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SECTORAL STUDIES PREPARED FOR THE SYMPOSIUM

NON-FERROUS METALS INDUSTRY

Presented by the Executive Director of the United Nations Industrial Development Organization

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Annex

Tables

There are two types of tables in this document - numbered and unnumbered. The numbered tables, listed below, are annexed, and in the text of the paper reference is made to them by number. The unnumbered tables occur throughout the document and follow the text.

PRIMARY METAL PRODUCTION AND CAPACITIES

Primary metal production

1. The developing world's share in ore production of non-ferrous metals has tended to increase in recent years, and this has in turn constrained the growth in their export earnings. It is not suggested that this necessarily represents an underlying trend, but it does represent a marked contrast with the situation that will emerge if current mining plans in a number of these countries are realized.

2. The developing world's share in primary non-ferrous metal production ranges from less than 5 per cent for aluminium up to nearly 70 per cent for tin. These shares did not change much over the five years to 1964, and in the case of copper and lead, a small decline was recorded. This paralleled the decline in the developing world's share of ores produced and there is no evidence in aggregate of an increase.

3. On average, over the 1959-64 period, the metal content of the ores annually exported for smelting outside the developing countries was aggregated (tons): copper 165,000, lead 300,000, zinc 580,000 and tin 40,000. These are inevitably rough estimates, since it is exactly these figures that are most fragmentary: the true values may well have been higher.

4. The lack of integration in the ore mining and primary metal production of the developing countries may also be expressed by the ratio between their shares in the ore and in the primary metal production. In 1964 these indicators were as follows: (See Table 1).

5. In terms of average 1965 prices, the aggregate value added "lost" to the developing countries by exporting ore rather than ingot metal might be for these metals, excluding aluminium, of the order of $100-150 million annually, or somewhat less than 1% of the developing world's 1962 value added in manufacturing.

6. Evidently, this amount might have a larger significance in the countries where the mining of these ores is of crucial importance, as for example in

Zambia, Bolivia, Chile, Congo, Peru and Malaysia.

7. On the other hand, the net "loss" in foreign exchange earnings would of course be much diminished by the increased fuel and raw material imports, capital charges and costs of technical assistance as that would be required for ingot production.

8. The world's total in aluminium production has more than doubled from 3.1 million tons in 1955 to 6.6 million tons in 1965. The share of developing countries in the production remained insignificant although their aluminium capacities grew more than ten times during this period but starting from a very low level. Without mainland China, the developing countries produced 16,000 metric tons in 1955 and 182,000 metric tons in 1965. Their share in the increase of aluminium production even dropped from 5.2% in 1956/60 to 4.4% in 1961/65. This was one-fourteenth of their share in bauxite production in the first, and one-sixteenth in the second period. Of the 1964 total production, roughly 1% was contributed by Africa (Cameroon), roughly 3% by Asian countries (excluding Japan) and rather less than 1% by Latin America. Thus in total, the developing countries contributed about 4-1/2% of world production. This picture is slightly different in alumina, an intermediate product between bauxite and aluminium.

9. The proportion of developing countries' ore production smelted locally is smaller for zinc than for copper, lead or tin. In developing Africa, the aggregate proportion has averaged 40-45 per cent of ore production in recent years, while in Latin America the aggregate proportion has averaged about 25%. The corresponding Asian average has been about 65%, but this is contributed almost exclusively by mainland China and North Korea. If these two countries are excluded, smelted zinc production in developing Asia is thought to be almost negligible, although the metal content of ore production is in the order of 50,000 tons annually. The other regional averages also conceal wide differences between countries. A number of countries have traditionally exported substantial amounts of zinc. These include: Algeria (about 350,000 tons), South West Africa (about 30,000 tons), Tunisia (about 25,000 tons),

Mexico (about 150,000 tons), Peru (about 200,000 tons). This reflects partly the relative difficulty of smelting some zinc ores (problems of zinc vapour condensation) and the considerable scale and capital intensity required in some cases for economic production.

Primary metal capacities

10. Aluminium reduction capacity in the developing world (excluding mainland China) has increased from some 107,000 tons in 1960 to about 180,000 tons in 1964. In Africa, the only smelter is that of Alucam in Cameroon: its capacity, only marginally increased since its inception in 1956, is about 55,000 tons. In developing Asia, there is a smelter of 20,000 tons of annual capacity in China (Taiwan), doubled since 1960, and about 53,000 tons of annual capacity in various projects in India. New smelters are being established at Koyna, Korba and Mysore and capacity at existing plants at Alwaye, Asansol and Rihand is being expanded. In Latin America, Brazil has had about 30,000 tons of capacity for a number of years, while new plants have been inaugrated in 1963 in Mexico (20,000 tons) and in 1965 in Surinam (60,000 tons). To this total should be added some considerable capacity in mainland China of which no details are available: some sources estimate it at 100,000 tons a year.

11. Copper smelting capacity in the developing countries totalled some 1,800,000 tons in 1965, 32% of world capacity. Copper refining capacity at about 1,360,000 tons annually was about 20-25% of world capacity. The four major producers are well known - Congo (Kinshasa), Zambia, Chile and Peru; their combined smelting capacity represents some 29% of total world capacity. Capacity estimates are shown in the table below.

Primary Copper Capacity - 1965

(1000 tons)

	Smelting	Refining
World	5,687	6,400
Developing countries	1,832	1,359
of which:		
Africa	915	886
- Congo	375	245
- Southern Rhodesia	15	21
- S.W. Africa	20	-
- Uganda	20	-
- Zambia	485	620
Asia	38	15
- India	10	10
- Korea, Rep. of	-	5
- Turkey	28	5
Latin America	879	458
- Mexico	80	31
- Chile	544	378
- Peru	255	41

Source: Copper - Metal Bulletin, special issue. May 1965.

12. Primary zinc capacity in the developing world is of the order of 300,000 tons a year. Of this figure, about 130,000 tons is in Africa - (Congo, Zambia and Algeria), - and about 145,000 tons in Latin America (Argentina, Mexico and Peru). Except in mainland China and North Korea, no plants of any significance are known in Asia.

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13. Lead smelting is carried out on a much smaller scale than that of other non-ferrous metals. There is evidence that in a number of countries nominal capacity bears little relationship to production - the main constraint being mine production rather than smelting capacity. In addition, in some large-scale plants lead is smelted together with zinc: this may already be the case in Mexico.

14. There are three tin smelters in Malaysia (one in Butterworth-of about 55,000 tons). Nigeria has one smelter (Jos) of about 10,000 tons a year. The Congo has a smelter (Manono-Geomines) which produced about 10,000 tons during the war but now under 2,000 tons. There is reported to be a 6,000 - 7,000 tons smelter in Brazil (Volta Redonda - Comp. Estanifera do Brasil). However, (as with lead smelting) much of the capacity must be nominal. In addition, there are a number of small smelters of about 1,000 tons - in Mexico, Argentina, Bolivia, Peru, Southern Rhodesia, Morocco, Indonesia, Thailand and North Viet-Nam. Given the fairly nominal relationship between capacity and production it is difficult to comment much on capacity trends. In Bolivia a contract was signed with a firm in the German Federal Republic for construction within two years of a smelter at Oruro with an initial capacity of 7,500 tons.

SEMI-FABRICATING PRODUCTION AND CAPACITIES

15. Statistics on semi-fabricating activity are highly fragmentary in the developing countries, due to the small extent of this sub-sector and its frequent integration with primary production and fabricating. The almost total absence of information on scrap production and usage further complicates the picture. However, on the basis of available figures supplemented by very free estimation, the rates of growth in semi-fabricating (shown in Table 4) are considered to be indicative for the developing regions. In tonnage terms, zinc appears to occupy the leading position in both developing Africa and Asia. This reflects a relatively small share in imports of already semi-fabricated parts and the growth of the galvanizing industry in a number of developing countries. Aluminium, copper and lead appear to be semi-fabricated in roughly equal quantities in the developing countries. It appears that aluminium

semi-fabricating has not grown generally at a much faster rate than other semi-fabricating; this is contrary to the impression current in many quarters that the aluminium industry is growing much faster than that of other non-ferrous metals. Aluminium consumption is, however, growing faster than semi-fabricating.

16. Data on semi-fabricating capacity are very difficult to obtain and are of doubtful value since nominal capacity figures can give no information on the age and type of plant.

17. Also it is evident that some plants are used for more than one non-ferrous metal and for alloys, and so it is only partly meaningful to allocate plants between different metals. There is considerable overlap in both terminology and practice between semi-fabricating and fabricating facilities.

18. With this caution, some fragmentary figures are given in Tables 5 and 6 for aluminium and copper. They are based on special issues of Metal Bulletin of 1963 and 1965. The aluminium figures may be considerably out of date.

CONSUMPTION OF SEMI-FABRICATED PRODUCTS

19. It would be extremely difficult to estimate the metal content of fabricated items consumed in the developing countries. Although it would inevitably be higher than the metal content of semis consumed since fabricated metal products are imported on a considerable scale, it is unlikely that its corresponding rate of growth is higher in view of the import substitution policies being applied in many developing countries. And given the large share of relatively developed countries in regional totals, semi-products probably account for a large proportion of the total. It has been estimated that for copper the inclusion of the metal content of imported fabricated goods would raise the developing world's share of world consumption from 6 to 10%.

20. It will be noted from Table 7 that non-ferrous metal consumption (of semi-products) has in recent years been growing faster in the developing than the developed countries. This gap has tended to be widest for copper and

zinc, in both of which the developing world increased its share in world consumption by more than 1% between 1959 and 1964 (in spite of the cyclical upswing in the developed world). Should these trends continue, the developing countries' share in world consumption would exceed 10% in 1970 for copper, zinc and lead. In the period 1970, the change should not have much effect on the primary metal producing industries, but over a longer period the effects will be marked.

21. It is apparent from Table 7 that the developing world's share in aluminium and tin consumption is somewhat lower than for the other major non-ferrous metals. This no doubt reflects largely the composition of industrial output in these countries.

THE ECONOMIC SIGNIFICANCE OF NON-FERROUS METALS

22. The presence and the mining of ore may initiate a long sequence of industrial operations located in the developing countries, as follows:

(a) Beneficiation and smelting, sometimes also refining after smelting, producing saleable metal;

(b) Production of semi-products from the metal through melting, casting, hot and cold working, heat treatment or by direct production of finished castings;

(c) Manufacturing of finished products. (Outside the scope of this paper.)

Starting with mining, this is the classical interpretation of ore-based industrialization, a way of vertical and horizontal diversification of the industrial production. The actual importance of the non-ferrous metal industries in the economies of the developing countries will be analysed in the terms of employment, value added and foreign exchange.

Employment

23. Although statistics on employment in non-ferrous metal primary production and semi-fabricating are fragmentary in the extreme, it is clear that the importance of this sector in total employment is generally very slight indeed.

Very approximate estimations based on a variety of sources suggest that this sector may contribute about 1.2% of total manufacturing employment in developing Africa, about 0.1% in developing Asia and about 0.4% in Latin America. By comparison, the figure for the US is somewhat above 4%. These average figures for the developing regions, however, do not adequately reflect the skewed country distribution. The modal share for each region would be close to 0.1%, slightly above for Africa and slightly below for Asia and Latin America. A rough size of distribution is shown in Table 7A.

24. The share of total employment in this sector between primary production (smelting and/or refining) on the one hand and semi-fabricating on the other, varies considerably between regions. The primary share ranges from above 90% in developing Africa through about 75% in Latin America, down to below 40% in Asia. More comprehensive statistics might tend to reduce these shares of primary production.

25. For some individual developing countries, the primary sector has much greater importance. In Zambia, it contributes more than 50% of manufacturing employment, in Cameroon about 7%, in the Congo (Kinshasa) about 4%, in Chile about 2% and in Malaysia about 1%. These estimates are only very tentative, as there is considerable difficulty in separating mining (and attendant operations) from primary metal production in the employment statistics of some countries. It is evident that in the developing world this sector only contributes more than 1% to manufacturing employment in the case of major primary producing exporters. Even in those cases, however, the small importance of the sector is striking in every case except Zambia.

26. It is difficult to analyse the way in which employment is split between different non-ferrous metals because different metals are worked together by single establishments. However, a major difference emerges between developing Asia, in which aluminium manufacture probably contributes more than 30% of the total, and tin perhaps as much as 15%, and the other two regions in which aluminium and tin together contribute about 10% of the sector's employment. In Africa and Latin America, employment in copper predominates.

27. Employment in the sector has been rising in recent years fairly rapidly in Latin America (14-15% annually), but not very rapidly in developing Africa (about 5% annually) or developing Asia (6-7% annually). The average developing country is heavily dependent on movements in the primary smelting/refining sector. In Latin America, the growth of aluminium manufacturing has been very rapid in recent years. In the other regions, there has been slackening in the growth of employment in basic copper (Africa) and tin (Asia) in recent years. A more rapid growth may be expected over the next few years.

Value added

28. In a typical developing country, non-ferrous metal primary manufacture and semi-fabricating contribute only residually to the Gross National Product. The contribution to total value added in manufacturing, typically, is also very small. Table 8, based on very free estimates by The Economist Intelligence Unit, London (since no reliable published figures are available for most countries), groups a number of countries, roughly, by order of importance. In perhaps eight African countries, three Asian countries and two Latin American countries, value added in this sector contributes more than 1% of value added in manufacturing; probably only in four countries - Cameroon, Congo, Zambia and China (Taiwan) - does the sector contribute more than 1 per cent of GNP at factor cost. It is to be noted, however, that even in developed countries, primary non-ferrous manufacturing contributes only marginally to Total Final Demand. Even in the United States, where the sector is large in terms of tons produced, primary non-ferrous manufacturing contributes only 0.64 per cent to Total Final Demand, according to the United States Census of Production of 1958.

29. It might seem surprising that value added is not generally more important in this sector, not even where it is a major one. There are a few exceptions, including Zambia. But it is very difficult to analyse the Zambian industry, because copper smelting and refining are generally treated with mining: a rough estimate would be that the manufacturing operations contribute 25-30 per cent of total value added in mining and manufacturing and about 15 per cent of GNP at factor cost. In the Congo (Kinshasa), the sector may contribute slightly more than

30% of value added in manufacturing although probably less than 5% to GNP. In Cameroon, value added in the aluminium industry appears to contribute very little more than 1% of GNP in spite of its role in the balance of payments accounts. Fragmentary figures for China (Taiwan) suggest that the sector's contribution to GNP may be slightly more than 1%. The small share of this sector in contributing to GNP is due partly to the very small amount of employment generated, the relatively high cost in smelting of the ore or concentrate inputs and the very high energy consumption.

Export earnings

30. Several developing countries are extremely dependent on exports of non-ferrous ores and metals. The most critical cases are: Zambia, Bolivia, Chile and Congo (Kinshasa). Zambia's dependence on copper exports only is paralleled by that of certain petroleum exporters. The estimates in Table 9 include the value of ores as well as metal, but it is to be noted that the development of local smelting industries may actually increase the dependence of some countries on their export earnings from non-ferrous metals. Such a development has effects on the debit side of the balance of payments - raw material inputs, capital charges, repatriated profits and incomes - which may be considerable, and which in the case of aluminium are critically important.

PRICE AND MARKET CHARACTERISTICS

Prevailing price systems

31. In relation to world pricing, non-ferrous metals exhibit certain commodity characteristics which sharply differentiate them from some other primary commodities. First, they are durable and can be stocked indefinitely without deterioration, although at a cost. The second important characteristic of these metals is the existence of a competing source of supply - secondary metal obtained from scrap.

32. As to the prevailing price systems with some over-simplification one may distinguish copper and zinc, which have a dual price system -

producers' price(s) and LME prices; lead and tin, whose prices are mainly determined by the LME; and aluminium which is not traded on the LME but for which there are producers' prices. However, of course the LME is not the only metal exchange, and there are markets in particular areas and countries, particularly developing countries, which are more or less insulated from the major price systems. The European Economic Community operates most restrictively in the case of aluminium and has varying tariffs against semi-products. In the Far East, the Japanese market and primary industry are large enough and isolated enough from European and North American markets for a semi-independent price structure to obtain. The Japanese price structure has some influence in other Far Eastern countries.

33. The role of some centrally planned economies in pricing has at times been important and may be so again in the future. The metals most concerned have been tin and aluminium. In tin, they have traditionally been net exporters - chiefly mainland China. In recent years the net flow has been small, although the flow from mainland China has tended to increase.

Market characteristics

34. Apart from the supply of secondary metal, however, the developed countries are considerable primary metal producers from domestic ores, and have considerable domestic ore reserves. Thus, in addition to competition from synthetics or from processes reducing the raw metal content of finished metal goods, any policies pursued by developing metal or ore producers which had the effect of raising the c.i.f. price of ingot metal of developed countries would run considerable risk of provoking increased high cost production. This market weakness of the developing producers is greatest for aluminium and least for tin.

35. In recent discussion of the effects of price movements on consumption for these metals, the view has tended to prevail that short-term price movements in themselves are as important as the actual price level. There are of course limits to the range of prices within which such a generalization could apply,

and it may in part be a rationalization of an inability to establish more reliable price elasticities.

36. These considerations provide an important justification for stable prices from a consumer point of view. From the producers' point of view, the need of stable prices is just as important - in development planning of investment and in projecting foreign exchange flows. In the case of aluminium, the developing export producers have to some extent mitigated this problem by long-term contracts with individual major firms which shift some of the risk (and attendant profit) to these firms, Alucam - Cameroon, Valco - Ghana, Suralco - Surinam.

37. An important consideration may be the inflationary impact of high but fluctuating prices in those industries where employment is considerable - the mining operations of copper, lead, zinc and tin production. At times when metal prices are high (e.g. 1965, 1966) it is difficult to resist wage settlements which would not be reached if longer term average prices were the decisive factor. There may, however, be priority conflicts here, apart from the need to avoid inflation and ensure smooth planning, for some developing countries and for some - capital intensive - projects the present value of high export receipts in the short run is very much more than the (nominally) same value received over a longer period. That is, the implicit discount rate should be very high.

38. This conflict could be represented in part as one of choosing between maximising short or long - run earnings, the choice being implicitly dependent on the discount rate assumed. Superimposed on this, however, is a problem of rigidities which occurs in any economy - wages can be raised but not lowered, employment and employment expectations can be created, but it is dangerous to reduce employment. This latter problem points clearly towards stable prices unless a particular case could be made out for unbalanced growth initiated in the export sector. However, the arguments for stable prices are reinforced by the demand considerations in the developed markets, outlined above.

39. Given the important cyclical effects of demand and the political and economic factors affecting developing suppliers, however, a pre-requisite for stable prices is adequate stocks and finance on the part of those administering the stable price policy and a willingness by producer and consumer countries to accept regulation of supply.

Price developments

40. Aluminium prices vary widely through the world in spite of their considerable stability in major world markets. This partly reflects far-reaching integration of the industry from mining through semi-fabricating. The following table shows some price differences for ingot metal in 1963 ($ per ton):

United States	507	Mexico	589
United Kingdom	507	Brazil	635
France	510	Cameroon	410
India	656 - 700	Norway	444
Japan	616		

Alongside the producer prices recently have been discount prices which in 1965 may have sometimes been $50 per ton below the normal price. In part these may be prices paid for Soviet aluminium sold to independent semi-fabricators. Some commentators talk of a "free" price, reflecting the inability of big producers wholly to control the market. The developing countries could be doubly disfavoured by such a system because, being individually of marginal importance to world trade, they may tend to buy at the highest and sell at the lowest price.

41. In India, where the domestic aluminium industry supplies the bulk of domestic supplies, fair ex-works prices for domestic producers are estimated at regular intervals on the basis of actual costs of the Tariff Commission as a basis for assessing the appropriate level of tariff protection, currently 35% ad valorem. The producers however then appear to be free to fix their own prices, not necessarily at the fair ex-works price.

42.4 The effects of recent price developments in copper are difficult to judge, as also are likely future price developments. The UN/ECA/FAO Zambia mission, writing in the opening months of 1964 when the Zambian producers' price was

about £250 a long ton, considered that price might rise to some £280 a long ton (which it did in 1964) with only very little substitution. Above this price the losses in sales to substitute might become serious, and above £300 a ton the price elasticity would reach or exceed unity, so that any further rise in price led to a more than proportional fall in volume and a fall in value of sales.

43. A number of qualifications are necessary. First, it was assumed that other competing prices remained constant: this has not happened, although the rise in copper prices since 1964 and 1965 has far exceeded that of other non-ferrous metals. Second, it was assumed that these substitution parameters would take time to work through. Third, however, the experts did not state whether these effects were net of the underlying growth in demand. If they were meant to be net effects, then they seem clearly false in the light of subsequent trends.

44. Primary tin prices have tended to rise since 1958 and in 1965 averaged about $3,863 a ton on the LME. The Third International Agreement in 1966 decided on a buffer stock price range of £1,100-1,400 per long ton ($3,009-3,829 per metric ton) for the period 1965-70. The Second Agreement's price range was £1,100-1,200 ($3,060-3,282) but by 1964 the buffer stock was exhausted and the average price range was above the ceiling. The new price range represents a compromise between consumer and producer interests, but it is probably implicit in the agreement that the effective floor will be £1,200 ($3,282) since the buffer stock manager may begin purchasing at this price (he must purchase at £1,100). In recent discussions of tin prices, there has been considerable acceptance even by consumers of the view that prices in the order of $3,300 must be a minimum for the next few years if a steady supply of primary tin (somewhat greater than the present level) is to be maintained. This is a considerable change from the levels implicitly accepted as desirable when the Second Tin Agreement was established in 1960, and reflects both supply difficulties in some major producing countries - Bolivia, the Congo and Indonesia, in particular - and the effects on demand

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of the prolonged economic upswing in the US.

45. It may be wondered, however, whether the average price will not remain for a year or so in the selling end of the buffer stock range or above. The major producers have tended to express the view that a further rise in average prices may be necessary to finance modernisation and consolidation of major mines and to ensure the viability of small-scale mining. It is difficult to form an opinion on this. The Robertson Report, produced under the auspices of the ITC, and based on questionnaires to governments and completed in 1963, attempted to make projections of supply and demand on the basis of alternative prices of £700 and £1,100 per long ton. The aggregate conclusions for the world were (except for centrally planned economies) ('000 long tons):

	1965		1970	
	£700	£1,100	£700	£1,100
Production	147-155	158-165	135-152	163-183
Consumption	165-170		184.5-200.5	

It will be noted that these projections have, in the case of 1965, already been falsified by events. The world output in 1965 (centrally planned economies not included), as estimated by ITC, was 152,000 tons, while the average price was some £1,413 and primary consumption may have been some 167,000 tons.

THE INSTITUTIONAL FRAMEWORK

Public and private sectors

46. The primary non-ferrous metal industry in developing countries has been hitherto largely owned and managed by expatriate international companies. With some exceptions indicated below, finance has come mainly from these external sources or from re-invested foreign exchange export earnings. The industry is to a large extent integrated with mining which is the predominant partner and the major user of investment funds. As a result only fragmentary figures are available on the flow of investment to the manufacturing sector.

47. Aluminium reduction in the developing world has been very largely a

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private sector operation. If the public sector Chinese (mainland) and North Korean facilities are excluded, the only public sector smelter in operation is thought to be Talce in China (Taiwan) (20,000 tons). This is wholly government-owned. This situation will change as several Indian public sector plants are scheduled to come into operation in the period to 1970. The projected Iranian smelter would be majority-owned by the Governments of Iran and Pakistan, while the projected smelter in the Republic of Korea would probably have government participation. In Africa, the possible U.A.R project would presumably be wholly in the public sector, It seems likely that presently envisaged Latin American projects will have majority private sector ownership.

48. It is much more difficult to analyse the role of foreign private and public capital in existing and projected aluminium smelters. First it seems clear that all the existing plants in the developing countries (excepting North Korea and mainland China for which data is not available) have close technical links to one or another of the major Western producers. In the case of Alucam in Cameroon the collaboration is with a consortium, although Pechiney is the dominant party.

49. The dependence of the developing countries' aluminium industries on the small number of big international companies, is a reflection of the high capital intensity of the industry and also of the lack of integration in their aluminium industries. In the case of present and potential African producers, of Asian producers outside India, and of Surinam, Venezuela or Guyana, the dependence for the foreseeable future on export markets in the developed countries dominated by the big firms is critical. This dependence stems both from the insufficiency of domestic markets and also from the need to earn foreign exchange to service the capital investment. It is typically written into the original contracts for establishing these plants that the foreign collaborator will have first call on the output.

50. Somewhat less than 90,000 tons, or 5%, of the developing world's copper smelter capacity in 1965 was state owned. Of this, 54,000 tons was contributed by ENAMI (Chile) and 28,000 tons by Etibank (Turkey). In addition, the

Mexican Government had holdings in the Conception del Oro smelter of 25,000 tons. A slightly higher tonnage of refining capacity was state owned, with ENAMI contributing 80,000 tons, Etibank 9,000 tons and the Republic of Korea Government 5,000 tons. Expatriate companies own or manage a very high proportion of smelter and refining capacity.

51. The "Chileanisation" laws passed in 1966 will, if fully carried into effect, profoundly affect the institutional framework of the copper industry in that country.

52. The primary tin smelting industry has up to now been even more concentrated in the hands of a few large companies than other non-ferrous smelting industries.

53. This situation may be changing somewhat now with the setting up of smelters in Thailand and Indonesia. Both are likely to have exclusive rights to smelt local ores. In October 1965 the Bolivian Government stated that its policy was to have all the country's ore smelted domestically. If these projects are fully realised, they will serve to reduce the monopoly elements that up to now have been a feature of this industry, as well as to increase the contribution of tin to the industry of these countries. On the other hand, as indicated elsewhere, value added in smelting non-ferrous ores is relatively small, and Bolivian ores in particular have traditionally proved technically complex and difficult to smelt. Moreover, the setting up of smelters in these countries - particularly Bolivia - will in the short run increase their economic dependence on tin exports.

Custom smelting

54. In aggregate in the developing world, custom smelting is relatively unimportant. A custom smelter does not own the sources of the ore he uses and may not even have large contracts to purchase ores from particular mines. In the developing countries, integrated ownership of mines and smelters has tended to predominate for copper and lead. In the case of tin, custom smelting has predominated in Asia, in Bolivia and in Nigeria. For zinc, the pattern varies considerably from region to region, but custom smelting

is important in some cases. Most aluminium smelting is not custom smelting, since the requirements of nearly full capacity operation have led mainly to captive alumina sources or bulk long term contracts.

55. Nevertheless, custom smelting seems likely to have an important continuing role in some developing countries. In some, the smelter is operated by a state concern; for example the ENAMI smelters at Paipote and Las Ventanas in Chile are understood to have participated in a zinc smelter operated by the Cia Minera Macucozac. The importance of custom smelting to a developing country may normally be that it allows the continued existence of small-scale (generally more labour-intensive) mining sectors alongside the large-scale sectors in those countries where private ownership of small mines or of rights to mine is judged to be important. Even if mining is a public sector activity it may still be that a central government authority or a private company will have the relationship of a custom smelter to local public mining enterprises. It may be that this will be the type of relationship which will be found to be suitable in Algeria, after the recent nationalization of private mines.

56. A variant of custom smelting is <u>toll smelting</u> in which the smelter does not actually purchase the concentrate or metal but merely charges a fee for smelting or refining it. This is at present the case with Indian zinc production, which is shipped under contract to Japan for smelting. Perhaps somewhat hypothetically, the arrangement between the Volta River authorities and Valco has in some contexts been described in the language of a toll arrangement, with Valco charging a fee per ton of alumina smelted. This seems likely to be a fairly nominal toll arrangement, since: first, Valco is under a contract obligation to smelt a certain volume (or at least to purchase a certain volume of electricity), second the alumina seems likely for several years at least, to be imported (from captive Kaiser sources); and finally, the bulk of the aluminium smelted will presumably have to be sold by Kaiser on international markets in order to earn the foreign exchange with which the electricity is to be purchased.

Regional and sub-regional co-operation and integration

57. The prospects of regional and sub-regional co-operation and integration are largely determined by the predominance of traditional patterns in this sector between developing primary producers and developed manufacturing countries.

58. This predominance reflects itself in the importance of the big international companies in aluminium, copper, tin and zinc, in the almost complete dependence hitherto of the developing countries on the flow of private foreign capital to develop the industry. In some areas, principally in Africa, the prevalence of traditional currency arrangements and preferential trading arrangements between developed and developing countries is still important. In the case of the EEC and its Associated Overseas Countries, there are now two aluminium smelters in the developing world (Cameroon and Surinam) whose almost exclusive function is to supply aluminium to EEC countries under the preferential AOC tariff system. It appears that Cameroon's aluminium would now compete on a price basis in African and world markets, and there is a limited but growing local trade. Nevertheless, well over 90% of the production continues to flow to EEC countries.

59. In typical cases of export producers, the export of metal to developed countries is the means of servicing the foreign capital invested in the industry. In the opinion of observers, only to a limited extent would it be possible to alter the trading pattern to promote local integration unless the sales with the integrated market were for hard currency. In some cases there are additional advantages to primary producers from export sales to developed countries: payments of taxes and royalties to the developing country tend to be paid more promptly (it has been suggested) if export of metals is arranged under traditional patterns by the international companies.

60. There is some evidence that freely convertible currency arrangements have hampered the development of this sector in some areas. In the franc zone or the currency board system applicable in some parts of the sterling area, it may be that the freedom to remit profits and capital has not promoted

the development of the smaller-scale semi-fabricating activities and has led to a higher proportion of the capital in large-scale smelting and refining being held abroad and a higher proportion of the profits being remitted. It seems that hitherto such currency arrangements in parts of the franc zone and sterling area have not sufficiently encouraged the employment of local labour or the input of local raw materials.

61. As to some specific initiatives, regional co-operation and integration in relation to the domestic market has been proposed, e.g. in the field of aluminium, at the regional conferences on industrialization. The primary aluminium industry appears to require minimum scales of plant capacity in excess of most developing countries' markets. Regional co-operation is necessary, if aluminium plants are to be established to supply local markets. Over and above the existing firm plans in developing regions, probably only one more project is feasible in Africa, one or two more in Asia and two or three in Latin America in the period to 1975, unless firm export markets in the developed countries were guaranteed.

62. ECAFE aluminium experts have recommended the establishment of a regional organisation. Establishment of a permanent inter-governmental committee and an Aluminium Advisory Committee (representing international companies) is suggested by an ECA expert.

63. At the level of semi-fabricating, some types of plant can be set up in most developing countries by 1970 to 1975, since the scale need not be more than 2,000 to 3,000 tons. In some cases, where regional markets are relatively well integrated, a joint project can be recommended. But freight is always an important factor in marketing these metals. Further, it may well be in some cases (as in Africa) the existence of a really local semi-fabricating plant will help to generate a local market which might not be generated if supplies needed marketing from some distance. Especially in the case of aluminium, present consumption levels are low, not simply because of low income levels, but because the market has not been actively stimulated at the local level.

TRENDS AND PROSPECTS

Aluminium

64. Consumption: Per caput consumption levels in developing African countries (at about 150 gms per annum) are among the lowest in the world, reflecting partly the very low average incomes, and partly the lack of fabricating and semi-fabricating facilities. Aluminium has special advantages in the developing Africa context which could lead to very rapid growth, including corrosion resistance and lightness, which make it suitable for low-cost housing applications, transport and electrification. If the past approximate relationship between GNP and aluminium consumption were taken together with semi-official ECA targets of 5.5 per cent compound GNP growth, the projected consumption growth would be about 7 per cent annually. A realistic maximum growth rate taking into account substitution in new uses might be some 15 per cent annually. On the other hand, if recent trends were straightforwardly extrapolated, the average annual growth would be 4 per cent.

65. These alternative projections give the following results ('000 tons) for Africa:

At average annual growth (per cent) of:

	4		7		15	
1964	1970	1975	1970	1975	1970	1975
34	43	52	51	71	79	158

Aluminium consumption is growing at nearly 12 per cent annually in developing Asia, and continuing growth of this order may be expected over the period to 1975. This would give ('000):

	1964	1970	1975
Developing Asia	290	563	983
- excluding mainland China	190	369	644

/...

66. Projections of Latin American aluminium consumption are complicated by difficulties in estimating the base year figure. The EIU 1964 estimate, 120,000 tons of semi-product, is well below the ECLA experts' 1963 figure of 125,000 tons. The discrepancies principally concern Brazil. The range of plausible forecasts for 1970 and 1975 for Latin America as a whole is thus rather wide, as is shown in the following table ('000 tons):

	1970	1975	Assumed rate of average annual growth %
ECLA experts	265	442	10.6
EIU base: i) at ECLA growth rate	220	365	10.6
ii) at 1959-1964 rate	211	341	9.9

The developing world's share of world aluminium consumption is likely to increase but not dramatically, assuming, as in the table below, a world growth rate for consumption of 8.5%. This is the trend 1959-1964 rate and is roughly in line with other projections and with informed opinion.

World Aluminium Consumption

	Assumed rate of growth % per annum	'000			% of Total		
		1964	1970	1975	1964	1970	1975
World:	8.5	7,500	12,300	18,500	100	100	100
Developing countries	11.2	444	834	1,419	5.9	6.8	7.7
Africa	7.0	34	51	71	0.5	0.4	0.4
Asia	11.7	290	563	983	3.9	4.6	5.3
Latin America	10.6	120	220	365	1.5	1.8	2.0

Copper

67. World copper consumption is projected to rise at some 4.5 per cent annually over the 1964-1975 period.

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World Copper Consumption

	Assumed annual rate of growth per cent	'000			% of Total		
		1964	1970	1975	1964	1970	1975
World:	4.5	5,280	6,917	8,606	100	100	100
Developing countries	8.0	368	581	852	7.0	8.4	9.9
Africa	9.1	30	50	77	0.6	0.7	0.9
Asia	8.0	226	359	529	4.3	5.2	6.1
Latin America	7.4	112	172	246	2.1	2.5	2.9

Lead

68. Future consumption prospects for lead are much affected by the possibility of substitution in its more important uses, even in paint and batteries. The projections shown below are illustrative of recent past trends. Asian growth seems to have been more rapid than in the other developing regions.

Lead Consumption

	Assumed annual rate of growth per cent	'000 tons			% of Total		
		1964	1970	1975	1964	1970	1975
World:	3.7	3,600	4,464	5,328	100	100	100
Developing countries	4.4	337	445	565	9.4	10.0	10.6
Africa	0.6	42	43	45	1.3	1.0	0.8
Asia	6.9	157	236	328	3.7	5.3	6.1
Latin America	3.0	138	166	192	4.0	3.7	3.7

Zinc

69. Projected rates of growth in zinc consumption are relatively high for each of the developing regions. The bulk of consumption growth has been in galvanising, a fairly small-scale activity. This trend seems likely to continue, although it may be that in sheeting products aluminium should and will supplant galvanised iron to some extent.

Zinc Consumption

	Assumed annual rate of growth per cent	'000 1964	1970	1975	% of Total 1964	1970	1975
World:	5.5	4,250	5,865	7,610	100	100	100
Developing countries	9.2	370	644	1,033	8.7	11.0	13.6
Africa	16.0	39	92	188	0.9	1.6	2.5
Asia	9.0	223	375	578	5.2	6.4	7.6
Latin America	8.5	108	177	267	2.6	3.0	3.5

Tin

70. Tentatively, the following projections are suggested, although they are considerably different from semi-official ITC forecasts.

Tin Consumption

	Assumed annual rate of growth per cent	'000 tons 1964	1970	1975	% of Total 1964	1970	1975
World:	1.7	1,740	1,914	2,105	100	100	100
Developing countries		34	40	49	2.0	2.1	2.3
Africa	1.2	5	5	6	0.3	0.3	0.3
Asia	3.3	21	26	32	1.2	1.3	1.5
Latin America	2.6	8	9	11	0.5	0.5	0.5

Aggregate Supply of Copper, Lead, Zinc and Tin

71. The question of aggregate world supply of copper, lead, zinc and tin is largely outside the scope of these papers, since it concerns mining rather than metal production. Very broadly speaking, it is probable that world mine capacity will be adequate for projected consumption in 1970 and 1975, although the world market may still be uncomfortably sensitive to political development in and around a small number of States. One can recommend that developing producers as a whole should maximise co-operation whether in situations of tight or spare capacity, in view of the need to maintain stable prices.

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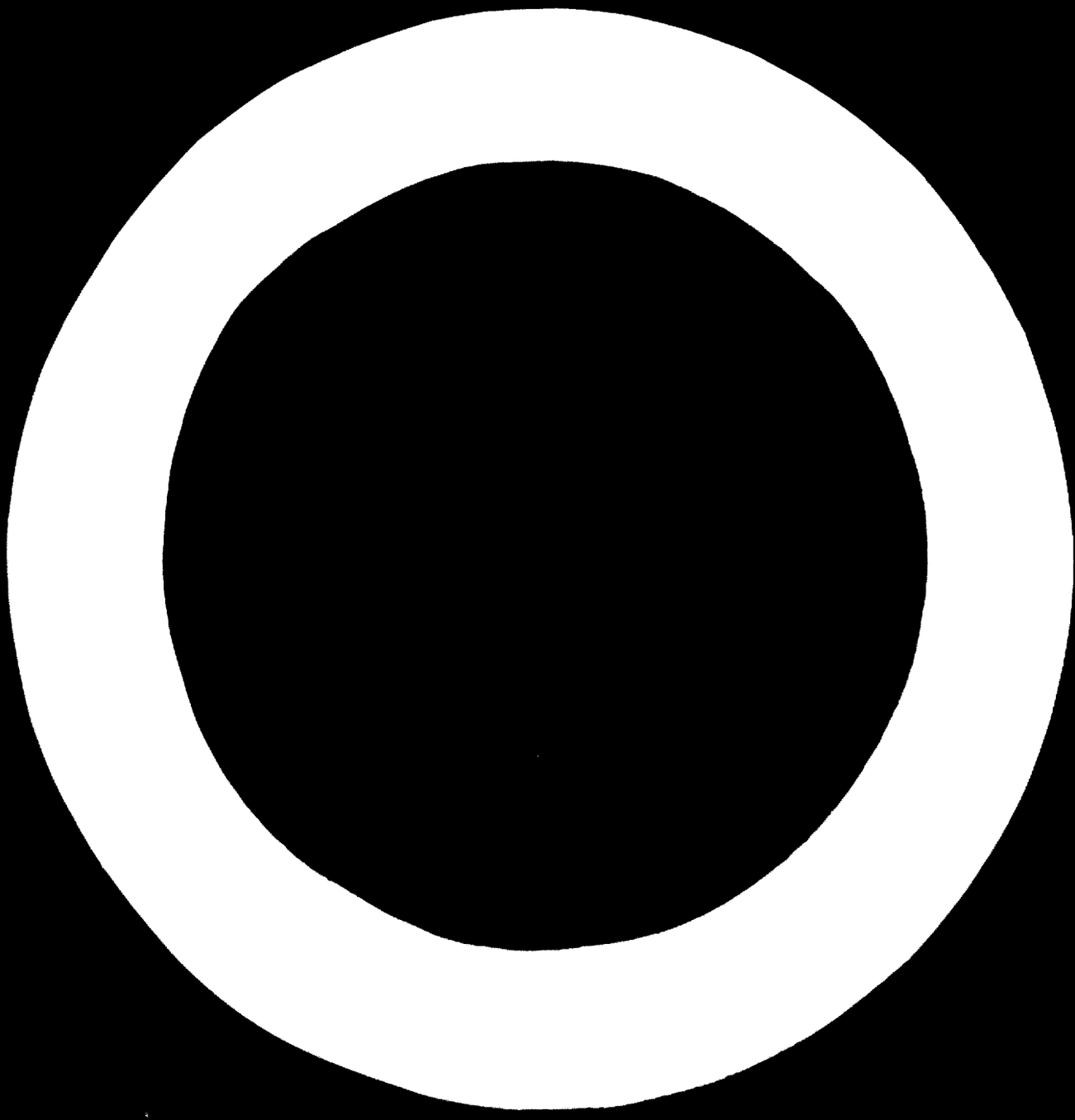


Table 1

Primary metal production

	Aluminium			Copper			Lead			Zinc			Tin		
	1959 ('000 tons)	1964	Average annual % change 1959-64	1959 ('000 tons)	1964	Average annual % change 1959-64	1959 ('000 tons)	1964	Average annual % change 1959-64	1959 ('000 tons)	1964	Average annual % change 1959-64	1959 ('000 tons)	1964	Average annual % change 1959-64
World:	4,040a/	6,000a/	8.1	3,585	4,700	3.6	2,180	2,600	2.9	2,800	3,700	5.7	138	170	4.2
Developing countries	153	270	12.0	1,499	1,879	4.6	471	541	2.8	268	413	9.0	77	116	8.5
Africa	42	52	4.4	824	968	3.3	64	91	7.3	91	119	5.5	4	11	2.70
Asia	99a/	173a/	13.2	83	132	9.7	126	148	3.2	84	155	13.0	70	98	6.9
Latin America	16	45	290.0	592	779	5.6	281	302	1.5	93	139	8.4	3	7	2.52
	per cent			per cent			per cent			per cent			per cent		
World:	100	100		100	100		100	100		100	100		100	100	
Developing countries	3.7	4.6		41.8	39.9		21.6	20.8		9.6	11.2		55.8	68.2	
Africa	1.0	0.9		23.0	20.6		2.9	3.5		3.3	3.2		2.9	6.5	
Asia	2.3	2.9		2.3	2.8		5.8	5.7		3.0	4.2		50.7	57.6	
Latin America	0.4	0.8		16.5	16.5		12.9	11.6		3.3	3.8		2.2	4.1	

a/ North Korean production is excluded since no details are available.

Table 2

Metal content of ore produced

	Copper		Lead		Zinc		Tin	
	1959	1964	1959	1964	1959	1964	1959	1964
Quantities ('000 tons)								
World:	3,600	4,600	2,300	2,500	3,100	3,900	141	171
Developing countries	1,668	2,019	793	320	826	1,021	133	162
Africa	879	967	275	247	212	269	17	18
Asia	133	190	146	201	167	243	91	117
Latin America	656	862	372	372	447	509	25	27
Shares (%)								
Developing countries	46.3	43.8	34.4	32.8	26.6	26.2	94.3	94.6
Africa	24.4	21.0	11.9	9.9	6.8	6.9	12.1	10.5
Asia	3.7	4.1	6.3	8.0	5.4	6.2	64.5	68.4
Latin America	18.2	18.7	16.2	14.9	14.4	13.1	17.7	15.7

Table 3

Primary metal production in developing regions, 1964
(in thousand tons)

	Al	Cu	PB	Zn	Sn	Total
DEVELOPING AFRICA						
Algeria	-	-	-	12.0	-	12.0
Cameroon	52.0	-	-	-	-	52.0
Congo (Kinshasa)	-	272.6	-	54.7	1.4	328.7
Kenya	-	1.4	-	-	-	1.4
Morocco	-	-	18.5	-	-	18.5
Nigeria	-	-	-	-	8.7	8.7
Southern Rhodesia	-	15.0	-	-	0.5	15.5
S.W.Africa	-	28.1	47.0	-	-	75.1
Tunisia	-	-	11.9	1.0	-	12.9
Uganda	-	18.0	-	-	-	18.0
Zambia	-	633.2	13.0	46.0	-	692.2
Total	52.0	968.3	90.4	115.7	10.6	1,235.0
DEVELOPING ASIA						
Burma	-	-	17.8	-	-	17.8
China	100.0	75.0	85.0	90.0	25.0	375.0
India	54.3	9.5	3.6	-	-	67.4
Indonesia	-	-	-	-	1.8	1.8
Israel	-	7.9	-	-	-	7.9
Korea, N.	-	10.0	40.0	65.5	-	115.5
Korea, Rep. of	-	2.6	-	-	-	2.6
Malaysia	-	-	-	-	71.4	71.4
China (Taiwan)	19.1	1.5	-	-	-	21.0
Turkey	-	25.6	1.1	-	-	26.7
Total	173.4	132.3	147.5	155.5	98.2	707.1
LATIN AMERICA						
Argentina	-	-	22.6	21.9	0.1	44.6
Bolivia	-	-	-	-	2.5	2.5
Brazil	25.0	1.5	15.0	-	2.1	43.6
Chile	-	577.8	-	-	-	577.8
Mexico	14.5	50.2	167.3	58.5	1.2	291.7
Peru	-	149.7	88.3	58.8	-	296.8
Total	39.5	779.2	293.2	139.5	5.9	1,257.0

Table 4

Growth of non-ferrous semi-fabricating

Average annual percentage change 1959-1964

	Al	Cu	Pb	Zn	Sn
Developing:					
Africa	5.5	10.5	0.3	25.0	5.9
Asia	5.4	2.9	6.1	10.7	4.3
Latin America	13.0	4.2	3.0	4.2	-3.4

Source: EIU estimates

Table 5

Aluminium semi-fabricating capacity - 1962

	Number of plants reported with capacities (tons) of:							
	Not Stated	Below 500	500-900	1,000-1,900	2,000-4,900	5,000-9,900	over 9,900	All sizes
Africa								
Algeria	4	-	-	-	-	-	-	4
Congo (Kinshasa)	-	1	-	-	-	-	-	1
UAR	2	-	-	-	1	-	-	3
Ghana	-	1	-	-	-	-	-	1
Ivory Coast	-	1	-	-	-	-	-	1
Kenya	-	-	-	-	1	-	-	1
Nigeria	-	-	-	-	-	1	-	1
Tanzania	-	-	-	-	-	1	-	1
Asia								
Ceylon	1	-	-	-	-	-	-	1
Hong Kong	2	-	-	1	-	-	-	3
India	22	-	3	-	8	1	2	36
Indonesia	-	-	-	-	1	-	-	1
Iran	-	-	1	-	-	-	-	1
Israel	5	-	-	-	1	-	-	6
Korea, Rep. of	-	2	1	-	-	-	-	3
Lebanon	2	-	-	-	-	-	-	2
Malaysia	-	-	-	-	1	-	-	1
Pakistan	1	3	-	1	-	-	-	5
Philippines	-	-	-	-	-	1	-	1
China (Taiwan)	-	-	-	-	-	-	1	1
Thailand	-	-	-	1	-	1	-	2
Turkey	2	-	-	-	-	-	-	2
Latin America								
Mexico	4	-	2	1	1	1	1	10
Cuba	2	-	-	-	-	-	-	2
El Salvador	-	-	1	-	-	-	-	1
Argentina	-	4	4	2	1	2	1	14
Brazil	1	1	1	3	2	1	1	10
Chile	1	-	1	1	-	-	-	3
Colombia	2	-	-	1	2	-	-	5
Peru	1	-	-	-	-	-	-	1
Uruguay	2	-	-	-	1	-	-	3
Venezuela	-	-	1	-	-	1	1	3

Source: Moment E/CN.14/AS/11/2/J 28 Oct 1965. Based on al Bulletin, Aluminium Issue, 1963.

Table 6

Copper semi-fabricating capacity - 1964

	Number of plants reported with capacities (tons) of:							
	Not stated	below 1,000	1,000-4,900	5,000-9,900	10,000-19,900	20,000-29,900	30,000+	All sizes
Africa								
Algeria	3	-	-	-	-	-	-	3
Morroco	1	-	-	-	-	-	-	1
Rhodesia	-	-	-	-	1	-	-	1
UAR	4	-	-	1	-	-	-	5
Asia								
India	38	-	6	1	2	2	1	50
Iran	1	-	-	-	-	-	-	1
Israel	6	-	2	-	-	-	-	8
Korea, Rep. of	2	2	1	2	-	-	-	7
Malaysia	-	-	1	-	-	-	-	1
Philippines	3	-	1	-	-	-	-	4
Pakistan	7	-	1	-	-	1	-	9
China (Taiwan)	7	-	-	-	-	-	-	7
Thailand	2	-	-	-	-	-	-	2
Latin America								
Argentina	-	-	1	2	1	-	-	4
Brazil	4	5	8	1	2	-	-	20
Chile	3	-	1	-	1	-	-	5
Colombia	3	-	1	-	-	-	-	4
Cuba	1	-	-	-	-	-	-	1
Ecuador	1	-	-	-	-	-	-	1
El Salvador	1	-	-	-	-	-	-	1
Mexico	14	-	-	1	2	-	-	17
Puerto Rico	1	-	-	-	-	-	-	1
Peru	1	-	1	-	-	-	-	2
Uruguay	2	-	-	-	-	-	-	2
Venezuela	-	-	2	-	-	-	-	2

Table 7

Apparent consumption of semi-fabricated products

	Aluminium			Copper			Lead			Zinc			Tin		
	1959	1964	average annual % change 1959-64	1959	1964	average annual % change 1959-64	1959	1964	average annual % change 1959-64	1959	1964	average annual % change 1959-64	1959	1964	average annual % change 1959-64
	('000 tons)			('000 tons)			('000 tons)			('000 tons)			('000 tons)		
World	5,000	7,500	8.5	4,240	5,280	4.5	3,000	3,600	3.7	3,250	4,250	5.5	1,600	1,740	1.7
of which:															
-developing countries	270	444	10.5	251	368	8.0	271	337	4.4	236	370	9.2	29	34	2.8
of which in:															
-Africa	28	34	3.9	19	30	9.1	40	42	0.6	19	39		5	5	1.2
-Asia	167	290	11.7	154	226	8.0	112	157	6.9	145	223	9.0	17	21	3.7
-Latin America	75	120	9.9	78	112	7.4	119	138	3.0	72	108	8.5	74	84	2.6
	(per cent)			(per cent)			(per cent)			(per cent)			(per cent)		
World	100	100		100	100		100	100		100	100		100	100	
of which:															
-developing countries	5.4	6.0		5.9	7.0		9.0	9.4		7.3	8.7		1.9	2.0	
of which in:															
-Africa	0.6	0.5		0.5	0.6		1.3	1.2		0.6	0.9		0.3	0.3	
-Asia	3.3	3.9		3.7	4.3		3.7	4.4		4.5	5.2		1.1	1.2	
-Latin America	1.5	1.6		1.7	2.1		4.0	3.8		2.2	2.6		0.5	0.5	

Source: United Nations Statistical and Trade Year books. United States Bureau of Mines. United Kingdom Overseas Geological Surveys. National statistics - EIU estimates.

Table 7a

Employment in non-ferrous metals[a/] as a percentage of total manufacturing employment

	More than 1.0	0.5 - 0.99	0.1 - 0.49	0.01 - 0.09
Africa	Cameroon Congo Zambia	Algeria Nigeria Uganda	Kenya Southern Rhodesia Tanzania Tunisia	Ghana Sudan U.A.R
Asia		Malaysia	Burma India Indonesia Israel Lebanon China (Taiwan) Thailand	Ceylon Hong Kong Jordan Pakistan Philippines Republic of Korea Turkey
Latin America	Chile	Peru	Argentina Brazil Mexico	Bolivia Colombia Uruguay Venezuela

Source: E.I.U. estimates, partly based on national and United Nations statistics.

a/ Smelting refining and semi-fabricating

Table 8

Value added in non-ferrous metal manufacture[a] as a percentage of total value added in manufacturing

	More than 1.00	0.50 - 0.99	0.10 - 0.49	Less than 0.10
Africa	Algeria Morocco Nigeria Uganda Congo (Kinshasa) Tunisia Tanzania Zambia[b]	Kenya Southern Rhodesia		Sudan
Asia	Burma Malaysia India[c]	Israel Pakistan Thailand Korea (Rep. of) Philippines	Jordan Iraq	
Latin America	Bolivia Peru	Argentina Colombia Uruguay Chile Mexico Venezuela		

Source: E.I.U. estimates, United Nations national accounts

a/ Smelting, refining and semi-fabricating.

b/ Mining and manufacturing.

c/ Industry, not manufacturing.

Table 9

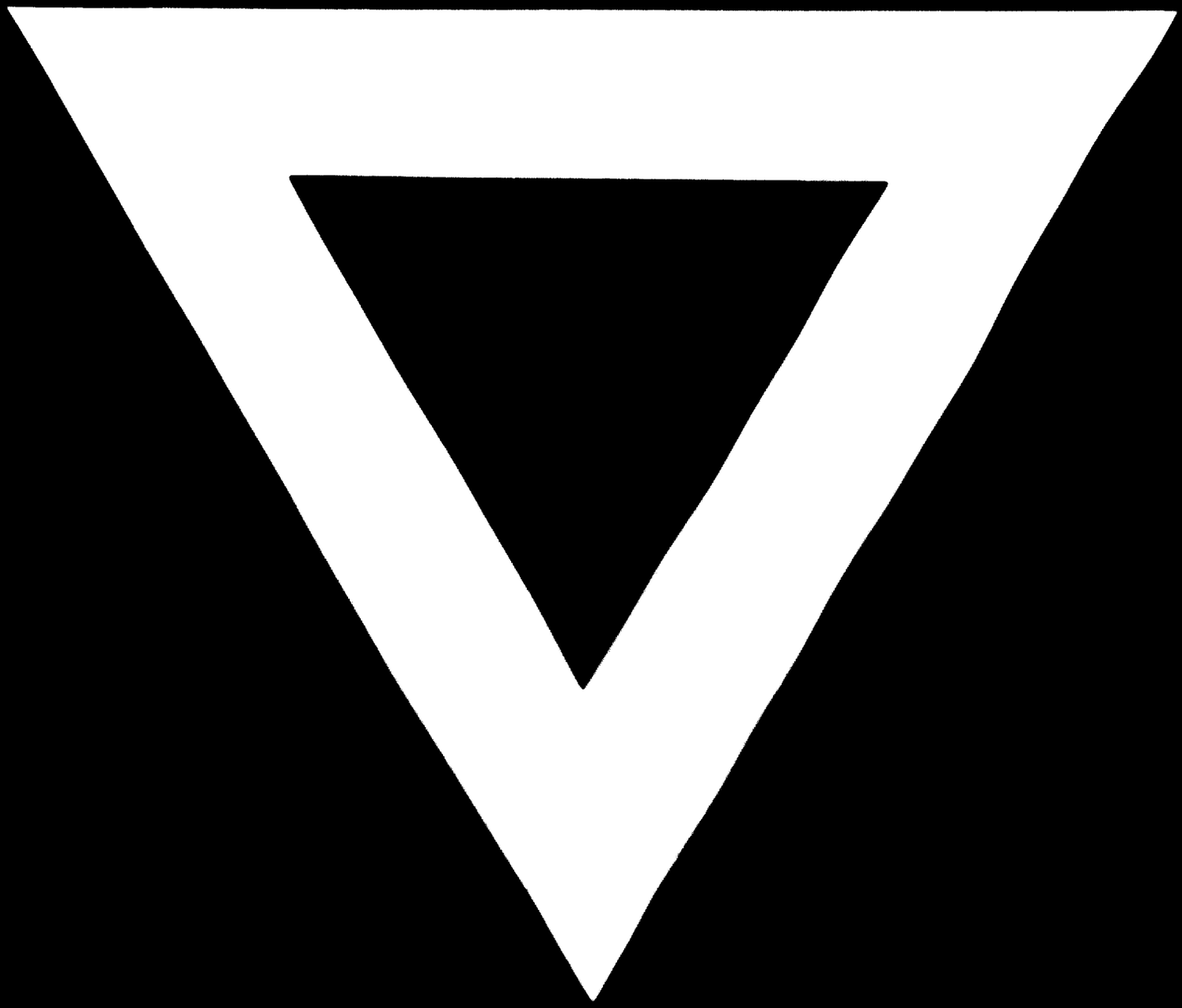
Value of exports of non-ferrous[a] ores and metal as percentage of total commodity exports (1965)

Zambia[b]	91
Bolivia[c]	79
Chile[b]	69
Congo (Kinshasa)[b]	60
Jamaica	46
Peru	24
Malaysia[c]	22
Cameroon	17
Uganda	13
Thailand	9
Mexico	7
Tunisia	4

Source: International Monetary Fund. International Financial Statistics.

a/ Aluminium, copper, lead, tin, zinc.
b/ 1963
c/ 1964

Note: Owing to omissions, some of the estimates are understatements.



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