,073	535,401	780,450	763,569
(b)	59,682	47,471	76,245	76,486
Mexico	36,514	31,544	54,945	51,136
(Cuba)	(14,203)	(11,018)	(13,036)	(15,000)
Chile	332,175	352,937	401,945	418,169
Ecuador	-	2,617	n.a.	n.a.
Peru	35,176	19,392	17,376	12,606
	(36,936)	(24,204)	(22,137)	(17,783)
(Bolivia)	(2,839)	(6,030)	(6,142)	(6,512)
Total America	1,177,946	1,158,405	1,508,116	1,511,549
Belgian Congo	121,985	141,611	148,456	153,024
(Cyprus)	(e36,000)	(2,634)	(15,536)	(19,196)
Finland	11,637	18,660	19,782	18,235
Germany (c)	67,700	17,562	31,510	61,261
	(30,000)	(e 460)	(e 235)	(e 360)
Norway	10,380	7,382	7,795	8,537
	(21,285)	(12,054)	(14,475)	(14,107)
Spain	14,747	8,018	7,321	
	(e22,000)	(11,964)	(10,625)	
Sweden	10,500	16,126	14,976	15,212
U.S.S.R. estimated	95,000	n.a.	n.a.	n.a.
Yugoslavia	41,330	n.a.	n.a.	n.a.
Japan	100,388	22,877	36,231	53,476
	(e70,000)	(16,865)	(21,542)	(25,315)
Korea (d)	e 6,000	519	386	506
Turkey	2,449	9,891	9,921	10,805
(Philippines)	(3,472)	(n.a.)	(n.a.)	(2,054)
Northern Rhodesia	213,031	182,966	194,841	209,506
Union of South Africa	13,255	26,182	28,470	28,371
(South West Africa)	(8,750)	(n.a.)	(4,085)	(5,907)
India	5,330	6,311	5,931	5,863
Australia	17,098	22,659	19,505	11,389
World (excluding U.S.S.R.)	1,900,000	1,700,000	2,200,000	2,200,000

(a) from domestic ore.
(b) from foreign ore.
(c) Bizone only from 1946
(d) South Korea only from 1946.

n.a. - not available
e - estimated.

of those deposits which have been estimated to contain one million tons of copper are totalled, a minimum of 4,000 million tons of ore, grading from 0.6 to 4.9 percent copper and containing 77 million tons of copper is available from these mines alone. There are many mines, however, with reserves of less than 1 million tons of copper and, taking into account also the deposits in U.S.S.R. and other countries, the minimum reserves of metallic copper available in ore deposits must be over 100 million tons. According to Barbour, the reserves of copper are distributed approximately as follows: South and Central America + 35 million tons, United States + 20 million tons, Canada + 5 million tons, Africa + 22 million tons, U.S.S.R. + 10 million tons, rest of Europe + 1 million tons.

The great ore deposits in which most of the world's reserves lie are of the disseminated type and are generally worked by open cut. Easily the largest of these is the Chuquicamata deposit in Chile, with ore reserves of the order of 1,000 million tons of +1.5 percent copper - this has been producing over 200,000 tons of copper annually in recent years. Much of the United States production is from similar disseminated orebodies, although secondary enriched and lode-type deposits are important. Canadian production is mainly from great massive replacement deposits and from others of lode type worked by underground methods. Northern Rhodesian and Belgian Congo deposits are of mineralised zones of rock, some 700 million tons of 3-4 percent ore, worked by underground methods. Russian deposits are of various types, none individually are comparable with the great American or African deposits, but in the aggregate they provide a useful contribution to Russia's requirements.

In addition to the great ore deposits there are innumerable small or relatively small ore-bodies which, although they play only a small part in the ultimate picture of ore reserves in the world, are useful assets in each country's current economy. Of particular interest are deposits in Finland, Germany, Norway, Spain, Sweden, Yugoslavia, Cyprus, South Africa, South-west Africa, India, [illegible], Korea and Japan. Although no deposits in Japan are individually large, production there totalled over 100,000 tons in 1938 from over 100 mines and constituted the seventh largest in the world. That production is again increasing.

In Australia, production is at present almost entirely from large open cuts on disseminated deposits, at Mount Lyell and Mount Morgan, with only small amounts from underground mines. Shortly, however, the main output will be from underground mining at Mount Isa.

The grade of ore worked throughout the world by open-cut ranges down to 0.6 percent copper, whilst by underground mining the grade ranges widely from 1.7 percent copper upwards. Accompanying metals, particularly gold and silver, and in some cases nickel, platinum, cobalt, zinc, lead, molybdenum, selenium, etc., add to the revenue of the majority of copper mines. In the absence of other metals credited against cost, an ore body of 2 percent copper would today be about an average payable proposition by underground mining.

Some idea of the average grade of ore is provided by the copper ores mined in the United States during 1945: Ores sent direct to smelter - 1,036,847 short tons, yielding 3.52 percent copper; Ores requiring concentration - 73,958,665 short tons, yielding .9 percent copper; total - 77,472,983 short tons (including zinc-copper ores), yielding .93 percent copper, and .0051 ounces gold and .119 ounces silver per ton.

WORLD MOVEMENT OF COPPER.

Almost the whole of the copper-ore mined is reduced to blister copper in the countries of origin. However, small amounts of rich copper ores, concentrates, matte, and copper-rich smelter drosses and tank house slimes are shipped for treatment elsewhere, but it is doubtful whether total shipments of this nature throughout the world would aggregate much over 100,000 tons annually. Some idea of this movement may be gathered from Table I in which copper-ore production is shown in parenthesis where it differ markedly from smelter production, or where there is no smelter output (as in Cyprus).

Much of the blister copper produced is not refined in the country of origin. Nearly 50 percent of the Chilean copper output is shipped as blister, mainly to refineries in the United States, and more than two-thirds of the Northern Rhodesian output is refined overseas at present, mainly in the United States and in the United Kingdom. Copper from the Belgian Congo is partly shipped as blister, largely to Belgium. However, since the war, the tendency is for increasing amounts to be refined in the country of origin, and during the next 10 years the movement of copper as blister is likely to decrease to unimportant amounts.

The data in Table I represents, generally, production of blister or refined copper of domestic origin plus blister or refined copper from imported matte or ore, but excludes copper refined from imported blister or from scrap. The United Kingdom does not appear in this Table as, although a large amount of copper is fire-refined in the United Kingdom (some small electrolytic plants do turn out a very little electrolytic copper), the greater part so refined is imported as blister. The relatively small amount of copper which goes directly into the manufacture of bluestone during treatment of the ores does not, of course, appear in the Table.

MARKET CONTROL.

The London Metal Exchange was regarded in the past as the dominant centre for the world's commerce in copper, although at times other institutions have exerted powerful influences. Amongst the latter was Copper Exporters Incorporated, formed in 1926 by agreement amongst practically all the leading copper producers of the world to sell copper direct to consumers and thus to control export prices. This institution continued until the depression; demand began to decline in 1929 when the price was pegged at 18 cents a lb., stocks accumulated to a quarter of a million tons despite reduction of output by some of the larger producers, and price was lowered by 4 cents a lb., and as the depression worsened dropped in 1930 to only 5 cents a lb. Reduction of output was eventually agreed upon down to as low as 25 percent of capacity from 1st. April, 1932, but this was shortly followed by a termination of the whole scheme. However, another cooperative agreement came into existence in 1935; this Copper Cartel consisted of the large producers of copper outside of the United States (mainly subsidaries of Anaconda Copper Mining Co. and Kennecott Copper Corporation in South America and Mexico, companies in Northern Rhodesia and Belgian Congo, Rio Tinto in Spain, and Bor in Yugoslavia), representing 50 percent of the world's production outside of the United States - U.S. Anti-Trust laws prevented U.S. producers of domestic copper from participating. Production was fixed periodically amongst the Cartel's members according to demand, and naturally this had its effect on prices. In the United States combinations of producers fixed export prices as a safeguard against powerful buyer's abroad, so that in effect the Copper Cartel's activities determined also U.S. prices.

The Copper Cartel's activities ceased with the war when prices were fixed by Governments. Although copper is now freely available once more on the American metal market, the British Ministry of Supply continues control of price and supply - so far, the London Metal Exchange has been re-opened only for dealings in tin. The demand for copper remains high and the tendency at present is for increased rather than controlled production; at least for the immediate future the necessity for a renewal of pre-war production agreements does not arise.

COSTS.

Production costs of course vary widely, according to the grade of ore, scale of operations, other metal credits, local conditions and so on. Some large important mines are rather marginal - for example, when prices began to fall after reaching a peak in early 1949 several American producers announced immediate cuts in production, although output was stopped up again as prices recovered later in the year.

For comparison later with Australian mines, costs of some of the lower cost overseas producers may be noted.

Northern Rhodesia (1948) -

Roan Antelope	£63.14. 5 per ton of blister, f.o.b. Beira
Mufulira	£56. 3. 4 " " " "

Namaqualand (1948) -

O'Okiep	£45. 9. 7 " " " " , ex mine.

Chile (1947, three major producers) -

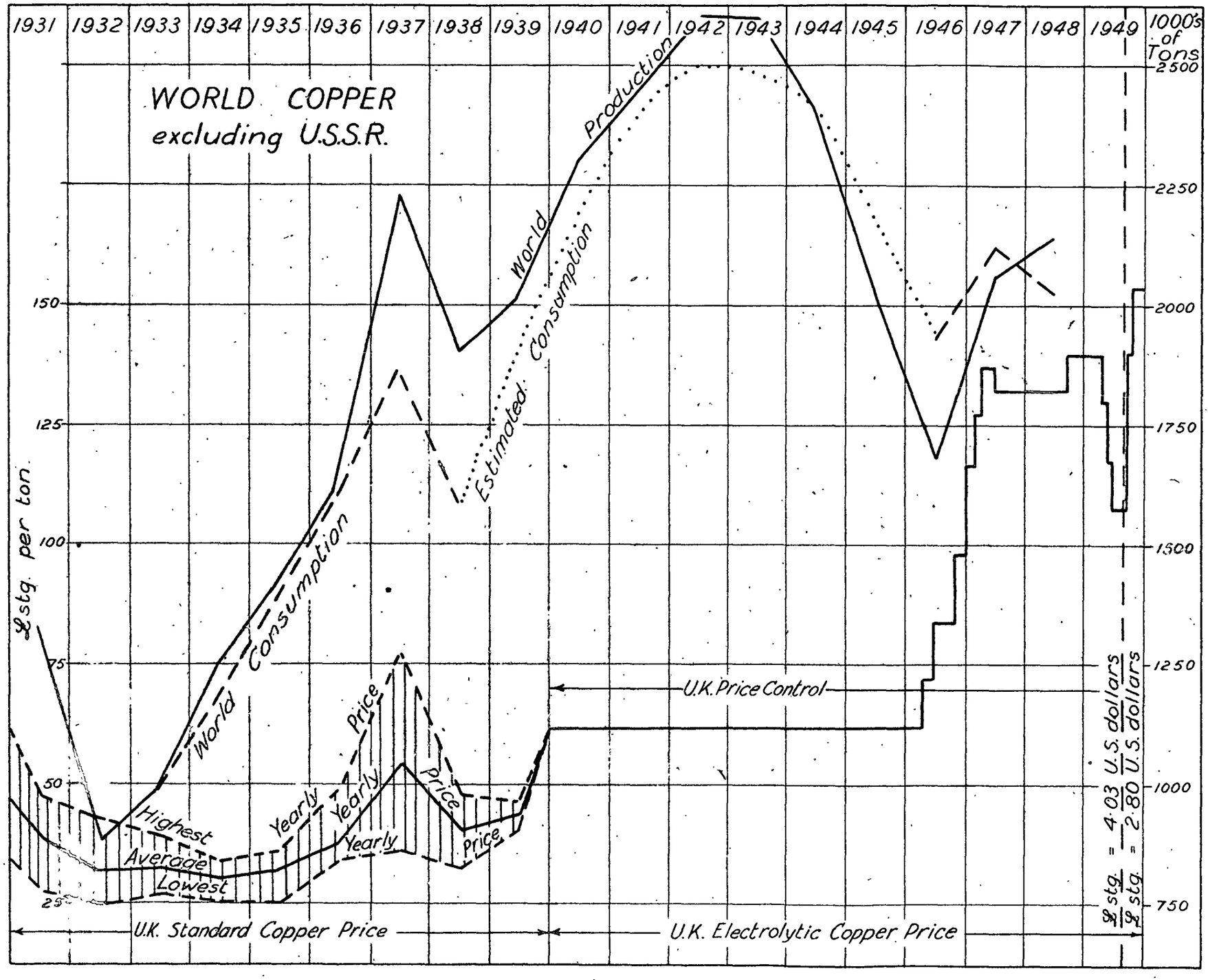
Operating costs	- 8.5 cents per lb., £47. 4. 5. per ton of blister
Chilean taxes	- 5.63 cents per lb., £31. 5. 7. per ton of blister
Total	- 14.13 cents per lb. £78.10. 0 per ton of blister

It is uncertain to what extent administrative charges are included in the above overseas data. The Chilean costs, in sterling, are based on the 1947 rate of exchange - on the revised 1949 rate, the total Chilean cost would be about £110.17. 7.

Costs of refining blister copper vary widely, and in general are considerably lower where the refinery is closely linked with the mine, mill and smelter as the final stage of the one company's operations. Costs of fire refining are invariably lower than electrolytic.

Perhaps the lowest refining costs in recent years were at the refinery of Rhokana Corporation, Northern Rhodesia, where costs decreased from £3. 6. 0. per ton of copper for a throughput of 26,000 tons in 1940-41 to £2. 9. 0. per ton for a throughput of 69,000 tons of electrolytic copper in 1944-1945. This refinery was a part of the operations of the one concern, but since 1947 the refinery has been acquired by The Rhodesian Copper Refineries Ltd.

Charges of some European refineries which treat blister copper on a customs basis are as follows:-


WORLD COPPER
excluding U.S.S.R.
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1000's of Tons
2500
2250
2000
1750
1500
1250
1000
750
£ stg. per ton
150
125
100
75
50
25
World Production
Estimated Consumption
World Consumption
Highest Yearly Price
Average Yearly Price
Lowest Yearly Price
U.K. Price Control
£ stg. = 4·03 U.S. dollars
£ stg. = 2·80 U.S. dollars
U.K. Standard Copper Price
U.K. Electrolytic Copper Price

Belgian works : Refining rough copper, 97% minimum, copper content less 1.5 units returned in wire bars - £17.17. 2 per ton of rough copper.

Refining blister copper, 99 percent, into electrolytic copper wire bars - £10 to £11 per ton of blister copper.

Swedish works : Refining rough copper, 97 percent minimum, copper content less 0.8 units returned as wire bars - £20.13. 6 per ton of rough copper.

It is of interest to include here, also, the costs (in sterling) of converting and refining copper in an English works dealing with copper matte and various classes of low and high grade copper bearing materials in the smelter, and scrap and blister in the refinery -

Copper Smelting : Smelting and converting to blister copper, 97.5% minimum - £10.15. 0 per ton of material treated.

Refinery : Refining scrap and blister into refined cakes and billets - £9.10. 0 per ton of blister copper treated.

PRICE.

Before 1939, the world price of copper fluctuated widely within short periods. Controls kept prices stabilised during the war, but following the return to open marketing in the United States after the war American prices again varied considerably. Although control was maintained in the United Kingdom, the British Ministry of Supply's prices have tended to follow the American and, indeed, fluctuations have been greater than were ever experienced on the pre-war London market. In the accompanying graph of London prices, the highest and lowest prices are shown during each year prior to 1939, and from then on the actual prices as they varied through each year. The abrupt rise in the U.K. price following devaluation of the £ in September, 1949, was, of course, merely to bring it into line with the U.S. price on the new exchange rate.

The price curve follows to some extent the curve of world production, although not entirely so. Since the war, the United States market has been the dominant factor determining price. Although prices during 1948 and 1949 rose to 2½ - 3 times their pre-war level so also have costs, and the marginal position of several important large scale producers has not been greatly altered. Thus, following the peak prices of early 1949, when prices fell for a few months, several American large producers reduced output for a period.

One of the factors influencing copper prices is the large amount of copper scrap re-entering industry. Much of this scrap is purchased and retreated by customs smelters and refineries - these customs plants rely on purchased material for their output, unlike those concerns which treat only their own ores. Customs smelters in general are not in the position to carry considerable stocks, and when scrap is readily and relatively cheaply available this low-priced scrap may tend to a lowering in the price of refined copper.

WORLD CONSUMPTION.

The figures in Table 2 on the consumption of copper in various countries are incomplete, but they serve to illustrate the difficult problem which now faces soft-currency areas in securing adequate copper supplies. The data for the United Kingdom and United States include only primary copper, but it is uncertain to what extent secondary copper enters into the amounts quoted for other countri

Table 2 - CONSUMPTION OF PRIMARY COPPER, PRINCIPAL COUNTRIES. In Ton

	Av. 1934-38	1946.	1947.	1948
Canada	45,122	71,640	97,512	95,856
U.S.A.	459,598	1,096,786	1,141,429	1,083,929
Total American	624,380	1,229,732	1,300,000(e)	1,250,000(e)
Australia	12,244	23,214	20,179	25,176
United Kingdom	252,623	325,404	350,124	356,796
Belgium	27,656	42,857	60,000	53,482
Czechoslovakia	25,746	3,125	22,321	39,286
France	106,018	100,893	114,286	88,839
Germany	232,821	17,589	31,518	61,161
Italy	77,712	23,214	55,357	55,804
Sweden	44,388	64,375	64,554	45,446
South Africa	4,133	4,500(e)	n.a.	10,956
India & Pakistan	25,000(e)	13,116	18,360	24,288
Japan	133,000			

e - estimated. n.a. - not available.

Consumption of primary copper in America is approximately 1,300,000 tons annually, leaving a total of about 900,000 tons available for non-American countries. Consumption in the United Kingdom is 350,000 tons, whilst European requirements (excluding Russia) are of the order of 450,000 tons (of which some 50,000 tons are absorbed in Belgium, a hard currency country), thus leaving about 100,000 tons available to the rest of the world.

FUTURE ECONOMIC POSITION.

At present, and as far as can be seen, perhaps the greatest single factor in the economics of copper is currency - the soft currency areas cannot avoid the purchase of much of their supplies from hard currency areas. This imported hard currency copper originates mainly in Chile, Canada and Belgian Congo - in Chile, the two largest producers are American owned and naturally demand payment in dollars.

Production in non-American countries consists of about 550,000 tons from soft currency countries and about 150,000 tons from Belgian Congo. Thus the soft currency area is producing about 300,000 tons less than the 850,000 tons required within the area, and this deficiency can be made good at present only by importing 100,000 tons of copper from Belgian Congo and 200,000 tons from America. There is little scope for making up this production deficiency of the soft currency area in the foreseeable future - the main possibility is Northern Rhodesia, where at least the electrolytic refinery capacity could be expanded to cope with the entire domestic blister production. There is of course, a certain amount of hard currency involved in some soft currency production, such as that part of Northern Rhodesian blister which is at present refined in the United States, but, broadly, in terms of money it is apparent that on present day prices, soft currency countries will need to import more than £45 millions of hard currency copper if the requirements of their secondary industries are to be met.

The United Kingdom must rely almost solely on Northern Rhodesia for soft currency copper, although some amounts of refined copper have been obtained recently from Germany and Sweden. Her annual requirements are nearly 200,000 tons in excess of imports from these sources, and for these requirements she must turn to U.S.A.,

Canada, Chile, Belgium and Belgian Congo.

It is doubtful whether the future will witness any great expansion of copper output. That output is fundamentally (apart from demand) determined by mine capacity. Here and there some mines may be able to expand output, and an occasional new mine may come into production, some taking the place of diminished output elsewhere, but there is nothing to suggest that these will noticeably expand over-all production. Some of the greater mines may be considering new projects, but these are rather with the view of maintaining output - Chuquicamata, the greatest single mine in the world, is considering the future when its operations will have to change over from treatment of oxidised ores to treatment of sulphides. There are several projects for new treatment plants, particularly refineries such as in Northern Rhodesia and Chile, but the effect of these would be merely to change the country of final treatment.

An important question to examine is - Will world consumption of copper greatly increase in the future? Living conditions of half the world's population in the East are definitely attaining higher standards, leading inevitably to greater demands for the basic materials of industry. Indian consumption of copper which has been less than one-tenth of a lb./new copper per head per annum, may be compared with the United States consumption of about 15 lbs. per head per annum. At first sight this would suggest that consumption will expand enormously in the near future. There is not, however, the foreseeable scope for a comparable expansion of output, and the position seems clear that such alternative materials as aluminium, of the ores of which no real shortage is likely, must inevitably take over much of the usage of copper.

The world's known copper reserves will suffice for some 60 years at the present rate of consumption. This of course, is not the whole story; many millions of tons of ore will be developed as mining proceeds, and improved technical practice and eventually necessarily increased prices will permit deeper mining and the inclusion of lower grade ores in reserves. It is the writer's guess (and these long term "estimates" carry no better implication) that normal uses of copper will continue for a further 100-200 years. Questions of the continuation of world supplies are at the moment academic, but this is no excuse for wastage.

Whilst the world remains divided into hard and soft currency areas, the relation of supply to demand in each area will remain contrasted. In America, notwithstanding curtailment of output of some large primary copper producers over a period of a few months during a price fall in 1949, supplies have been adequate, although demand remains keen, but it only requires a very small turn of the business cycle for over-production to become apparent. No such position is likely to be reached in soft currency countries whilst the distinction between the two currencies remains. Further, should the currency problems be solved and a world-wide recession encountered, the present producers in soft currency areas will, on the whole, be more able to reduce prices than the large producers in dollar areas. The position, although on a relatively higher scale of cost and price, will be similar to that of pre-war - if anything non-American production should be in a stronger position than American for maintenance of output.

The question may be asked - What will be the general level of future copper prices? Amongst many factors involved, the dollar-sterling exchange rate is important. Nowadays the dollar is the yardstick of currency and the price of copper in sterling will vary with the dollar-sterling rate. Taking into consideration the operating costs of the larger producers, who provide the basis of supply, and the future demand and the extent to which this demand can be met, if one may dare to hazard a guess, the long term price over the next

decade should be of the order of £stg. 100-£120 per ton or 12½-15 cents per lb. on present exchange rates. The only significance which should be attached to such a figure is that mines whose total costs are of about this order at present are likely to be marginal or near marginal in the future.

PART II - THE AUSTRALIAN COPPER POSITION.

AUSTRALIAN PRODUCTION.

At the present time the principal producers of copper are Mount Lyell Mining and Railway Co. at Queenstown, Tasmania, and Mount Morgan Ltd., at Morgan, Queensland. Other small producers are New Occidental Gold Mines N.L. at Cobar, N.S.W. and Lake George Mines Pty. Ltd., Captain's Flat, N.S.W. Small parcels of ore from Queensland and Northern Territory, and copper matte and speiss from Port Pirie add to the output of refined copper available in Australia. Lead-copper drosses from Mount Isa and lead-copper concentrates from the lead-zinc ores at Read Rosebery, Tasmania, are exported.

The metal available in Australia from these various sources in recent years is summarised in Table 3.

Table 3. AUSTRALIAN COPPER PRODUCTION.

	1946. Tons.	1946. Containing tons Cu.	1947. Tons.	1947. Containing tons Cu.	1948. Tons.	1948. Containing tons Cu.
Treated in Australia						
Mt. Isa Blister	3,953	3,539	-	-	-	-
Mt. Morgan "	2,986	2,952	2,827	2,794	3,178	3,136
New Occidental Cons.	)	864	)	845		813
Lake George Cons.	)	683	)	624		479
Mt. Lyell Blister	9,201	9,134	7,730	7,668	6,366	6,326
Port Pirie Matte	1,943	750	1,890	750	1,425	560
" " Speiss	1,398	560	2,866	1,150	2,160	870
Other		126		-		126*
Total copper available		18,608		13,831		12,210
Refined copper produced		22,659		19,505		11,389
Shipped overseas.						
Read Rosebery Cons.		246		286		248
Mt. Isa Lead-copper dross	e190	e180	e1,980	e990	e2,430	e490

* Excludes 259 tons used as fertilizer in W.A.
e estimated.

AUSTRALIAN RESOURCES.

Table 4 summarises the 1949 estimates of reserves and probable output of the present known copper deposits in Australia - the several small producers would not make any real difference to the ultimate picture. Any important change in the over-all estimates

would arise only if a new large deposit were found. The position of New Occidental will be indefinite for two or three years, as is noted later.

Table 4. AUSTRALIAN COPPER RESERVES.

Mine.	Ore Reserves tons	Grade % Copper tons	Copper content of ore reserves tons	Probable Recoverable Copper tons	Estimate Annual Output tons.	Life in Years
Mt. Isa	2,950,000	4.02	119,000	108,000	17,000	7
Mt.Morgan	5,212,000	1.98)				
	1,987,000	.47)	113,000	95,000	5,500	13-17
Mt.Lyell	33,000,000	.76	250,000	200,000	7,500	27
New Occidental - see accompanying comments, page						
Lake George	1,570,000	.60	9,400	6,600	650	10
E.Z. Rosebery	1,500,000	.48	7,200	5,600	300	12

The estimates of reserves for Mt. Lyell and Mt. Morgan represent the ultimate totals in the known orebodies, and any addition to reserves must come from the discovery of new ore-bodies - it may be remarked that additional reserves have been exposed in recent months at Mount Morgan. The reserves quoted for the remaining mines represent merely developed ore, and the ultimate reserves and life are indefinite.

AUSTRALIAN MINES.

Mt. Isa Mines Ltd. The copper ore-bodies at Mt. Isa occur in a so-called "dolomite breccia" in the hanging wall of the great lead zinc deposit; they do not crop out at the surface but have been found as a result of exploration at depth and have been developed only in recent years. In contrast to the adjacent lead-zinc deposits, the copper ore is much more patchy in distribution and will require a greater amount of exploration in maintaining reserves in future, but the indications point to the occurrence of quite considerable ore-bodies. The main ore-body developed to date is 500 feet long and up to 120 feet wide, the limits being defined by assay values.

The stage of copper plant erection had not been reached during the war and, in consequence of copper shortage, the lead-zinc plant, with suitable modification, was turned over for a time to copper production. The plant returned to its normal lead-zinc activities in 1946. The Company had hoped in 1946 to complete the erection of a copper mill and smelter at an early date, but post-war shortages of materials have seriously retarded the construction programme. However, at present the construction is scheduled for completion by December, 1951; it is not at all unlikely that as the worst of labour and material shortages have been surmounted, construction may be completed by the first half of 1951. Nevertheless it would be unwise to expect from Mt. Isa any addition to Australia's copper output before the end of 1951 or early 1952. Even when production is commenced shortages of coal and of machine miners are likely to be bottlenecks to production.

The aim, justified by the reserves to date, is for an output of 36,000 tons of copper ore per month which is expected to provide 17-18,000 tons of copper per year. The actual mill and smelter capacity will be in excess of this - approximately 24,000 tons -

so that there will be scope for expansion should future developments make this advisable.

The unique feature about Mt. Isa will be the mining of entirely separate copper and lead-zinc ore-bodies using the one haulage shaft, and the completely distinct copper and lead-zinc mills and smelters. It is doubtful whether this feature is shared by any other mine in the world at the present time.

Although the lead-zinc ore-bodies at Mt. Isa carry a little copper - a copper lead dross is exported - the copper ore-body is practically devoid of lead and zinc. Typical analyses of blister produced during the war ranged between -

Copper	98.64 - 99.12%
Gold	.0218 - .0294 oz.
Silver	6.576 - 8.48 oz.
Arsenic	.007 - .017%
Antimony	.004 - .007%
Lead	.040 - .1225% (av. about .07)
Bismuth	.0001 - .0002%
Nickel	.013 - .023%
Zinc	.006 - .015% (av. about .007)

These analyses suggest that, under normal treatment and marketing circumstances, fire-refining should suffice and that electrolytic refining would be pointless. Accordingly the Company propose to fire-refine. Whether Australian consumers will be willing to accept such a tonnage of fire-refined copper will be apparent only in the future. Certainly the product should be fully comparable with the best of high conductivity copper fire-refined in the U.K. and, provided the requisite shapes can be supplied, sufficient consumers may be prevailed upon to accept Mt. Isa high conductivity fire-refined instead of electrolytic copper to permit the marketing of the entire output in Australia. However, should it prove necessary, it would be possible to despatch blister from Mt. Isa for electrolytic refining.

Mount Morgan. A great proportion of the revenue of this mine is derived from gold, although the ore-treatment is that normal to copper production. Of the reserves noted in Table 4, those showing 1.98% copper carry 4.00 dwt. gold, whilst those showing .47% copper carry 1.64 dwt. gold. Although commonly spoken of as low-grade ore-body it can be scarcely included in this category on present day standards. Formerly worked underground it was revived as an open-cut proposition, and has been worked as such for the last 20 years. With deepening of the cut, now down to 750 feet, the amount of overburden has increased enormously, and the higher grade reserves quoted in Table 4 will necessitate the removal of some 19 million tons of overburden part of which will however be treated as low grade ore.

At the present capacity of the two mills, and allowing for ore dilution in mining, the quoted reserves would permit a production of about 5,500 tons for 13 to 17 years. These represent the final reserves of the Mount Morgan open cut; however, the Sugarloaf deposit immediately adjacent to the south-west is now being explored by drilling, and an additional 600,000 tons, carrying 1% copper and 5½ dwt. gold, has been proved to date. Whether this orebody, if sufficiently large, will be worked as a separate cut or as an extension of the present Mount Morgan cut is uncertain, but the latter seems not unlikely.

The higher grade ore is treated in No. 1 mill, the lower grade, mainly from overburden, in No. 2 mill. Production of the two mills during the year ended 26th. June, 1948 was as follows:-

		No. 1 Mill.	No. 2 Mill.
Ore milled	tons	540,650	229,600
Grade: Heads - Gold	dwt.	2.95	0.86
Copper	%	0.69	0.169
Tails - Gold	dwt.	1.01	0.47
Copper	%	0.095	0.059
Concentrates produced	tons	31,299	5,911
Grade - Gold	dwt.	34.6	15.4
Copper	%	10.4	4.3
Gold produced	oz.	54,101	4,562
Copper produced	tons	3,268.5	255.25
Gold recovery	%	67.9	46.3
Copper recovery	%	87.1	65.8
Ratio of Concentration		17.3 : 1	38.8 : 1

Treatment costs in No. 1 mill were 7.46/- per ton (now 8/-) and in No. 2 mill 4/6 per ton.

Smelter production from Mount Morgan ore for the same period was 3623.94 tons of blister, containing 3,577.18 tons copper, 62,140.05 oz. gold and 16,075.65 ozs. silver. In addition there was a small production from the direct smelting of purchased ore. The blister is despatched by rail and sea to Port Kembla for electrolytic refining.

There is a considerable amount of pyrite in the ore. In the past this pyrite, which carries a certain amount of gold, was not recovered and was dumped with the residues. Recently a pyrite concentrate has been recovered for despatch to fertilizer producers in Brisbane. The possibility of recovering elemental sulphur from the Mount Morgan ore is now receiving the Company's close consideration and should this prove to be an economic proposition the present treatment practice at Mount Morgan would be revised, both in the mill and smelter.

Cobar. The developed reserves at the three principal mines of New Occidental Gold Mines N.L. are negligible. However, a recent decision of the Directors, following the development of an extension of the Chesney ore-body which contained good copper values, visualises possibilities of greatly expanded operations in the future. It is now intended, after raising the necessary capital, to explore the three main ore-bodies - New Cobar, Chesney, and New Occidental - by diamond drilling down to 4,000 feet (in addition to the present exploration on the Gladstone lode). Should these three ore-bodies prove to continue strongly at that depth, then the present scale of operations would be terminated and an extensive development and construction programme undertaken. On the basis of the size and values of the ore-bodies in the present bottom levels, an ore-production of 80,000 tons of ore per month with over-all recoverable average of .9% copper and 1.9 dwt. gold is contemplated. The three ore-bodies would be connected to the one haulage shaft. All ore would be treated at the one mill, with production of a copper concentrate, and the latter would be smelted to blister copper. Assuming that the above figures are realised, blister copper production would be of the order of 9,000 tons annually and gold 90-95,000 ozs.

It is assumed that a drilling programme extending over 3 years will be necessary before a final decision can be taken, that is to mid-1955. Development and construction, if undertaken, will require a further 5-6 years; hence it is unlikely that the third or mining stage would be attained before a lapse of 8-9 years.

On present prices the value of the contemplated output, if the grade of ore in the lower levels continues, would be 60/6 per ton of ore, whilst operating costs, as outlined later, would be of the order of 41/-.

At this stage, then, the proposed exploration programme can be regarded as one which may lead to decided expansion in output. There are of course several hazards to the expanded project - persistence of values and lode dimensions, future prices and costs are the principal - but these are common to all mining at the stage of exploration now contemplated.

From the point of view of copper production, no more than the present scale of output, 700 tons a year, may be expected during the next 3 years, after which all output is likely to terminate for a period of about 5 years before being resumed on the larger scale.

Mt. Lyell. The reserves at Mt. Lyell quoted in Table 4 contain, in addition to 0.76% copper, 1.68 dwt. gold and 1 dwt. silver per ton. The deposit is a low-grade proposition in every respect, particuarly in view of its relatively small output as compared with open-cut mines of similar grade in other countries. Although of decidedly lower grade than Mount Morgan, this is partly offset by the much lower amount of overburden per ton of ore sent to the mill.

Production at Mt. Lyell is taken right through to electrolytic copper, the cathodes being sent to Port Kembla for smelting and casting into shapes. The tank house slimes are treated at Port Kembla for their gold-silver content.

The annual production of copper is of the order of 7,500 tons per year - the 1949 production of metal was of course, seriously reduced as a result of the coal strike - from a mine output of the order of 1¼ - 1½ million tons annually. On the present-day output the life of the mine is approximately 27 years if the exploration now being carried out does not expose further reserves. Output could be lifted to about 10,000 tons per annum with further capital outlay, but the justification for this on present costs is doubtful.

Pyrite concentrates are produced and despatched to the mainland from Mt. Lyell. Freight and other charges have, however, not permitted any considerable revenue from this low-priced product.

MOVEMENT OF COPPER.

The principal producer, Mount Lyell Mining and Railway Co. Ltd., ships the whole of its cathode copper and other products to Port Kembla for distribution by Electrolytic Refining and Smelting Co. of Australia Pty. Ltd. or by Metal Manufacturers Ltd., except for small amounts consumed in Tasmania by Austral Bronze Ltd.

Mount Morgan Ltd., besides treating its own ores, also purchases ores and concentrates, which are smelted to blister copper along with the company's concentrates. All blister copper from Mount Morgan is despatched to Port Kembla for refining and realisation.

The Electrolytic Refining and Smelting Co. of Australia Pty. Ltd., receives concentrates from New Occidental Gold Mines N.L. and Lake George Mines Pty. Ltd. and ores from various small producers, matte and speiss from Port Pirie, and tank house slimes from Mt. Lyell for smelting and refining, whilst blister from overseas as well as from Mount Morgan is electrolytically refined.

The refined copper is distributed through Metal Manufacturers Ltd., Port Kembla, to other fabricators in the different States.

Lead copper drosses from the lead smelter at Mount Isa and lead-copper concentrates from lead-zinc ores of Electrolytic Zinc

Co. of Australasia Ltd., Read Rosebery, Tasmania, are exported to the United States - United States smelters pay for both the copper and lead content as the latter is recovered, whereas at Port Kembla there is as yet no provision for the recovery of lead in these products.

REFINING CAPACITY.

The capacity of present plants and of plants in course of erection are fully adequate to smelt all the copper that this country is likely to produce in the foreseeable future. Also, there would be no difficulty in fire refining such blister as may be suitable for this treatment. The position may, however, be otherwise in regards to electrolytic refining capacity.

The present annual tank house capacity for electrolytically refining copper in Australia is :-

At Mt. Lyell	13,000 tons
At Port Kembla	14,000 tons.
	27,000 tons.

However, for various technical and economic reasons it would not normally be a practical proposition to refine any copper at Mt. Lyell, other than that produced at Mt. Lyell - any Mt. Lyell refining capacity in excess of its own production therefore cannot normally be utilised. The total practical capacity for electrolytic refining is, accordingly, at the moment about 21,000 tons. By 1951 it is proposed to expand the capacity of the tank house at Port Kembla to 19,000 tons, so that the total practical electrolytic refining capacity in this country will be about 26,000 tons. Assuming that Australian output until Mount Isa comes into production, will be about 16,000 tons, there is additional capacity for electrolytically refining only 10,000 tons of imported blister copper. Hence any imports in excess of this must be of refined copper.

Shapes cast at the Port Kembla refinery vary according to requirements, but the annual amount recently has been approximately as follows:-

Billets	6,000 tons
Wire Bars	10,000 tons
Cakes	9,000 tons
Ingots	small amount.

COSTS.

Relative cost of production per ton of copper at Mt. Lyell and Mt. Morgan are summarised in Table 5. The costs shown are derived from the 1949 Report and Statement of Accounts published by each company, and should not be compared without qualification. At the present time Mt. Lyell is the only large scale copper producer in Australia which may be regarded as such - although operations at Mt. Morgan technically follow copper treatment practice, the revenue has been mainly from by-product gold.

Certain charges may be allocated differently in each mine, but the figures serve to emphasise some very important points.

The higher all-round mining, concentration, and smelting costs per ton of copper produced at Mt. Morgan, notwithstanding the higher copper grade of the ore, are attributable to several very cogent causes: the enormously greater volume of overburden removed at Mount Morgan in mining the relatively smaller through-put of ore in the mill and the lower copper recovery, and the necessarily considerably lower grade of concentrate sent to the smelter (from which follows a higher smelting charge). These are factors inherent in the type of ore body and type of ore.

Technically, operations at Mount Morgan are for copper extraction and quite obviously if this mine were regarded solely as a copper revenue earner it would not be in existence to-day; recent increase in the price of gold will raise the gold credit by about 50%, leaving a very wide margin for any fall in the price of copper. Mt. Lyell, on the other hand, depends for its mine revenue almost entirely on copper and it is apparent that constant

Table 5. COSTS AT MT. LYELL AND MT. MORGAN.

	Mt. Lyell.		Mt. Morgan.	
	per ton ore	per ton copper.	per ton ore	per ton copper.
Mining	5/3 (1)	£50. 2. 0.(3)	12/7 (6)	£142. 2. 0.(7)
Concentration	1/10(2)	17. 7. 0.(3)	6/8	73. 5. 0.(7)
Smelting and Converting		29. 1. 0.(4)		35. 8. 0.(7)
Working cost of Blister		96.10. 0.		250.15. 0.
Administration etc.	1/1 (1)	10. 1. 0.(3)	2/7(6)	27.15. 0.(7)
Gross cost of blister		106.11. 0.		278.10. 0.
Refining and realization		13. 9. 0.(5)		26. 2. 9.(9)
Gross cost refined blister.		120. 0. 0		304.12. 9.
Less gold & silver credits (8)		7.10. 8.		180.14. 0
Refined copper per ton		£112. 9. 4		£123.18. 9

(1) On 1,428,190 tons ore. (2) On 1,426,114 tons ore. (3) On 7,454 tons recoverable copper in ore and concentrates. (4) On 3,840 tons copper in blister. (5) On 4,414 tons cathode copper. (6) On 806,692 tons (wet) of ore. (7) On 3,744.45 tons of contained copper. (8) Gold calculated at £10.15.3, silver at 4/8.2d. Credit for pyrite production not deducted in either case. (9) Actual costs, ex Mount Morgan, of refining and realisation (of this, £17.14.2 for refining, balance includes freight and other charges.)

attention to costs has been vital to Mt. Lyell and will remain so if this mine - the most important producer at present in Australia - is to keep open. Relevant to this, it should also be remembered that, as a gold producer, Mt. Morgan is not subject to income tax, whereas such profits as Mt. Lyell may earn are taxable. The 1949 costs at Mt. Lyell, particularly for concentration, are remarkably low when referred to on an ore-tonnage basis.

It may be of interest to remark on the probable cost at Mount Isa following resumption of copper production, and at Cobar if the proposed scheme there comes to fruition. In both cases mining will be by underground methods, and mining costs on an ore-tonnage basis will be considerably higher than those at Mount Lyell and Mount Morgan. Although considerable credit for gold will be received at Cobar, there will be no such credits at Mount Isa.

It would appear unlikely that at Mount Isa any differentiation can be made between the earnings of those working on the copper and lead sections respectively, and it may be assumed that the lead bonus will need to be paid to all.

On the basis of Mount Isa's published present-day lead-zinc costs, and making allowance both at Mount Isa and Cobar for various factors, a rough general estimate of operating costs may be permitted, as follows:-

	Mount Isa per ton ore.	Cobar per ton ore.
Mining and Development	22/-	25/-
Milling	8/-	8/-
Smelting & refining	18/-	8/-
	48/-	41/-

At Mount Isa, administration and other charges might bring the total cost to 52/- per ton of ore, that is, roughly £70 per ton of copper produced, ex Mount Isa. On the basis of the cost of the lead bonus on lead-zinc production in 1948-49, (28/2 per ton of ore produced), this bonus would add £38 to the cost of copper production, or a total cost of the order of £108 per ton of refined copper. It is admitted that these figures appear to err on the conservative side, and they should be considerably improved upon with capacity production in practice - however, the tendency today is for rising wages to take up savings from improved practice.

At Cobar, the ore will be of much lower grade and as refining is not likely to be undertaken, smelting and refining costs will be very different from those at Mount Isa. The above conservative estimates for Cobar costs permit obvious scope for reduction, but would leave 19/6 per ton of ore (on the basis of present values in the bottom levels of the mines) to cover administration and other charges, return of capital over 20 years, and reasonable dividends. Costs on the above basis would be of the order of £250 per ton of copper, and with gold credits in the vicinity of £150 per ton the net cost would be of the order of £100 per ton of copper.

Payments and charges for customs smelting at Mount Morgan and Port Kembla are very similar:-

(a) Payment for ores and concentrates etc. - A deduction of 1% is made from the net dry weight of all fine materials as draftage.

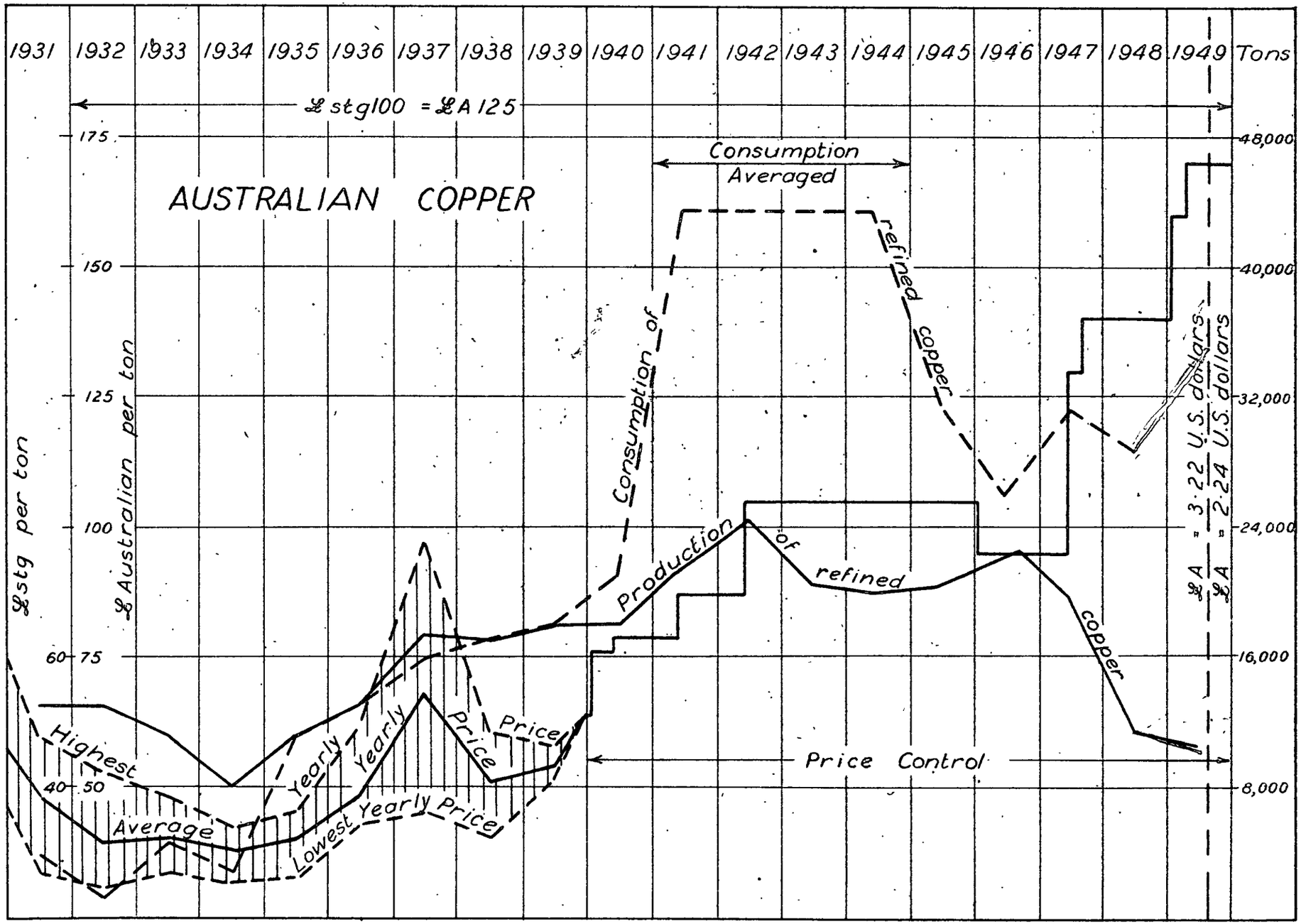
The gross copper content less 1.3 units per ton of material final weight is paid for at the price for copper fixed by the Prices Commissioner.

(b) Treatment charges are deducted as follows:-

Receiving, sampling, assaying and smelting, net dry weight per ton of material:

Mount Morgan - £2/15/-.
Port Kembla - copper ores and matte, £2-18-9.
copper concentrate, precipitates and furnace products, £3.3.9.
Concentrating, refining and realisation, per unit of copper paid for - Mount Morgan 7/-, Port Kembla, 5/-.

At Port Kembla, terms for gougers are slightly lower. In addition, payments are made for gold and silver according to a definite schedule, less charges for refining and realisation of these metals. At Mount Morgan, ores containing appreciable arsenic, antimony, bismuth, lead or zinc are not accepted. At Port Kembla, scheduled penalties


AUSTRALIAN COPPER
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
Tons
£stg100 = £A125
Consumption Averaged
£stg per ton
£Australian per ton
175
150
125
100
75
60
50
40
48,000
40,000
32,000
24,000
16,000
8,000
Consumption of refined copper
Production of refined copper
Highest Yearly Price
Average Yearly Price
Lowest Yearly Price
Price Control
£A = 3·22 U.S. dollars
£A = 2·24 U.S. dollars

are charged on zinc, lead, arsenic, antimony, bismuth, nickel, chrome.

PRICE.

The Australian price of copper before the war was governed by the overseas price. During and since the war the price has been subject to control, and all copper - imported and domestic - has been pooled. The record of prices changed under the Control is of interest.

From.	To producer.	To consumer.
Dec. 1939.	£63.17. 6	£63.17. 6
Feb. 1940	£76. 0. 0.	£76. 0. 0.
" 1941	£76. 0. 0.	£78.10. 0.
May 1941	£85. 0. 0.	£86.10. 0.
May 1942	£100. 0. 0.	£105. 0. 0.
Jan. 1946	£100. 0. 0.	£95. 0. 0.
May 1947	£130. 0. 0.	£130. 0. 0.
Aug. 1947	£130. 0. 0.	£140. 0. 0.
March 1948	£140. 0. 0.	£140. 0. 0.
July 1948	£160. 0. 0.	£140. 0. 0.
Jan. 1949	£160. 0. 0.	£160. 0. 0.
March 1949	£180. 0. 0.	£170. 0. 0.

The price difference between that paid by the consumer and that paid by the producer between 1941 and 1946, and 1948 and early 1948, permitted a considerable sum to be accumulated in the Copper Price Equalisation Pool, but this has been largely offset by the higher price paid since July, 1948 to the producer and for imported copper.

During the middle of 1949, the drop in price overseas placed the Australian price considerably out of step with imported copper and copper products, and consideration of a downward revision of the local price appeared necessary. The most important present-day producer, Mt. Lyell, might not have withstood such revision without assistance. However, devaluation of sterling in September was followed by a revision of the sterling price of copper to a level eventually well above that which it attained in the early part of 1949. The danger of price reduction to Australian producers has been removed for the present, but it will obviously recur.

AUSTRALIAN CONSUMPTION.

Australian copper statistics during recent years are summarised in Table 6. In this Table Col. 2 refers to production of refined copper from ores mined and smelted in Australia. Actual sales of refined copper of Australian origin in these years were as follows:-

1940 - 18,169 tons.	1943 - 20,842 tons.	1946 - 22,957 tons.
1941 - 20,958 tons.	1944 - 19,685 tons.	1947 - 20,207 tons.
1942 - 24,625 tons.	1945 - 18,687 tons.	1948 - 10,515 tons.

The difference is of course accounted for in the variation of stocks held by the producers.

Columns 3 and 4 refer to imports and exports in financial years up to 1945 and to calendar years after 1945. Imports have been partly of refined copper and partly of blister copper which is refined at Port Kembla. These exports and imports exclude some copper concentrates which, over the whole period amount to only a few hundred tons of contained copper and which are negligible in the ultimate picture.

Column 5 indicates the apparent consumption during the period as calculated from the preceding columns. However, large stocks of blister and refined copper were built up by

Table 6. SALIENT AUSTRALIAN COPPER STATISTICS. IN TONS.

(1) Year.	(2) Refined Copper Production.	(3) Imports.	(4) Exports.	(5) Apparent consumption excluding stock variations.	(6) Approximate consumption primary copper.
1940	18,141	3,055	-	21,196	
1941	21,668	18,095	-	29,763	
1942	24,609	40,604	-	65,213	
1943	20,457	53,644	-	74,101	
1944	19,898	15,521	-	35,419	
1945	20,498	5	-	20,503	30,089
1946	22,659	155	6,840	15,974	25,560
1947	19,505	1,311	407	20,409	29,995
1948	11,389	9,264	-	20,653	30,239
1949					

Government during the war years 1942-1944, and for the following 4 years, according to the Materials Officer, Department of Supply and Development, 38,344 tons of stocks of electrolytic, furnace refined, and blister copper were sold. Distributing this equally over the 4 years at 9,586 tons a year, the approximate consumption from 1945 is as shown in column 6. The latter figures ignore stocks held by consumers, but any considerable rise in those during the period was unlikely, although there seems to have been a considerable rise in stocks held at Port Kembla in 1949.

The above data refer to primary copper consumption. There is, of course, a considerable amount of scrap in normal circulation; in addition, during the post-war period, the Disposals Commission sold a large quantity of copper in brass and other non-ferrous alloys of various types and of which there is no detailed record on a tonnage basis. Some of this was exported in 1946, but most has been absorbed into local industry - the latter represents an abnormal addition to the secondary copper in circulation, and had it not been available additional imports of primary copper would have been required. As a very rough estimate we might take the amount of this abnormal secondary copper as equal to about 3,000 tons per year.

It is likely that the actual consumption in 1945-1947 was a little less than as indicated in the above figures, and rather more for 1948, so that the equivalent of new copper entering industry for the latter year was probably closer to 35,000 tons. Consumption of new copper for 1949 was of about the same order and probably would have been greater had the metal been available.

Estimates of demand for 1950 range from 40,000 to 50,000 tons, but it is doubtful whether at the moment there is the mill capacity to fabricate this amount - rolling, wire-drawing and extrusion mill expansions are under way but are unlikely to be available during the year. Some estimates for the future are even higher and range to 60,000 tons per annum. Undoubtedly, the various new hydel and other power scheme will greatly increase the demand for high conductivity copper during the next decade or two.

So far as can be judged at present from the data made available by the principal fabricator the expected 50,000 tons demand would consist of:

Electrolytic copper - 44,000 tons.
Fire refined - 6,000 tons.

This would be distributed as follows:-

Wire drawing	23,000 tons
Tubes	7,500 tons
General alloy and industrial purposes	19,500 tons

GENERAL ECONOMIC POSITION IN AUSTRALIA.

Estimates may be made of the Australian position in the near future on the data available at present. These estimates may be broken up into three periods: the first up to the end of 1951 when Mount Isa may be expected to come into production, the second between 1952 and 1957, and the third from 1958 onwards when the new project at Cobar, if successful, may be in production.

Several assumptions have to be made in these estimates. The trade's estimate of consumption at 50,000 tons is accepted to 1951, although the capacity to fabricate this amount of copper at anyrate in 1950 is not assured. From 1952 onwards, in view of projected developments in the country, particularly of hydel and other power schemes, it is not improbable that a consumption of 60,000 tons will be attained, and it would be as well to accept this as an average figure.

Table 7. ESTIMATES OF FUTURE POSITION.

	Annual Consumption.	Annual Production.	Annual Imports. Total tons.	Refined tons.	Blister tons.
1950-1951	50,000	16,000	34,000	28,500	5,500
1952-1956	60,000	33,000	27,000	16,000	11,000
1957 -	60,000	42,000	18,000	17,000	1,000

In estimating production, 1949 is recognised as a disturbed year, mainly because of the coal strike, and the estimated figures in the Table gives the Australian copper production likely to be available in Australia under favourable working conditions. The figure 1950-1951, 16,000 tons, may be exceeded in 1950 because of a carry over of concentrates at Mt. Lyell not smelted in 1949 but it may be less by 1,000 in 1951. By 1952 Mount Isa should be in production (taken at 17,000 tons), New Occidental is likely to stop the present scale of operations, but some improvement of output from Mount Lyell is a reasonable assumption. The output quoted for the period 1952-1956, 33,000 tons is not likely to be exceeded unless Mount Isa or Mount Lyell are able to boost their production to an unexpected extent; the output may, however, easily be 3,000 tons less. For the period 1958 onwards, the estimate of 42,000 tons depends on New Occidental realising its expectations. If hopes at Cobar are not realised then the overall position will remain more or less as for the period 1952-1956, unless prospecting now in progress in such regions as Cloncurry and Chillagoe expose important deposits. It has been assumed that the Mt. Lyell electrolytic refinery cannot accept overseas blister, and further that the Port Kembla tank house capacity will be 14,000 tons until 1951, expanding to 19,000 tons thereafter. It is also assumed that the proposed fire-refined copper from Mount Isa will be fully marketable in Australia - if not it may become essential to expand electrolytic refining capacity.

The import figures assume that requirements of both refined and blister copper will be met from overseas. The general trend overseas is such that this may not prove to be the case, as

electrolytic refining capacity is steadily increasing in the producing countries. Shortage of production in soft currency areas may force us to take whatever is available, whether it be refined or blister. If forced to purchase blister in excess of Port Kembla's capacity, then it will be necessary to arrange for its refining overseas - judged by the position at present it would be economically unsound to expand local electrolytic refining capacity beyond the present contemplated 19,000 tons.

In terms of present prices, the imports quoted represent about £A6½ million for 1950 and 1951, £A5 million for 1952-1956, and £A3½ million from 1957 onwards. Next to mineral oils, the value of copper imports will exceed that of any other imported mineral or metal. It is naturally of serious concern that the minimum amount must be derived from hard currency sources.

It will be apparent from the review of the world position in Part I of this note that, in the scramble for the limited amount of soft currency copper, Australia can expect little more than crumbs which may be picked up in competition with other soft currency consumers. By and large, we have been able to satisfy much of our requirements from such soft currency areas as Rhodesia and South Africa; a little has been available from Japan but India and Continental countries are interested in that source. Apart from these crumbs, to satisfy the real demand of this country for primary copper we must enter into the hard currency market for further imports, and as between Belgian Congo and Chile, the former is, perhaps, preferable to the latter from the point of view of exchange difficulties It may be suggested that there is scope for discussion with the British Ministry of Supply, concerning the equitable distribution of available soft currency copper amongst Empire countries.

It will be apparent from the above review that this country cannot afford to let copper production languish and, indeed, that the maximum effort should be directed to exploration and development of new orebodies. The three factors here are price, cost and incentives.

As indicated in Part I, it is the writer's guess that the world copper price over a long term should be of the order of 12½-15 cents per lb. or £stg.100-120 per ton. However, recent signs would indicate that any serious drop in present price would result in very severe curtailment of production in America, and the above long term price should be regarded as a likely minimum. On this price Australian producers, and particularly Mount Lyell, would be marginal.

Australian costs, per ton of ore milled, will bear comparison with most mines overseas; indeed, Mount Lyell costs for 1948-49 per ton of ore are so low as to be almost phenomenal. Converted into costs per ton of copper metal, the Australian figures are well above the African, but there are many large producers, particularly in America, whose costs per ton of metal exceed the Australian and which depend to a considerable extent on other metal credits.

In general, an assured steady price at a reasonable level provides adequate incentive to maintain production and to explore for new ore bodies. Producers and consumers may react differently as to the reasonableness of any particular price. If copper production is to be maintained and increased in Australia, the producers' estimate of a reasonable price must carry greater weight than the consumers'. Assurance of a domestic market would also be an incentive to copper production, provided stability of price can be assumed, for Australian producers would have little resilience on a falling overseas market in competition against many of the large overseas producers.

Section 23(o) of the Income Tax Assessment Act exempts from taxation "the income derived by a person from the working

of a mining property in Australia or in the Territory of New Guinea principally for the purpose of obtaining gold, or gold and copper, provided that in this case the value of the output of gold is not less than forty per centum of the total value of the output of the mine." Because of this, mines such as Mount Morgan and the proposed Cobar project are favourably treated as compared with straight copper producers. It is perhaps worth noting that this provision in the Income Tax Assessment Act might result in the limiting of copper production relative to gold in mines where the revenue from each is not greatly different.

(J. A. DUNN.)
Mineral Economist.
20-12-1949.