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ECONOMIC ASPECTS OF COPPER PRODUCTION AND MARKETING

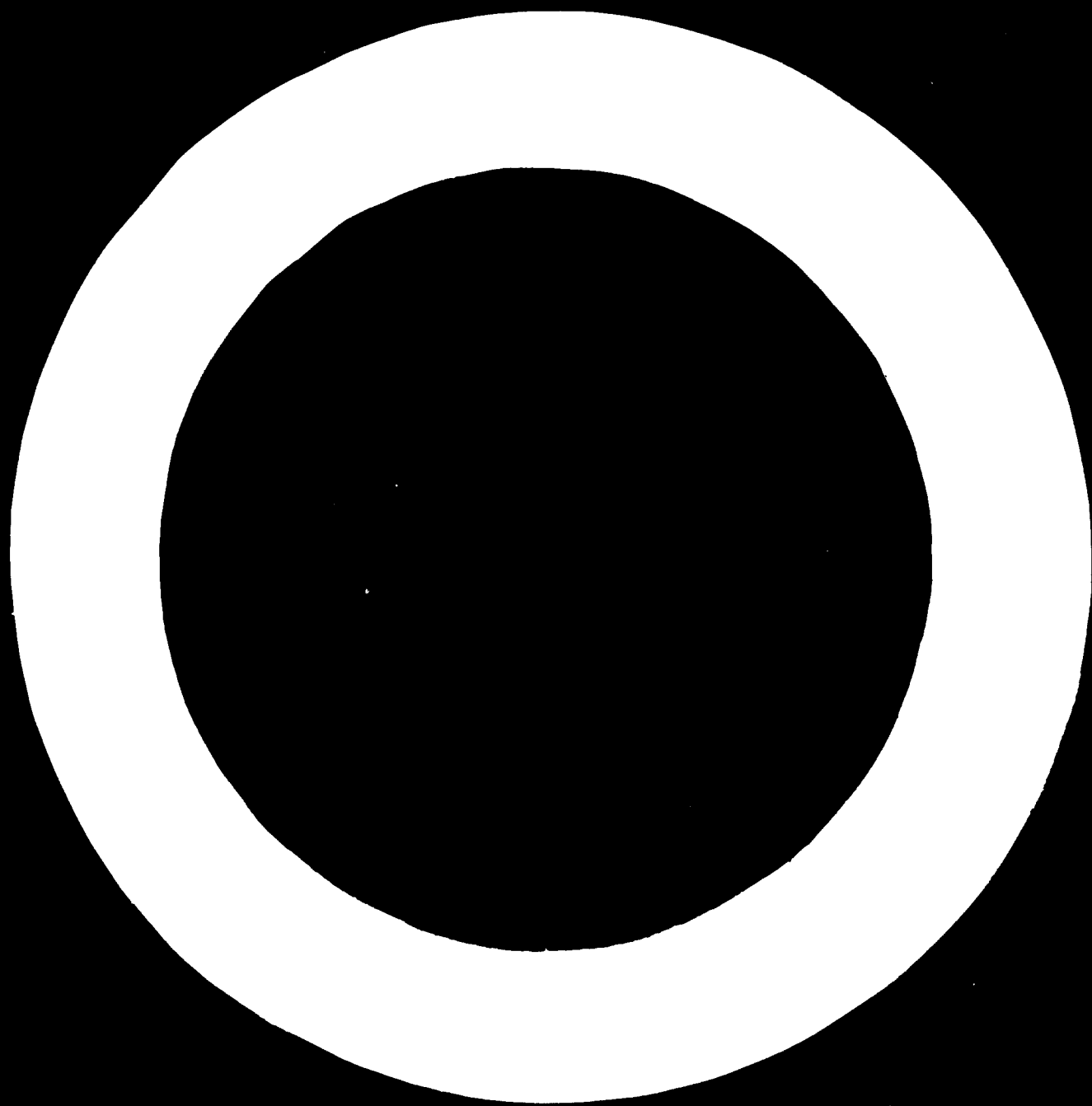
POSSIBILITIES FOR DEVELOPING COUNTRIES ^{1/}

by

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ECONOMIC ASPECTS OF COPPER
PRODUCTION AND MARKETING

POSSIBILITIES FOR DEVELOPING COUNTRIES

INTRODUCTION

1. I should make it clear at the outset that the views and opinions expressed in this paper are my own and they are not necessarily those of any of the organisations with which I am connected in the non-ferrous metals industry.
2. The historical statistics are accurate in so far as data are published but in the absence of official data I have made estimates.
3. Any division of the countries of the world into two types must, of course, be somewhat arbitrary. I have taken the developed countries to be those in North America, Western Europe, Australia, South Africa, Japan and the Centrally Planned Economies.
4. The rest of the world I have included as developing countries.
5. The paper distinguishes three main areas of the copper industry. Namely, the United States, the Centrally Planned Economies and the Rest of the World. It is with this third area that I am mainly concerned as this includes not only all the developing countries but also the markets for their products.
6. The paper describes the recent trends in the copper industry and also forecasts future developments.

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7. I have defined the copper industry in the broadest sense to include not only mining, smelting and refining but also the fabrication of semi-manufactured products such as sheet, strip, plate, rods, wire, tubes and castings.

MINING

8. Copper is present in the earth's surface in many countries but the major part of the mining of copper is carried out in seven countries.

9. Table 1 gives the detailed figures of production. The output of the mines has increased over the ten years (1960 to 1969) of the development decade by 1.7 million tons or 40%.

10. From these data it will be seen that almost a quarter of the world's copper is mined in the United States and two-fifths in other developed countries (the Centrally Planned Economies, Canada, Western Europe, South Africa, Japan and Australia). The balance comes mainly from the developing countries in Latin America, Africa and Asia.

11. Table 2 shows the mine production of the developing countries. These countries now produce 40% of the output of the world's mines.

SMELTING

12. The smelting of copper is carried out in many cases close to or at the mine, but also by custom smelters in the consuming areas.

13. Tables 3 and 4 give the production of the smelters. This includes both the production from concentrates and also secondary blister and rough copper from scrap and residues.

TABLE 1
WORLD MINE PRODUCTION

		Thousand Metric Tons									
		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
North America	- Total	1,378.4	1,455.3	1,529.3	1,511.2	1,572.8	1,687.0	1,755.6	1,421.9	1,667.3	1,913.6
U.S.A.		979.9	1,057.0	1,114.4	1,100.6	1,131.1	1,226.3	1,296.5	905.5	1,092.8	1,413.4
Canada		398.5	398.3	414.9	410.6	441.7	460.7	459.1	556.4	574.5	500.2
Africa	- Total	981.4	984.4	968.7	987.9	1,043.9	1,122.6	1,141.4	1,182.0	1,204.5	1,276.4
Zambia		576.4	574.7	562.3	588.1	632.3	695.7	623.4	663.0	684.9	719.5
Congo (Kinshasa)		302.3	295.2	297.0	271.3	276.6	288.6	316.9	321.5	325.5	364.8
S. & S. W. Africa		69.7	79.3	72.1	89.5	95.7	99.9	162.5	161.3	155.8	152.6
Rest		33.0	35.2	37.3	39.0	39.3	38.4	38.6	36.2	38.3	39.5
Centrally Planned Economies	- Total	625.2	679.7	744.6	749.3	850.8	917.5	980.5	1,015.0	1,055.0	1,083.0
U.S.S.R.		500.0	550.0	600.0	600.0	700.0	750.0	800.0	825.0	850.0	875.0
Rest		125.2	129.7	144.6	149.3	150.8	167.5	180.5	190.0	205.0	208.0
Central & South America	- Total	795.8	813.6	820.6	862.6	876.0	845.8	905.4	930.5	961.9	980.1
Chile		532.1	547.4	585.9	601.1	621.7	585.3	636.7	660.2	658.2	686.8
Peru		181.7	198.1	166.8	180.0	176.4	177.4	184.0	186.4	213.5	199.0
Rest		82.0	68.1	67.9	81.5	79.9	83.1	84.7	83.9	90.2	94.3
Asia	- Total	215.2	229.5	236.0	246.3	240.3	249.9	253.4	281.2	305.8	325.2
Japan		89.2	96.4	103.6	107.2	106.0	107.1	111.7	117.6	119.7	120.3
Philippines		44.2	51.9	54.7	63.9	60.5	62.7	73.8	66.2	110.3	131.4
Rest		81.8	81.3	77.7	75.2	73.8	80.1	77.9	77.6	75.6	73.5
Europe	- Total	127.4	135.4	151.6	157.8	156.3	150.4	144.3	150.5	169.9	202.5
Australia	- Total	111.2	97.2	106.7	114.8	136.3	91.6	111.3	91.8	105.6	128.1
WORLD TOTAL		4,234.6	4,395.2	4,559.7	4,629.9	4,848.4	5,065.0	5,301.9	5,073.5	5,473.0	5,908.9

TABLE 2
MINE PRODUCTION BY DEVELOPED AND DEVELOPING COUNTRIES

	Thousand Metric Tons		
	WORLD TOTAL	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
1960	4,234.6	2,401.1	1,833.5
1961	4,395.2	2,543.3	1,851.9
1962	4,559.7	2,710.1	1,849.6
1963	4,629.9	2,729.8	1,900.1
1964	4,848.4	2,887.9	1,960.5
1965	5,065.0	3,053.7	2,011.3
1966	5,301.9	3,265.9	2,036.0
1967	5,073.5	2,958.3	2,115.2
1968	5,473.0	3,276.3	2,196.7
1969	5,908.9	3,600.1	2,308.8
Annual average rate of increase	+3.8%	+4.6%	+2.6%

TABLE 3
WORLD SMELTER PRODUCTION

	Thousand Metric Tons									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
North America										
- Total	1,558.6	1,530.6	1,559.3	1,569.3	1,622.8	1,710.1	1,750.3	1,271.3	1,677.1	1,880.8
U.S.A.	1,186.7	1,166.4	1,217.0	1,230.1	1,256.9	1,325.2	1,364.7	846.5	1,225.9	1,508.5
Canada	371.9	364.2	342.3	339.2	365.9	384.9	385.6	424.8	451.2	372.3
Africa										
- Total	942.0	941.6	927.3	957.5	1,032.2	1,104.6	1,093.5	1,142.2	1,191.2	1,260.5
Zambia	575.6	568.5	554.0	578.1	636.8	695.9	595.5	633.1	663.7	703.7
Congo (Kinshasha)	301.9	294.1	295.4	271.1	275.6	288.6	316.9	321.5	325.5	364.8
S. & S. W. Africa	48.4	53.1	49.2	77.1	83.0	85.6	148.0	156.0	166.9	155.3
Rest	16.1	25.9	28.7	31.2	33.6	34.5	33.1	31.6	35.1	36.7
Centrally Planned Economies (1)										
- Total	634.0	688.6	751.0	722.5	861.8	924.6	966.0	1,025.1	1,064.0	1,097.0
U.S.S.R.	500.0	550.0	600.0	600.0	700.0	750.0	800.0	825.0	850.0	875.0
Rest	134.0	138.6	151.0	162.5	161.8	174.6	166.0	200.1	214.0	222.0
Central & South America										
- Total	733.0	754.0	757.9	767.2	794.7	770.8	813.9	847.2	866.9	877.8
Chile	504.8	524.5	557.9	557.0	586.7	557.5	605.3	630.5	623.1	646.6
Peru	166.8	179.8	145.1	157.2	155.7	158.4	153.7	163.9	187.8	170.3
Rest	61.4	49.7	54.9	53.0	52.3	54.9	54.3	52.8	56.0	60.9
Europe										
- Total	316.5	308.0	351.7	356.5	369.0	408.3	436.8	447.0	502.2	526.5
Germany F.R.	94.1	94.2	96.6	96.7	113.9	127.0	143.5	149.1	191.8	200.0
Rest	222.4	213.8	252.9	259.8	255.1	280.7	293.3	297.9	310.4	326.5
Asia										
- Total	253.1	321.5	322.0	339.6	373.6	377.6	405.1	426.7	477.4	516.1
Japan	247.1	263.7	281.8	302.9	336.3	337.4	363.9	366.8	437.5	480.0
Rest	6.0	31.6	40.2	37.6	37.7	40.2	41.3	39.9	39.9	36.1
Australia										
- Total	75.2	65.1	90.2	92.0	93.3	79.5	96.6	73.2	101.9	123.3
WORLD TOTAL	4,542.9	4,609.4	4,759.4	4,844.6	5,142.4	5,375.5	5,582.2	5,238.7	5,880.7	6,282.0

Note:- (1) Primary only

TABLE 4
SMEALTER PRODUCTION BY DEVELOPED AND DEVELOPING COUNTRIES

	Thousand Metric Tons		
	WORLD TOTAL	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
1960	4,542.9	2,879.8	1,663.1
1961	4,609.4	2,935.1	1,674.3
1962	4,759.4	3,083.2	1,676.2
1963	4,844.6	3,159.4	1,685.2
1964	5,142.4	3,358.8	1,783.6
1965	5,375.5	3,545.5	1,830.0
1966	5,532.2	3,781.5	1,800.7
1967	5,238.7	3,365.4	1,873.3
1968	5,880.7	3,949.9	1,930.8
1969	6,282.0	4,262.9	2,019.1
Annual average rate of increase	+3.7%	+4.4%	+2.2%

14. The proportion of the total output of blister which comes from the developing countries is about a third and is therefore rather less than for mine copper. This is due to the fact that concentrates are shipped to the industrial countries for smelting.

15. Some years ago it appeared as if primary copper would be smelted and refined more and more at or close to the mines, rather than in the consuming countries.

16. Even if this had occurred the large secondary metal industry, which is based on the use of scrap and residues as a raw material, would continue to be located in the industrialised countries where the scrap is produced.

17. Now, however, it appears as if this trend is being reversed. Some countries - notably Japan and, to a lesser extent Western Europe - are contracting for the supply of concentrates and blister to feed their smelters and refineries. The companies concerned offer finance to allow the development of new mining ventures.

18. In exchange they enter into long-term contracts with the mines for the supply of minerals.

REFINING

19. Production of refined copper is spread much more widely throughout the world and much of the refining takes place in the industrialised countries.

20. Refined copper can be produced both from primary and secondary blister and also from scrap. The production of refined copper which is now over seven million tons per annum is substantially higher than smelter production. The production figures are given in Tables 5 and 6.

TABLE 5

WORLD REFINED PRODUCTION

	Thousand Metric Tons									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
North America										
U.S.A.	2,020.8	2,030.4	2,073.1	2,065.9	2,191.2	2,350.5	2,390.2	1,850.2	2,157.7	2,435.3
Canada	1,642.6	1,661.8	1,725.8	1,722.2	1,821.1	1,956.7	1,997.4	1,396.7	1,681.9	2,026.5
	378.2	368.6	347.3	343.7	370.1	393.8	392.8	453.5	475.8	408.8
Centrally Planned Economies										
U.S.S.R.	799.9	850.9	908.9	941.0	1,051.4	1,110.6	1,173.6	1,213.9	1,247.7	1,262.0
Rest	610.0	660.0	700.0	720.0	820.0	875.0	930.0	960.0	990.0	1,002.0
	189.9	190.9	208.9	221.0	231.4	235.6	243.6	253.9	257.7	260.0
Western Europe										
Belgium	970.9	577.7	994.2	1,014.1	1,079.8	1,137.0	1,129.0	1,139.9	1,262.1	1,229.3
Germany F.R.	201.8	202.8	202.0	250.0	260.0	280.0	293.0	305.0	330.3	286.7
United Kingdom	320.1	314.9	318.8	302.8	324.2	342.4	352.3	355.7	407.4	402.1
Rest	213.1	226.0	221.1	200.5	224.9	227.6	179.8	169.3	197.7	198.2
	235.9	234.0	252.3	260.8	270.7	287.0	303.9	309.9	326.7	342.3
Africa										
Zambia	560.3	598.3	595.4	603.2	667.7	708.1	682.4	728.5	800.8	863.3
Congo (Kinshasa)	402.6	418.9	433.5	439.2	497.1	522.3	493.7	535.1	550.7	598.1
South Africa	144.7	150.9	136.2	132.0	141.3	152.6	157.6	161.0	167.0	183.3
Rest	11.8	17.2	12.6	16.9	13.9	16.0	13.9	15.2	62.6	61.2
	1.2	11.3	13.1	15.1	15.4	17.2	17.2	17.2	20.5	20.7
Asia										
Japan	271.5	301.6	296.5	323.2	365.4	366.1	425.6	493.2	573.1	658.9
Rest	248.1	277.0	270.4	295.2	341.7	365.7	404.8	470.0	548.4	629.2
	23.4	24.6	26.1	28.0	23.7	20.4	20.8	23.2	24.7	29.7
Central & South America										
Chile	286.2	289.7	331.9	329.6	353.6	378.6	443.9	471.8	490.4	561.4
Rest	225.6	226.3	263.7	259.0	277.9	288.8	357.2	386.4	393.6	453.0
	60.6	63.4	68.2	70.6	75.7	89.8	86.7	85.4	96.8	108.4
Australia										
	84.2	78.6	92.7	104.0	101.7	95.2	115.4	96.9	118.9	137.3
WORLD TOTAL	4,993.8	5,127.2	5,292.7	5,381.0	5,810.8	6,166.1	6,360.1	5,994.4	6,650.7	7,147.5

TABLE 6
REFINED PRODUCTION BY DEVELOPED AND DEVELOPING COUNTRIES

	Thousand Metric tons		
	WORLD TOTAL	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
1960	4,993.8	4,135.7	858.1
1961	5,127.2	4,231.8	895.4
1962	5,292.7	4,351.9	940.8
1963	5,381.0	4,437.1	943.9
1964	5,810.8	4,779.7	1,031.1
1965	6,166.1	5,075.0	1,091.1
1966	6,360.1	5,226.9	1,133.2
1967	5,994.4	4,786.1	1,208.3
1968	6,650.7	5,397.4	1,253.3
1969	7,147.5	5,754.3	1,393.2
Annual average rate of increase	+4.1%	+3.7%	+5.5%

21. The total output of refined copper has risen by some 2.2 million tons in the last decade and 1.3 in the last five years.
22. The output of secondary refined copper from scrap and residues has almost doubled in the last decade and now amounts to about 1.2 million tons.
23. The production of secondary copper is almost entirely in the industrialised countries of the world and, indeed, principally in the U.S.A., Japan, United Kingdom, U.S.S.R. and Germany.
24. During these ten years, production of refined copper in Japan has risen to 630,000 tons making it the third biggest producer of refined copper in the world - after the U.S.A. and the U.S.S.R. Most of this is from imported raw materials.
25. The other principal increases in refined copper production have taken place in Chile, Zambia, U.S.A. and U.S.S.R.
26. The rate of increase in the output for the principal producing areas is shown in Table 7 (Mines) and Table 8 (Refineries). The developing countries have not increased their mine production during this period so rapidly as the developed areas.
27. Large new projects are in course of development in Chile, but are not yet in full production.
28. Mine production in the Centrally Planned Economies has almost doubled in the decade.

TABLE 7
RATE OF INCREASE OF MINE PRODUCTION OF COPPER
BY MAIN PRODUCING AREAS

	Thousand Metric Tons		
	1960	1969	Annual average rate of Increase
<u>DEVELOPED AREAS</u>			
U.S.A.			
Canada	979.9	1,413.4	+ 4.2%
Centrally Planned Economies	398.5	500.2	+ 2.5%
Western Europe	625.2	1,083.0	+ 6.3%
S. & S. W. Africa	127.4	202.5	+ 5.3%
Australia	69.7	152.6	+ 9.1%
Japan	111.2	128.1	+ 1.6%
	89.2	120.3	+ 3.4%
Total Developed Areas	2,401.1	3,600.1	+ 4.6%
<u>DEVELOPING AREAS</u>			
Zambia	576.4	719.5	+ 2.5%
Congo (Kinshasha)	302.3	364.8	+ 2.1%
Other Africa	33.0	39.5	+ 2.0%
Chile	532.1	686.8	+ 2.9%
Peru	181.7	199.0	+ 1.0%
Other South & Central America	82.0	94.3	+ 1.6%
Other Asia	126.0	204.9	+ 5.6%
Total Developing Areas	1,833.5	2,308.8	+ 2.6%
<u>WORLD TOTAL</u>	4,234.6	5,908.9	+ 3.8%

TABLE 8
RATE OF INCREASE IN REFINED COPPER PRODUCTION
BY MAIN PRODUCING AREAS

	Thousand Metric Tons		
	1960	1969	Average average rate of increase
<u>DEVELOPED AREAS</u>			
U.S.A.	1,642.6	2,026.5	+ 2.4%
Canada	378.2	408.8	+ 1.0%
Centrally Planned Economies	799.9	1,262.0	+ 5.2%
Western Europe	970.9	1,229.3	+ 2.7%
Japan	248.1	629.2	+10.9%
Australia	84.2	137.3	+ 5.5%
South Africa	11.8	61.2	+20.1%
Total Developed Areas	4,135.7	5,754.3	+ 3.7%
<u>DEVELOPING AREAS</u>			
Zambia	402.6	598.1	+ 4.5%
Congo (Kinshasha)	144.7	183.3	+ 2.7%
Other Africa	1.2	20.7	+37.2%
Chile	225.6	453.0	+ 8.0%
Other Central & South America	60.6	108.4	+ 6.7%
Other Asia	23.4	29.7	+ 2.7%
Total Developing Areas	858.1	1,393.2	+ 5.5%
<u>WORLD TOTAL</u>	4,993.8	7,147.5	+ 4.1%

29. The other main developing areas are Zambia, Peru, and Congo (Kinshasa) which also have extensive development programmes. In addition, new output can be expected fairly soon in Botswana, Indonesia, Malaysia, Mauritania and Bougainville. Much of the output of these mines will go to Japan.

CONSUMPTION

30. Before discussing the trend in consumption of copper and the possibilities for the developing countries, it is important to be clear on our definitions.

31. One of the great merits of copper is that it is virtually indestructible and once it is produced the metal is never actually consumed in the physical sense of disappearing.

32. The data on consumption relate to the point at which copper is transformed from a piece of metal into a product such as rod, wire, sheet or tube.

33. It is also possible to speak of the consumption of copper when these semi-manufactures are used for the production of final consumer or industrial goods. However, this copper eventually re-appears as scrap and therefore it is never actually used up.

34. If we measure consumption at the stage of transformation into semi-manufactures, the copper usage is made up of primary refined metal, copper which is refined from scrap and residues and copper scrap which is used directly by manufacturers without being re-refined.

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35. Copper is consumed in one form or another in all countries of the world. Most, however, is used in the industrialised countries.

36. Tables 9 and 10 give the world consumption of refined copper. This rose between 1960 and 1969 by some 2.3 million tons. The main increases in consumption have been in the United States, U.S.S.R., Japan, Germany, France, Italy and Canada.

37. Over the last ten years consumption has grown at a rate of 4.4% per annum compared with only 4.1% for production. The growth of consumption has therefore outstripped the available supplies. This has only been made possible by releases from the U.S. Government stockpile 798,000 tons.

38. This rapid rise in consumption is due to the growth of industrial output, improved standards of living, and the growth of population.

39. The developing countries consume only $3\frac{1}{2}\%$ of the world's total.

40. Thus the consumption of copper varies enormously in the different countries of the world. Table 11 shows that consumption per capita in the industrial countries is from 4 to 12 kilogrammes per annum but in the developing countries it is a fraction of a kilogram (Table 12).

41. Consumption in the developing areas is small but future prospects are extremely good.

.../...

TABLE 9
WORLD REFINED CONSUMPTION

	Thousand Metric Tons									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Western Europe										
Germany F. R.	1,912.7	1,978.4	1,898.9	1,942.7	2,154.7	2,144.6	2,021.0	1,984.9	2,169.1	2,336.7
United Kingdom	516.2	561.9	500.6	493.5	561.1	536.3	458.7	501.2	608.8	655.7
France	560.3	528.9	526.1	558.2	632.9	650.1	542.5	514.3	539.2	546.8
Italy	236.7	243.6	243.7	250.2	291.6	287.0	261.5	271.3	292.9	334.8
Rest	185.0	202.0	214.0	228.0	292.9	192.0	195.0	222.0	226.0	260.3
	414.5	442.0	414.5	412.5	467.1	479.2	483.2	476.1	502.2	541.1
North America										
U.S.A.	1,331.3	1,455.9	1,582.7	1,736.4	1,839.4	2,022.4	2,379.1	1,959.5	1,932.7	2,142.2
Canada	1,224.6	1,327.1	1,451.2	1,582.4	1,655.9	1,818.6	2,140.9	1,755.9	1,705.8	1,924.2
	106.7	128.8	137.5	154.0	183.5	203.8	238.2	203.6	225.9	216.0
Centrally Planned Economies										
U.S.S.R.	911.6	951.8	1,025.1	1,041.0	1,055.0	1,114.6	1,177.3	1,247.4	1,275.0	1,320.0
Rest	651.6	681.8	735.1	736.0	740.0	782.6	817.3	867.4	875.0	930.0
	300.0	270.0	290.0	305.0	315.0	332.0	360.0	380.0	400.0	420.0
Asia										
Japan	376.7	453.7	397.3	445.9	542.4	508.0	531.2	679.1	752.1	870.0
Rest	304.0	372.9	301.1	352.0	457.5	427.5	482.5	615.0	695.2	806.9
	72.7	80.8	96.2	93.9	84.9	80.5	48.7	63.1	56.9	63.1
Central & South America										
Total	90.1	95.6	99.9	104.5	172.6	176.1	145.4	117.5	161.1	178.8
Australasia										
Total	65.8	60.1	76.0	74.5	99.4	102.5	109.5	90.7	103.2	99.7
Africa										
Total	35.3	32.4	31.9	42.1	47.7	44.4	41.7	39.5	40.2	45.4
WORLD TOTAL	4,723.5	5,027.9	5,127.8	5,397.7	5,911.3	6,112.6	6,405.2	6,118.6	6,433.4	6,995.3

TABLE 10
REFINED CONSUMPTION BY DEVELOPED AND DEVELOPING COUNTRIES

Thousand Metric Tons

	WORLD TOTAL	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
1960	4,723.5	4,551.4	172.1
1961	5,027.9	4,846.1	181.8
1962	5,127.8	4,921.8	206.0
1963	5,397.7	5,186.8	210.9
1964	5,911.3	5,639.6	271.7
1965	6,112.6	5,844.0	268.6
1966	6,405.2	6,199.4	205.8
1967	6,118.6	5,926.8	191.8
1968	6,433.4	6,204.2	229.2
1969	6,995.3	6,742.2	253.1
Annual average rate of increase	+ 4.4%	+4.5%	+4.4%

TABLE 11

PER CAPITA CONSUMPTION OF COPPER IN ALL FORMS IN
CERTAIN DEVELOPED COUNTRIES

Kgs. per head

	1968
Austria	4.5
Belgium	6.8
France	7.5
Germany F.R.	11.7
Great Britain	11.2
Italy	6.5
Japan	9.6
Netherlands	7.9
Scandinavia	9.0
Switzerland	10.7
U.S.A.	12.2

TABLE 12
PER CAPITA CONSUMPTION IN CERTAIN DEVELOPING COUNTRIES

	1968
<u>SOUTH AMERICA</u>	
Colombia	0.1
Venezuela	0.6
<u>ASIA</u>	
Iran	0.2
Israel	2.9
Philippines	0.1
Thailand	0.1
<u>AFRICA</u>	
Algeria	0.1
Ghana	0.1
Libya	0.5
Morocco	0.2
Tunisia	0.1
Zambia	0.1

SEMI-MANUFACTURES AND CASTINGS

42. Copper is used in the first instance for the production of a variety of semi-manufactures. These include sheet, strip and plate, wire, rods, bars and sections and tubes. About 10% of the copper is used for castings and a small amount for chemical compounds - mainly copper sulphate. The production of semi-manufactures in the world is given in Table 13.

43. Many developing countries start by mining copper and then follow this by the erection of smelters for the production of blister copper and probably rather later by refineries for the production of fire refined and electrolytic copper.

44. The problems of smelting and refining are partly those of technical know-how and partly of obtaining sufficient investment funds for the erection of the plants. The minimum economic scale for a refinery is now of the order of 100,000 tons per annum.

45. As we have seen above, 40% of the world's copper is produced by the developing countries. The production of semi-manufactures in the developing countries, however, is small. Out of a total production of 9.6 million tons only some 3½% is in the developing countries. The reasons for this are partly economic and partly historical. Fabricating must be on a large scale but these products are difficult to produce economically in developing areas with small individual markets.

.../...

TABLE 13
WORLD PRODUCTION OF COPPER AND COPPER ALLOY SHEET - MANUFACTURES

	Thousand Metric Tons									
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
- Total	2,455	2,573	2,478	2,523	2,939	3,024	2,860	2,738	2,988	3,298
<u>Western Europe</u>	603	670	594	611	723	750	670	664	771	896
Germany F.R.	764	724	688	734	840	853	783	691	725	738
United Kingdom	315	327	339	356	399	391	393	384	398	473
France	234	275	294	323	293	303	326	355	373	390
Italy	539	577	563	599	584	727	688	644	721	801
Other W. Europe	1,542	1,641	1,811	1,895	2,167	2,336	2,640	2,248	2,322	2,584
<u>U.S.A.</u>	1,160	1,210	1,310	1,335	1,410	1,550	1,590	1,696	1,750	1,820
<u>Centrally Planned Economies</u>	501	596	552	575	761	684	719	901	1,039	1,178
<u>Japan</u>	223	237	277	300	357	362	412	365	393	397
<u>Other Developed Countries</u>	180	230	260	280	350	360	270	250	300	340
<u>Developing Countries</u>										
<u>WORLD TOTAL</u>	6,061	6,487	6,688	7,008	7,984	8,316	8,491	8,201	8,792	9,617

46. The scale of operation of the semi-manufacturers is rising rapidly and much larger units are now being formed in all industrialised areas. To establish semi-manufacturing units in the developing areas it would be necessary to extend the markets.

47. Secondly, many semi-manufactures are sophisticated products which must be produced to a high degree of quality in a large range of sizes, shapes and alloys. They are therefore most easily produced near the market.

48. The development of semi-manufactures does however create additional employment in the countries concerned and this brings obvious benefits. On the whole, though, copper fabricating is not a labour intensive industry.

49. The problems involved in establishing a fabricating industry are therefore -

- (1) the scale of the home market;
- (2) the fact that many products are based in part on scrap;
- (3) the alloying elements (zinc, nickel etc would have to be imported);
- (4) the acquisition of technical know-how;
- (5) the distance from export markets;
- (6) the large amount of investment funds which are required;
- (7) shipping rates are fixed in relation both to the value and the volume of the cargo. On both counts, semi-manufactures cost more to transport;
- (8) many countries have erected tariff barriers against the import of semi-manufactures;
- (9) a multiplicity of products and sizes are required.

50. I have described some of the problems which exist for the developing countries if they want to go into fabricating. These relate to the present techniques of production, transport and selling.

51. It may well be that certain technical developments in the industry will make some of the processes in the smelting - refining - fabricating chain unnecessary in the future.

52. If these new techniques are successful they will lead to a fundamental change in the economics of fabricating.

GEOGRAPHICAL PATTERN

53. The copper industry of the world is broadly divided into three regions. The biggest production and consumption of copper is in the United States of America which uses some two million tons per annum but is largely self-supporting. It imports blister mainly from Latin America for refining and re-export. Apart from this tonnage, the net imports amount only to 140,000 tons per annum.

54. The second main area covers the Centrally Planned Economies which are also virtually self-supporting. In 1969, the total trade between these countries and the rest of the world was only some 70,000 tons.

55. In the rest of the world, copper is largely mined in Africa and Latin America and consumed in Western Europe and Japan. Western Europe has virtually no mine copper and Japan has a relatively small production. The market for the developing countries, therefore, lies largely in these two areas.

56. The Centrally Planned Economies are very large and important producers and users of copper. This can have an important effect on world metal markets both as suppliers and, on occasion as buyers. Whilst the trade in copper is minimal at present it must not be assumed that this situation will endure indefinitely. These countries could well become net exporters to the rest of the world. Other members of the Conference may be able to express their views on this subject.

PRODUCTION FORECASTS

57. It is possible to forecast production of newly mined copper with a fair degree of accuracy as it takes about five years to develop a new mine. Even projected extensions of existing mines are usually known well in advance because these developments require not only a period of time in which to carry out the physical work but also time in which to raise the large sums of finance required.

58. There are problems, however, in forecasting future output even of newly mined copper. It is dangerous to count on all the forecast projects because work on many of these new developments is much slower than is hoped for in the initial plans. If all the possible sources of copper were to come to fruition over the next five years, they would create a large surplus in the market.

59. Experience has shown though that many of these mine developments will be delayed for one reason or another and also that certain deposits will be worked out.

60. There are also always continuing difficulties in the mining areas either for physical reasons or industrial disputes. The production of copper is therefore always less than capacity.

61. It is likely that the mine production of copper will increase to 9.5 million tons in 1980. Smelter production is forecast to rise to 10.1 million tons.

62. Of the mine output, it is estimated that the developing countries will provide 3.5 million tons

63. The output of refined copper will probably rise to 11.3 million tons by 1980.

64. All these figures of production are based on the long-term expansion plans of the countries concerned.

CONSUMPTION FORECASTS

65. Copper has been used by man for seven thousand years but the enormous growth in consumption has only taken place in the last 50 years - that is to say during the period of widespread electrification.

66. As 96% of the world's copper is used in the industrialised countries; our forecasts about consumption in the next decade must inevitably be based on our view of conditions in these countries. Even a spectacular growth in copper consumption in the developing countries would not make any substantial difference to the world's use of copper. In the long run, of course, the future of copper consumption will turn largely on the use which is made of it by the very large - and rising - population of the developing countries.

.../..

67. I have based my forecasts of consumption on the total usage of copper i.e. primary refined copper, secondary refined and scrap used directly. It is, in my view right to examine the total market for copper rather than a part. Consumers do not use primary copper as such. They will use copper in whatever form in its most economic and convenient form. For some uses they must use newly mined copper. For other uses, they will almost always use scrap. There is a range of intermediary uses where either or both may be used.
68. It is clear that the growth of consumption will continue although the rise is likely to be somewhat slower in the second half of the decade. Total consumption will grow to about $14\frac{1}{2}$ million tons in 1980.
69. The world will, therefore, need 3.7 million tons more copper by the end of the decade but the industry will be capable of producing somewhat more.
70. These figures would seem to indicate on the face of things that a surplus of copper is likely to arise in the future and that this will result in a depressed market. Such a conclusion would be quite incorrect. In the past the mines have been able to operate on average at about 93% of their normal rated capacity. For practical purposes this is the maximum rate of operation which they are likely to achieve over the years, although in particular years the operating rate may be higher or lower. The production figures really represent the maximum obtainable tonnage in the long-run.
71. These forecasts indicate that the mines may in future operate at something of the order of 85% rather than over 90% of capacity.
72. The forecasts of consumption have not been based simply on mathematical projection as this would only assume that what has taken place in the past will continue in the future. We are now in a period of rapid technological economic and political change and we must take account of these changes in the forecasting of copper.

73. These forecasts are based on the long-term growth prospects for copper and they do not take account of short-term cyclical fluctuations in the market. Copper has traditionally been subject to these rapid changes in demand. Consumption in any one year may therefore be higher or lower than the figures postulated. Nevertheless, the mines must have the capacity to meet the maximum requirements of the consumers year-by-year otherwise the latter will be compelled to turn to substitutes.

.../...

SUBSTITUTION

74. The demand for copper has risen rapidly in recent years. Nevertheless, during this period copper has lost a number of major markets.

75. The relative advantages of copper over other materials depend on a number of factors - some economic and some technical. The balance of advantage is often fairly fine and consumers will only use a more costly metal when it has demonstrably better qualities for a particular application.

76. It may appear paradoxical to discuss lost markets for copper during a period when consumption has risen so rapidly. However, it is possible to visualise higher and lower rates of expansion of a metal and therefore there is no contradiction between saying that important applications have been lost in recent years but total consumption of copper has risen. The consumption of copper in its most essential uses has more than exceeded the loss in more vulnerable applications. Nevertheless, these losses to substitute materials are vital to the future of the industry. It should be borne in mind that substitution of one material for another is a continuing process. Indeed the present users of copper must be thankful for the fact that some applications now use alternative materials. If copper had maintained all its uses, we should now be living through a period of desperate shortage and astronomical prices.

.../...

77. The problems of substitution for the copper industry should therefore not be over-emphasised but on the other hand they must always be considered when the long-term future of the industry is under discussion.

78. The electrical industry is by far the largest single market for copper and it is one where substitution has been in progress for many years. About four years ago this substitution made a sudden leap forward in the field of insulated cables where in the past copper had always been supreme.

79. The various disadvantages of using aluminium - for example the difficulties of joining it had been overcome and this combined with the higher copper price led to the sudden turn to aluminium. The consumption of aluminium for electrical conductors has been growing more rapidly than the use of copper. During this period the consumption of copper for conductors has risen in absolute terms more than the use of aluminium, but the trend against copper is marked.

80. This is the principal market for copper and is one which is extremely vulnerable to substitutes. Copper will be used for some electrical applications at almost any price, but there are many other uses in which aluminium is a feasible alternative.

81. There is also a new threat to copper in the shape of copper/aluminium bonded wire. This material is composed of 90% aluminium and 10% copper. If it can be used successfully for house wiring cables and enamelled wires it will eat into a further large area of copper usage.

82. Substitution is less apparent in the other consuming industries. In many countries copper is the principal material for domestic water tubes. The recent period of high prices stimulated the research and development into the use of other materials such as plastics against stainless steel.

83. The copper industry was able to deal with this substitution by reducing the wall thickness of the tubes and more recently by reducing the diameter. The use of copper has therefore been maintained but only at the cost of the reduction in the tonnage of copper which is used.

84. This is a typical example of a different type of substitution which is taking place. Not only are other materials being used, but also the amount of copper used in particular applications is continually falling. The present tendency in design is for products and components to become smaller and thinner. A typical application of copper will, therefore, use progressively less copper per unit of output.

85. The total demand for copper is therefore dependent on two factors which work in opposite directions. There is a continually increasing demand in the established uses owing very largely to higher living standards and electrification and at the same time copper is losing markets through substitution and miniaturisation.

86. The actual demand over the years is an amalgam of these two effects.

.../...

87. Substitution is normally irreversible. If a manufacturer changes over his plant during a period of high copper prices or scarcity he will not normally be willing or able, to return to the use of copper. A market once lost is lost forever.

SCRAP

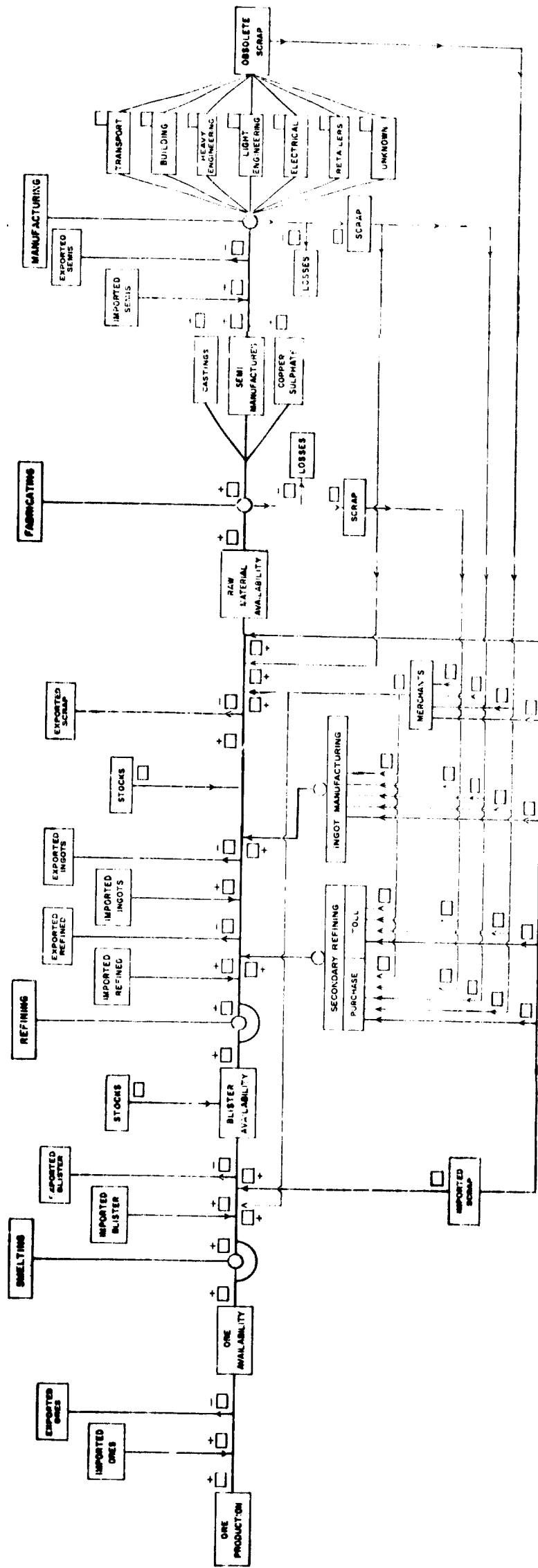
88. The United Nations Industrial Development Organisation held a meeting on the Utilisation of Non-Ferrous Scrap in Developed Countries in Vienna in November, 1969. This dealt in the main with the utilisation of scrap and its technical problems.

89. Scrap is, however, a very important raw material for the copper using industry. As such, the movement of scrap and its availability has a major influence on the market and the price for primary copper. Many copper products can be made either from scrap or from secondary refined copper or from primary copper. The fabricators are, therefore, able to choose which they wish to use.

90. The movement of scrap is extremely complex and is difficult to measure in statistical terms. A diagram of the circulation of scrap is attached.

91. All metal producing and consuming companies in the world create scrap of one sort or another. Most metal producers, from smelter to fabricator, use scrap or residues in addition to primary metal.

DIAGRAMMATIC FLOW CHART OF COPPER



92. It is possible to distinguish several main categories of scrap, although it must be emphasised that these are a general grouping and that particular parcels of scrap do not conform necessarily to this classification. The main types are:-

- (1) Scrap which is generated and consumed in the same plant.
- (2) Ashes and residues which are produced in copper and brass mills and foundries and returned to smelters and refineries.
- (3) New scrap which is sold by the engineering industries to the metal manufacturers.
- (4) New process scrap which is sold to merchants and returned by them to smelters, refineries or fabricators.
- (5) Old scrap which is collected by merchants and sold to smelters, refiners or fabricators.

93. In practice it is difficult to distinguish between these different types as much old scrap may include some process scrap.

94. In addition to the new process scrap, large quantities of old scrap are recovered every year. Indeed one of the principal virtues of copper is that it is virtually indestructible. Apart from chemical uses which are of minor importance, most copper is recovered for use at some time or another.

.../...

95. Old scrap arises from the breaking up of machinery and equipment from cars, ships, aircraft and vehicles; from old cables and material from demolished buildings. Government Departments, telephone authorities, the armed services and the railways are also important sources of scrap.

96. The users of scrap are:-

- (1) Smelters who use residues and other low grade scrap for the recovery of blister copper.
- (2) Refineries who use better scrap to produce fire refined and electrolytic secondary copper.
- (3) Ingot makers who produce specification ingots out of a variety of scraps.
- (4) Copper and brass mills, particularly the rolling mills and rod mills. The brass rod mills use a very large proportion of scrap in their products. This scrap is used in combination with virgin metal.
- (5) Foundries which use a very large proportion of scrap for production of castings, etc.
- (6) Chemical works which use scrap largely for the production of copper sulphate, but also for a number of other chemicals.

97. The total scrap used in the world is at present of the order of 3.6 million tons. This represents about 40% of the total copper consumption in the world. Scrap is mainly used in the highly industrialised countries but it is precisely these countries which, in any event, use some 96% of the world's copper.

98. Scrap is, therefore, a vital source of supply and indeed even in the U.S.A., which is the world's largest producer of virgin copper, scrap is as important a source of supply as the mines.

99. The influence of scrap on the price is considered later but meanwhile it should be noted that the conditions under which scrap is produced and consumed are totally different from mined copper.

100. For the consumer of copper, the two sources of supply are complementary. However, scrap is produced in the developed countries and quite frequently close to a metal consumer. Scrap, therefore, will always find a market and indeed may on occasion replace primary copper.

101. The supply line for primary copper between developing and developed countries is usually very long. The supply line for scrap is very short. Moreover, scrap is of course created as a bi-product and its cost of production is nil. The price, therefore, depends entirely on supply and demand.

PRICE

102. The key to the expansion of the revenues of the developing countries is the future of copper demand and the copper price. The estimates of demand have shown that there will be a ready market for additional supplies of copper over the years. The future price level is much more difficult to assess.

103. The basic function of any pricing system is to equate supply and demand. It should do this at a price level which is high enough to encourage new investment in mining and yet is not so high as to price the metal out of the market and drive all its customers to use substitutes.

104. The copper industry has always been subject to great fluctuations in the price. There are a number of different prices in use in various parts of the world, but the most important are:-

- (1) The U.S. producer price.
- (2) The daily London Metal Exchange quotation.
- (3) The price levels determined in the Centrally Planned Economies.

105. The first two price series are given in Tables 14 and 15.

106. The U.S. producer price applies to the sale of primary copper by the large U.S. copper companies. There are, however, other price levels in the U.S. for scrap and custom smelter copper and fabricators have to use a blended price based on their average buying price for materials.

107. This dual price structure has given rise to acute problems in the United States and a Government Inquiry into copper pricing has just been under-taken. This Committee of Inquiry was unable to make any constructive proposals for dealing with the problems.

108. The London Metal Exchange is a commodity market which determines the price basis for virtually all transactions other than those in North America and the Centrally Planned Economies. It is a free market used by almost every country in the world. It therefore reflects the conditions of supply and demand in the world.

.../...

TABLE 14
COPPER PRICES
UNITED KINGDOM
ELECTROLYTIC COPPER WIRE BARS
SETTLEMENT PRICE

£ per Metric Ton

Year	Average	High	Low
1936	42	54	37
1937	59	80	41
1938	45	54	36
1939	48	54	46
1940	50 (1)	50 (1)	50 (1)
	61 (2)	61 (2)	61 (2)
1941	61	61	61
1942	61	61	61
1943	61	61	61
1944	61	61	61
1945	61	61	61
1946	76	96	61
1947	129	135	115
1948	132	138	130
1949	131	151	102
1950	176	199	151
1951	217	230	199
1952	255	282	223
1953	265 (3)	280 (3)	248 (3)
	229 (4)	244 (4)	211 (4)
1954	245	305	212
1955	345	399	284
1956	324	430	258
1957	216	269	173
1958	194	257	157
1959	234	264	206
1960	242	276	215
1961	226	245	213
1962	230	233	224
1963	230	232	227
1964	345	523	231
1965	461	561	323
1966	546	776	349
1967	411	598	340
1968	517	810	425
1969	611	734	502
1970 (January - May)	698	749	566

Notes:- (1) January - August
(2) September - December
(3) January - July
(4) August - December

TABLE 15
COPPER PRICES
UNITED STATES OF AMERICA

ELECTROLYTIC COPPER - DOMESTIC REFINERY

Year	Cents. per lb		
	Average	High	Low
1936	9.5	11.8	9.0
1937	13.2	16.8	9.9
1938	10.0	11.0	8.8
1939	11.0	12.3	9.8
1940	11.3	12.3	10.3
1941	11.8	12.0	11.8
1942	11.8	11.8	11.8
1943	11.8	11.8	11.8
1944	11.8	11.8	11.8
1945	11.8	11.8	11.8
1946	13.8	19.3	11.8
1947	21.0	23.3	19.2
1948	22.0	23.2	21.2
1949	19.2	23.2	15.7
1950	21.3	24.2	18.2
1951	24.2	24.2	24.2
1952	24.2	24.2	24.2
1953	28.8	30.8	24.2
1954	29.7	29.7	29.6
1955	37.5	45.3	29.7
1956	41.8	47.8	35.4
1957	29.6	35.6	25.4
1958	25.8	28.8	23.5
1959	31.2	35.2	28.6
1960	32.1	34.2	29.6
1961	29.9	30.7	28.6
1962	30.6	30.6	30.6
1963	30.6	30.6	30.6
1964	32.0	33.8	30.6
1965	35.0	37.0	33.6
1966	36.2	47.2	35.6
1967	38.2	39.6	36.2
1968	48.8	42.3	41.7
1969	47.5	52.8	41.7
1970 (January - May)	57.4	59.7	52.1

109. The turnover of the L.M.E. is over 2.3 million tons per annum but much of this is in the form of paper transactions. It arises from hedging operations and other transactions between dealers.

110. The actual physical metal handled by the market is about 230,000 tons per annum. The price quotations are used as a basis for the long-term contracts of the producers and for buying and selling of scrap. They therefore influence the pricing of about $6\frac{1}{2}$ million tons of copper per year.

111. Producers have held in the past that this was an unsatisfactory method of pricing metal. Indeed, the aluminium and nickel producers have established their own prices and they have now been followed by zinc producers. There is now a dual price system for all these metals - one fixed by producers and one determined in the Market. The copper producers have sometimes operated their own producer price. For example, when the London Metal Exchange was shut during the War and, more recently, attempts were made to get away from L.M.E. pricing and the daily fluctuations. These attempts had to be abandoned owing to the problems created by dual pricing.

112. In practice it proved to be impossible for two widely different prices for copper to exist for any length of time. This is partly due to the large supplies of secondary metal and scrap and partly to the desire of some producers to obtain the best possible price.

.../...

113. The pricing of commodities by a commodity exchange inevitably leads to an unstable price because there is a daily fixing. The short-term factors prevalent on a particular day influence the making of the price. In addition, the long-term factors of supply and demand operate in the market but these only affect the long-term movements in price.

114. The wide spread of production costs in the industry also contribute to the instability of the price.

115. The advantage of the market is that copper can always be bought and sold - at a price. In other commodities this is not always so, and we have seen recently a desperate shortage of nickel.

116. Fundamentally, however, the price of copper must depend on the long-term supply and demand relationship. If supply grows more rapidly than demand the price must weaken. In recent years we have seen a continuing strong market for copper - indeed demand has risen steadily and more rapidly than production. As a result prices have risen rapidly and remain at a higher level. In 1969 copper rose by almost £200 per ton - from £502 on January 2nd to £695 at the end of December. In 1970 there was a further rise in the price to £749 in May, but within a space of weeks it had fallen by £150 per ton.

117. For the future, it would appear that prices will remain at around this level for some time to come but inevitably there will be a lower level of price over the next decade. In this connection, I have referred to prices in terms of 1970 monetary values. If the present rate of inflation throughout the world continues, the price of copper will also remain high, but, relative to

the general price level, it is likely to fall. This assumes that there will be no unforeseen change in the supply and demand relationship.

118. The great increase in the price has benefitted the developing countries. It has also stimulated the development of new mines and the extension of existing properties.

119. A few years ago, the long-term price for copper was held to be £240 per ton and mining companies worked on this basis when considering whether to develop a mine or not.

120. Now, the long-term price has probably doubled to something in the region of £500 per ton.

121. It must always be borne in mind that a mine is a wasting asset. Even the largest and richest will, one day, be worked out.

122. The developing countries must make use of this mineral wealth to raise their living standards, to improve their agriculture, and to create other non-mining industries.

REQUIREMENTS FOR INVESTMENT FUNDS

123. The requirements of the developing countries for investment funds are very large and the capital available from the developed areas of the world is insufficient to meet this demand. Given this lack of availability of capital funds the developing countries must use them to the best purpose.

124. The capital required for developing new mines and for the erection of smelters and refineries is also increasing. This is due both to the technological developments which require larger scale metallurgical units and also to the fact that many new mines will be based on relatively low grade ores. Few new high grade ores or deposits have been discovered in recent years and it is unlikely that they will appear in the immediate future. A low grade ore does not necessarily mean that the cost of producing copper need be any higher than in the existing mines. Indeed some of the new mines which have come into production in recent years have quite low costs per ton of output despite the fact that the ore is of low grade.

125. The increase in the production of copper from open cast pits and the development of methods of large scale earth moving and extraction have made this possible. But these methods require a very large capital investment in the initial stages.

126. The costs of producing copper have risen sharply in most areas of the world. A few years ago the estimated cost of developing a new mine was of the order of £500 to £600 per ton of annual capacity. Extensions to existing mines were something like a third less.

127. Now a figure as high as £1200 is being quoted.

128. The major part of copper mine output is now refined in the mining countries of the world. The smelters and refineries in the consuming areas have been using less primary material and have turned more to using scrap.

129. This trend has been evident in Western Europe over the past 10 years but it may well change in the next decade.

130. A number of new mining developments have been financed in part by smelters in developed countries. These include the new mine developments in Mauritania, Bougainville and Indonesia.

131. Much of this financing has been provided by Japan. The smelters and refineries in Japan rely in the main on primary material. The supply of scrap, even including large imports, is insufficient to provide the smelters with their raw materials. The Japanese companies have, therefore, provided finance to many mines throughout the world and as a result have placed contracts with these mining companies for supplies of concentrates and blister copper.

132. Each developing country must decide on the merits of the case whether it will gain more from the investment of a given sum in mining or in fabricating. Indeed it may well be that capital investment in fields outside the copper industry altogether will result in greater employment and greater productivity.

133. It is, therefore, impossible to generalise and to say that it will always pay the lesser developed countries to fabricate their copper.

STRUCTURE OF THE COPPER INDUSTRY

134. Traditionally the copper industry of the world has been dominated by a small number of large mining companies mostly in the United States. These large companies have developed mine deposits not only in the United States itself but also in many other parts of the world.

135. In addition they have developed fabricating plants in the U.S. and Canada although not, in the main, elsewhere. The recent political changes in the world have been reflected in the mining scene. It has now been accepted that copper mines are a vital source of wealth to the countries in which they are located and that, therefore, the governments of these countries must control and indeed participate in the ownership of the mines.
136. New legislation has been passed in the four principal mining countries - Peru, Chile, Zambia and Congo - which lay down new legal codes for mining operations.
137. In addition in Chile, Zambia and Congo the Government has entered into partnership with the overseas companies which formerly owned the mines. Indeed, in some cases the Government now has complete ownership.
138. Nevertheless, most countries still look to a form of partnership with the existing companies and they have entered into long-term agreements with them to manage the mines. In these countries, the mines are now operated by new companies which have been set up with majority holdings by the Government.
139. The marketing of copper is also increasingly coming within the ambit of Governments.
140. It must be expected that, in the future, marketing as well as production will be carried out by organisations which are either totally owned by, or at least controlled by, the Governments of the developing countries.

141. These changes will make a great difference to the mining operations and to the relationship between the mining companies and their Governments. It seems unlikely that there will be any great effects on the marketing and consumption of copper.

142. To achieve further success in their production and marketing, the developing countries should bear in mind the following points:-

- (1) The world needs more copper and much of this should come from the developing countries.
- (2) This underlines the need for more intensive exploration.
- (3) Mining legislation must be such as to attract overseas companies to carry out, or participate in, this exploration.
- (4) Tax codes must be equitable and provide an incentive to mining companies to provide investment funds.
- (5) To provide an expanding market, new research and development work is necessary.
- (6) More and better information is needed on trends in production, sales and consumption.

SUMMARY

INTRODUCTION

1. The paper outlines the economic aspects of the copper industry and the part which is played by the developing countries.
2. The copper industry is defined in its widest sense to include not only mining, smelting and refining, but also the consumption of copper and the production of semi-manufactures.

MINING

3. The output of the copper mines has increased by 40% over the last decade. The developing countries now produce some two-fifths of the world's primary copper.

SMELTING

4. The smelting of copper is carried out in many cases close to or at the mine, but also by custom smelters in the consuming areas. The latter produce blister copper not only from ores and concentrates but also from scrap and residues. The proportion of the total output of blister which comes from the developing countries is about one-third and is, therefore, rather less than for mine copper. This is due in part to the fact that concentrates are shipped to the industrial countries for smelting.

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5. Some years ago it appeared that primary copper would be smelted and refined more and more at or close to the mines, rather than in the consuming countries, but it seems likely that this trend will be reversed. Some countries are contracting for the supply of concentrates and blister to feed their smelters and refineries. The companies concerned offer finance to allow the development of new mining ventures. In exchange they enter into long-term contracts with the mines for the supply of minerals.

REFINING

6. The production of refined copper is spread much more widely throughout the world. Out of a total production of refined copper of 7.1 million tons, the developing countries produce 19%. The developing countries have increased their production of refined metal over the last decade more rapidly than the developed areas. Large new projects are in course of development in Africa and Latin America.

CONSUMPTION

7. The consumption of refined copper is now about seven million tons per annum. This is used almost exclusively in the industrialised countries. The developing countries consume only $3\frac{1}{2}\%$ of the world's total.

8. The consumption per capita in industrial countries varies between 4 and 12 kilogrammes per annum but in the developing countries it is only a fraction of a kilogramme, Consumption in the developing areas is small but future prospects are extremely good.

.../...

SEMI-MANUFACTURES

9. Production of semi-manufactures is overwhelmingly in the industrialised countries of the world. Out of a total production of 9.6 million tons per annum only 340,000 is in the developing areas.

10. The problems facing the developing countries in establishing a fabricating industry are:-

- (1) the scale of the home market;
- (2) the fact that many products are based in part on scrap;
- (3) the alloying elements (zinc, nickel, etc. would have to be imported);
- (4) the acquisition of technical know-how;
- (5) the distance from export markets;
- (6) the large amount of investment funds which are required;
- (7) shipping rates are fixed in relation both to the value and the volume of the cargo. On both counts, semi-manufactures cost more to transport;
- (8) many countries have erected tariff barriers against the import of semi-manufactures;
- (9) a multiplicity of products and sizes are required.

GEOGRAPHICAL PATTERN OF INDUSTRY

11. The copper industry of the world is broadly divided into three regions. The biggest production and consumption of copper is in the United States of America which is largely self-supporting. The second area covers the Centrally

Planned Economies which has a rather limited trade with the rest of the world.

12. The third area covers the remaining countries. In this area copper is largely mined in Africa and Latin America and consumed in Western Europe and Japan. The market for the developing countries, therefore, lies in these latter two regions.

13. The market for developing countries will be affected in the future to an important extent should the Centrally **Planned Economies** become large net exporters or importers of copper.

CONSUMPTION FORECASTS

14. As 96% of the world's copper is used in industrialised countries, the forecasts for the immediate future must look to the uses in these countries. Even a very large increase in consumption in the developing countries would not greatly affect the total demand.

15. Total consumption of copper in all forms, i. e. primary, refined, secondary refined and scrap used directly is estimated to increase to about $14\frac{1}{2}$ million tons by 1980.

16. These forecasts are based on the long-term growth prospects for copper and do not take account of short-term cyclical fluctuations in the market.

17. The demand forecasts take account of two main factors. First there is the growth of existing markets for copper particularly in the electrical field, but against this must be set substitution by other materials. Copper has

many important properties so the importance of substitution should not be over estimated. Nevertheless, copper is in competition with other natural and synthetic materials. The total demand depends on these two factors which operate in opposing directions.

SCRAP

18. Scrap is an important source of raw material for the copper users and accounts for about 40% of their total consumption. For many uses primary copper is essential but over a wide field particularly of alloys scrap may be used in place of refined metal. In some respects it has an advantage from the point of view of the consumer in that it is locally produced and not subject to interruptions in supply.

PRICE

19. The price of copper must depend on the long-term supply and demand relationship. In recent years we have seen a continuing strong market for copper and indeed demand has risen steadily and more rapidly than production. As a result prices have risen rapidly and remain at a high level. In 1969 copper rose by almost £200 per ton but in the early months of 1970 it fell by some £150 per ton.

20. For the future it would appear that prices will remain on about this level for some time to come although a lower level of price can be expected in a few years time. In this connection the price is expressed in terms of 1970 monetary values. If the present rate of inflation throughout the world continues, the price of copper will also remain high, but relative to the general price level it is likely to fall.

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INVESTMENT

21. The capital required for developing new mines and for the erection of smelters and refineries is increasing rapidly. This is due both to the technological developments which require larger scale metallurgical units and also to the fact that many mines will be based on relatively low grade ores. The low grade ore does not necessarily mean that the cost of producing copper need be any higher than in the existing mines, but it usually requires greater initial capital for developments.

STRUCTURE OF THE INDUSTRY

22. The structure of the copper industry in the developing countries is changing rapidly. New legislation has already been passed in the four principal mining countries - Peru, Chile, Zambia and the Congo - which lay down new legal codes for mining operations. In addition, new companies have been established in most of these countries. In the main, the Governments have a controlling interest in these companies with minority participation from the old mining companies.

23. The marketing of copper is also increasingly coming within the ambit of Governments.

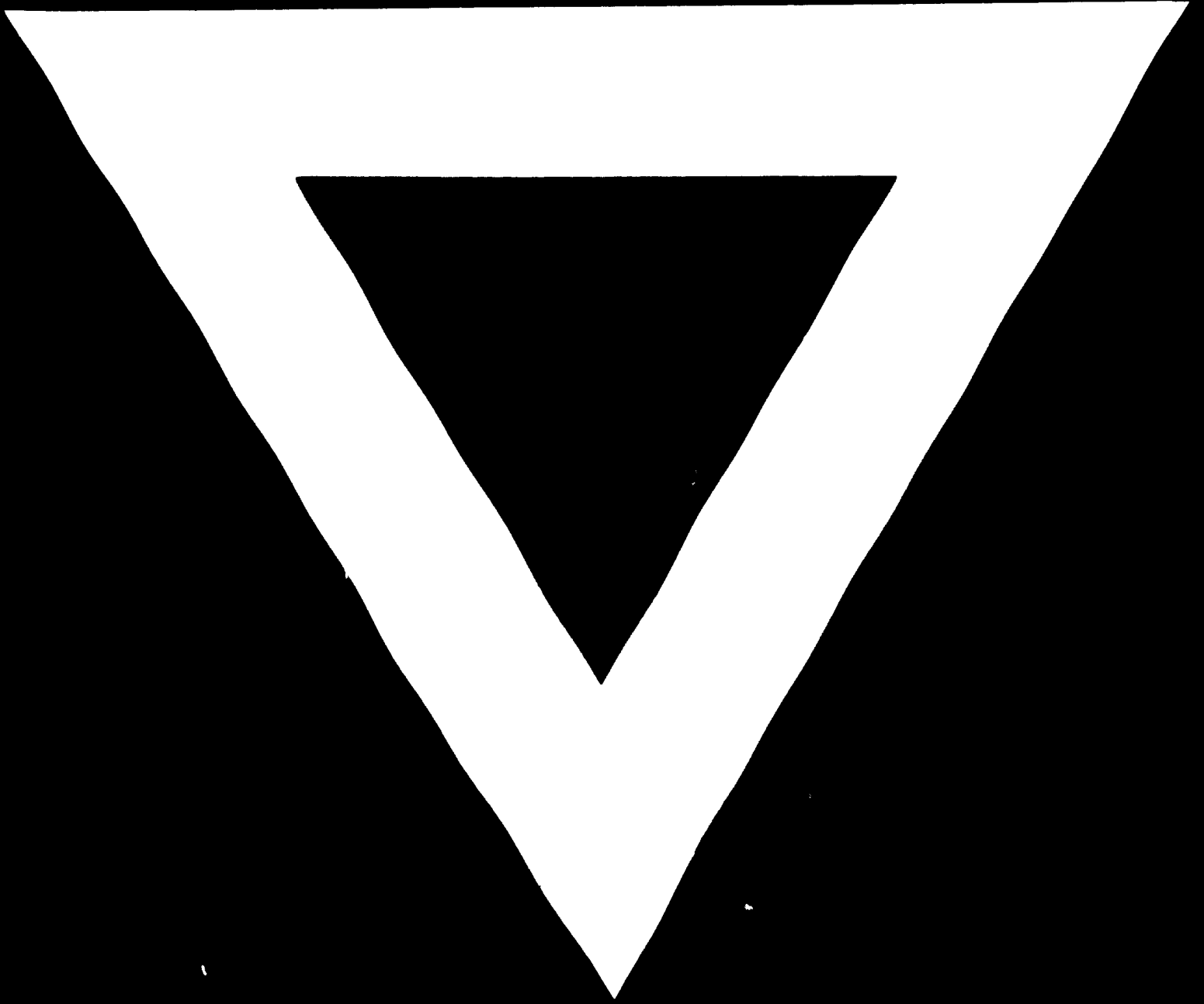
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