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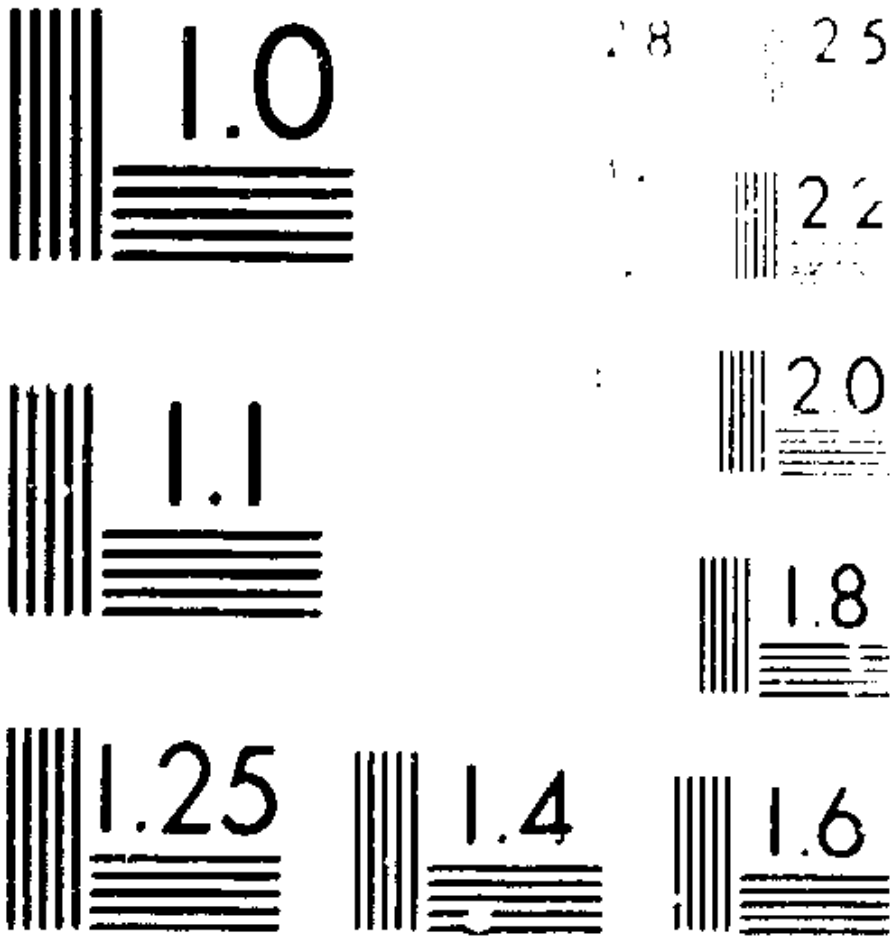
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STATUS OF

THE SEMI-PRODUCTS ALUMINIUM INDUSTRY

IN SOME DEVELOPING COUNTRIES *

by

R. Kumar**

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* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

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FOREWORD

To give a survey of the aluminium semi-products industry is a very complex task. There are a few hundred types of semis with different qualities, fabricated with different technologies. Therefore such a survey should essentially deal with

(a) the background of the primary metal production
(b) new and old technologies for production of aluminium semis
(c) qualities required by the consumers in developed and developing countries
(d) complex marketing questions

The main part of Prof. Kumar's paper deals in a comprehensive way with the marketing situation of a number of developing countries in the field of aluminium semi fabrication possibilities, import and export situation and consumption.

It is hoped to treat the other three subjects in a Workshop on aluminium transformation, which is in the planning stage and for which the present report would serve as one of the background papers.

Pending the preparation of other papers on the subject it is felt that the present one would already be of interest to the different aluminium fabricating industries as well as to equipment manufacturers and decision-makers and planners.

UNIDO would also like to refer here to its publication on "The Economic Use of Aluminium" (UNIDO/IOD.335) which deals in the main with the question of development of aluminium consumption and aluminium production facilities in developing countries, the present and future potential of aluminium, the economic and technical factors for aluminium development and the principal uses of aluminium. Copies of the paper may be obtained on request.

UNIDO would greatly appreciate receiving the opinion and suggestions of the readers of the present study.

INTRODUCTION

If the evolutionary period of the World could be successively called the stone, the bronze and the iron ages, modern times could then be truly called the energy age because the industrial revolution of the 'North' was pre-empted by the discovery of the electric motor. The availability of the easily transportable energy transformed the face of the World through widespread industrialisation, generation of new employment and consequent urbanisation, modernisation of agriculture, increased social and civic amenities for the community etc. Indeed, it delinked the working of the human mind from primeval and tribal attitudes to one of enlightened vision. Although a comparatively new metal, aluminium performs a vital function in this arduous task.

All countries need aluminium for a variety of purposes ranging from electrification to domestic kitchens, from constructional towers to architectural applications in railings and panels etc and from grain storage silos to industrial explosives. Though the utilisation of aluminium has been established in all the developing countries, the level of its consumption is at present very much lower than in the developed countries. Many of them meet most of their requirement of the metal through imports of manufactured goods, semi-manufactures and the primary metal. In the developed countries, almost three quarters of the total consumption of aluminium passes through the semi manufacturing stages which cover the production of rolled plates, bars, rods, sheets including circles, extruded sections for a variety of end applications, continuously cast and simultaneously rolled wire rods for cables and conductors, production of all types of foils, and

powder and paste.+

Quite a few of the developing countries are endowed with vast deposits of bauxite and/or with plentiful resources for the generation of electric power cheaply either through the hydro-electric or the thermal routes. These are the two important raw material resources required for the production of the metal. The primary metal industry has, however, been established in only a few of them and the semi production industry in yet smaller number. Whereas unprocessed primary aluminium is exported from some of the developing countries to the developed countries of the 'North', some of it comes back to them as semis or as fully manufactured products at much higher prices. Lack of technological expertise and trained man power, financial resource constraints and their rather restricted domestic demands along with complexities of international shipping do not seem to have commended the semi products aluminium industry to many of the developing countries.

Taking into consideration the fact that the metal aluminium occupies an unique position amongst the engineering materials required to meet the needs of the industry and society, the Lima declaration and plan of action adopted at the Second General Conference of the UNIDO in March 1975 had "recommended inter alia that the developing countries should devote particular attention to the development of basic industries and reach a share in the total world industrial production of 25% by the year 2000 AD. In the aluminium industry field, this target does not seem unreachable and UNIDO is undertaking efforts to assist developing countries in this aspect. This is done through technical assistance projects, mainly provision of experts and training rendered to individual countries or through other programmes

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+ Throughout this paper, the word 'semis' refers collectively to these industries

such as the Workshop on Case Studies of Aluminium Smelter Construction in Developing Countries (Vienna, June 1977) or the Seminar for high level governmental and corporate officials on Bauxite - Alumina - Aluminium (Budapest, May 1978).

Recognising the pivotal role of aluminium in the building up of the infra-structure necessary to promote industrial and economic development of the countries of the Third World, the UNIDO desire to extend their participation in the task of global reconstruction through technological assistance in the area of semi aluminium industry in the hope that their participation would catalyse the establishment of the industry for domestic as well as export markets. This paper attempts to provide information on the status of the existing aluminium semi industry in some of the developing countries (the choice of the countries is by no means exhaustive but about fifty countries are covered) and was also directed towards obtaining an understanding of the pattern of present consumption and anticipated growth in the belief that the establishment of the aluminium semi products industry from imported or indigeneous aluminium in all the developing countries would be desirable not only on account of its own merits but would additionally provide fillip for the establishment of less capital intensive, but employment oriented, manufacturing industry; thus simultaneously reducing the value of their imports. In this context the fact that the market for aluminium semis is expanding in the developed countries is of particular interest because some of the developing countries, now exporting primary aluminium, could export semis of a simple quality.

It is anticipated that the paper will be followed by an international workshop on the subject where individual developing countries would present their national papers for exchange of experience within the developing countries themselves, through the UNIDO, to identify

areas of priority technology development as well as those where such assistance could profitably be obtained from the developed countries by way of acquisition of new technology with markets or for product development specifically suited to their markets. However, the UNIDO can seek to promote the implementation of these programmes only at the request of the Governments concerned through appropriate technical assistance programmes.

The methodology adopted in the preparation of the paper was to obtain specific information through correspondence and reference to any pertinent published information by scanning through a number of scientific, technological and other publications. The present writer has had opportunities to visit some ten developing countries on one or the other occasion either as a member of the Government of India team of technological experts or through the UNIDO or on his own besides being directly involved with the hopes and aspirations of his own country - India - through his research and development activities at the National Metallurgical Laboratory, Jamshedpur. It was a fortuitous circumstance that the period of the preparation of the paper coincided with his stay at the University of Aston in Birmingham, United Kingdom, as a Commonwealth Visiting Professor in the Department of Metallurgy & Materials on an invitation extended through the Association of Commonwealth Universities. This greatly facilitated international correspondence and communication and reference to the published literature.

CHAPTER I

O V E R V I E W

The economic affluence of the North owes a great deal to the establishment of heavy metallurgical, chemical, engineering and manufacturing industries which created widespread employment, increased the purchasing power and was sustained by extensive product and market development work. Introduction of mechanical transportation systems provided the necessary support for the cheap movement of raw materials, manufactures and populations; and thus assisted the commercialisation of technology. The industrial infra-structure is based on the use of metals, plastics & other non-metallic materials of construction - glass, cement and timber; infact the dependence of the industrial culture on these materials is so great that their annual per capita consumption is often regarded as an indicator of the economic status of any country. The world production of aluminium in 1978 was 14.08 million tonnes (Europe 40.5%, North America 38.8%, Asia 12.7% Oceania 3%, South America 2.7% and Africa 2.4%). For every tonne of aluminium consumed, the consumption levels of the other materials are of the following orders of magnitude:

Steel	60 tonnes	Cement	59 tonnes
Copper	0.7 tonne	Wood	270 Cu.m
Zinc	0.5 tonne	Plastics	2.5 tonne.

It is now generally agreed that the future of the Third World countries lies in their rapid industrialisation along with the modernisation of agriculture and adoption of family planning methods provided politicians and statesmen can ensure that their strategy for development remains technocratic and techno-economic.

The comparison between the densities of polpulation in the developed and the developing countries shows that under-development is not the product of numbers as much as it is due to the failure to harness either the human or the natural resources.

Table 1. National Statistics of Some of the Developing Countries

Country	Population mid 1976 X10^6	Area Km^2 X10^6	Number of persons per Km^2	Area Available per person X1000 Sq.m
Algeria	16.5	2.36	7	146.0
Argentina	25.7	2.78	9	110.0
Bahrain	0.3	0.001	367	4.1
Bangla Desh	80.4	0.14	521	1.9
Brazil	110.1	8.51	12	81.7
Burma	30.8	0.68	48	22.4
Cameroon	7.6	0.48	13	75.4
Chile	10.4	0.76	14	72.8
China	835.8	9.56	85	11.8
Colombia	24.3	1.14	21	47.5
Cuba	9.5	0.12	79	12.6
Ecuador	7.3	0.28	25	40.0
Egypt	38.2	1.00	36	27.5
El Salvador	4.1	0.02	189	5.3
Ethiopia	28.7	1.22	22	44.4
Ghana	10.3	0.24	40	24.9
Guinea	4.6	0.25	18	57.2
Guyana	0.8	0.22	4	269.0
India	620.4	3.29	178	5.6

(Contd)

Table 1 Continued

Indonesia	130.9	1.90	68	14.8
Iran	33.6	1.65	20	49.0
Iraq	11.5	0.44	25	40.3
Jamaica	2.1	0.01	175	5.5
Jordan	2.8	0.10	27	37.7
Kenya	13.9	0.58	22	45.2
Korea	35.9	0.10	340	2.9
Kuwait	1.0	0.02	52	19.4
Libya	2.5	1.76	1	733.0
Malaysia	12.6	0.33	35	28.4
Mexico	62.0	2.02	29	34.8
Morocco	17.2	0.45	38	26.4
Mozambique	9.4	0.78	12	87.0
Nigeria	77.1	0.92	66	15.1
Pakistan	71.3	0.80	85	11.8
Peru	16.1	1.29	12	83.4
Philippines	43.3	0.30	138	7.2
Saudi Arabia	9.2	2.15	4	247.0
Singapore	2.3	0.001	3818	000.5
Sri Lanka	13.8	0.07	208	4.8
Surinam	0.4	0.16	3	408.0
Syria	7.7	0.19	38	26.1
Thailand	40.0	0.51	80	12.5
Tanzania	15.1	0.95	16	63.8
Tunisia	5.7	0.16	34	29.3
Turkey	40.9	0.78	49	20.4
UAE	0.7	0.08	4	105.0
Uruguay	10.8	0.18	17	59.3

Table 1 Continued

Venezuela	12.4	0.91	13	77.9
Zaire	25.4	2.35	10	96.0
Zambia	5.1	0.75	6	157.0

The World in Figures: The Economist 1976.

The values of the GDP are often regarded as a good indicator of the economic, industrial or agricultural development of any country. The per capita GDP of the developing countries varies a great deal and these countries range from very poor to very rich but are arranged in Table 2 in five categories.

Table 2 Arrangement of the Developing Countries According to Their Per Capita GDP.

Less than $ 200	Between $ 200-499	Between $ 500-1999	Between $2000-4999	More Than $ 5000
Bangladesh	Cameroon	Algeria	Bahrain	Kuwait
Burma	China	Argentina	Iran	Libya
Ethiopia	Egypt	Brazil	Singapore	UAE
India	Ghana	Chile	Venezuela	
Mozambique	Guinea	Colombia	Saudi Arabia	
Pakistan	Indonesia	Ecuador		
Sri Lanka	Kenya	El Salvador		
Tanzania	Nigeria	Guyana		
Zaire	Philippines	Iraq		
	Thailand	Jamaica		
	Zambia	Jordan		
		Korea, Malaysia		
		Mexico, Morocco,		
		Peru, Surinam,		
		Tunisia, Turkey,		
		Uruguay		

GDP AND ALUMINIUM CONSUMPTION:

Table 3 shows that there is some relationship between the consumption of aluminium in any country and its GDP (1)+. In order to establish aluminium semi products industry for the local and the regional markets, it is necessary to ensure the marketability of the

Table 3 The per Capita GDP & Its Relationship to the Consumption of Aluminium:

GDP/per Capita $	Aluminium Consumption Kg	GDP/ Capita $	Aluminium Consumption Kg
300	0.5	2,000	6.75
500	1.0	4,000	17.5
1000	2.6		

products through simultaneous and the otherwise much needed increase of the GDPs of the developing countries expeditiously by ensuring their all round agricultural, economic and industrial development along with the spread of basic and vocational education.

ELECTRIC ENERGY AND INDUSTRIALISATION:

Electric and thermal energy is used in the industry to provide the motive power to drive the machinery as well as to add comfort to dwellings. An idea of sectorwise distribution of the consumption of energy and of electricity in an industrialised society can be had from the data of the United States (2) shown below as a percentage of the total consumption for the year 1978:

+ The numbers in parenthesis refer to references listed at the end of the paper, if not otherwise stated in the text.

	Electricity	Energy
Industry ...	40.0%	37 %
Residential ...	33.3%	17 %
Transportation	23.1%	13 %
Commercial ...	3.6%	33 %

It is of interest to note that the aluminium industry uses less than 4 % of the total US electric energy supply.

Much of the electricity generated in the developing countries appears to be consumed mostly by the industrial sector because, despite the low per capita consumption of energy, some of the countries like Brazil and India are regarded as semi industrialised. Massive programmes of the generation of electricity are, therefore, a necessary prelude for any effort to effect social welfare and ensure industrial growth and these would be instrumental in promoting the use of aluminium in cables and conductors.

Generation of electricity in most of the developing countries should not present any problem of resource scarcity as they are generously endowed with deposits of coal/natural gas/hydraulic resources; some of the countries with the largest resources for hydro-electricity are listed below (3):

Country	Reserve as a % of World Total	Country	Reserve as a % of World Total
Argentina	1.9	Brazil	5.3
Burma	2.3	Cameroon	1.2
Chile	0.9	China	13.5
Colombia	3.1	Ecuador	1.3
India	2.9	Indonesia	1.5
Mexico	1.0	Pakistan	1.1
Peru	1.1	Venezuela	0.9
Zaire	6.7		

INDUSTRIAL DEVELOPMENT OF THE ALUMINIUM INDUSTRY

Inspired by the national development plans, the primary metal industry in some of the developing countries has often been established under bilateral programmes of technical and financial assistance from the developed countries; in such cases, the metal produced is largely consumed by the down stream engineering industries in the concerned developing country itself for domestic consumption or for export as processed or fabricated commodities- notable examples are the establishment of the steel and aluminium industries in India and Brazil. In other instances, the industry has been established through foreign initiative and investment by the transnational industrial organisations to exploit the natural endowments of minerals/energy/metal in the developing countries for the benefit of the down stream engineering industries in the developed countries; nowhere is this situation seen more explicitly than in the aluminium industry. No doubt, the heterogeneous industry also create employment but it remains external to the national economy or aspirations as it removes most of the secondary and cumulative benefits of massive investments from the developing country to the developed country/countries.

The establishment of aluminium semi production industry in the developing countries is a matter of profound economic importance. It improves the balance of the trade situation and promotes the overall industrial development. The human resource situation as the availability of the professionally qualified engineers and technicians is as vital for the success of any programme of industrialisation as are the availability of market and the capacity of the people to buy manufactured goods.

ALUMINIUM INDUSTRY - A MODULAR APPROACH:

An unique feature of the aluminium industry is that, despite its high vertical integration in the developed countries, the industry can be considered as consisting of the following modules, each of which can be considered as an independently viable stage in terms of technology and attractive return on the capital invested:

(a) Mining of bauxite

(b) Production of alumina from the bauxite,

(c) Electrolytic smelting of alumina into aluminium,

(d) Production of semis,

(e) Manufacture of engineering components/consumer items, and

(f) Founding of aluminium directly from the stage (c) above.

BAUXITE AND ALUMINA:

An important starting point in looking towards the aluminium industry is the availability of the raw material inputs. From the point of view of ores, most of the World's aluminium is presently obtained from bauxite which was first found in many of the developing countries only but is also now found in Australia. According to an estimate (6), the developing countries have over 94% of all the reserves of the World, but only nineteen of the developing countries (presently under consideration) are known to have commercially exploitable deposits of bauxite; the extent of their proven and estimated reserves are shown in Table 4, reproduced from reference (10).

The aggregated share of all the developing countries in the total world production of bauxite has declined from about 5% in 1967 (5,6) to 33% in 1978 as shown in Table 5. The decline in the percentage share of the developing countries in the world bauxite production is largely due to the development of bauxite mining in Australia by the

Table 4 - Bauxite Reserves of Developing Countries

Country	Proven	Estimated
	million tonnes	
Brazil	330	3000
Cameroon	100	1400
China	100	00
Cuba		10
Ghana	290	300
Guinea	2900	7800
Guyana	80	250
India	680	750
Indonesia	20	100
Jamaica	700	500
Malaysia	15	50
Morocco		10
Pakistan		10
Phillipines	20	50
Tanzania		10
Turkey	40	60
Venezuela		200
Zaire		100

same transnational, vertically integrated aluminium manufacturing organisations who also own the bauxite mines and alumina plants in some of the developing countries. If the bauxite production of Australia is not taken into account, Table 5 shows that the share of the developing countries in the world production again rises to about 50%

Table 5 Share of the Developing Countries in the Total World Production of Bauxite

Year	World Production X1000 tonnes	Total Production of Developing Countries as a % of World Production	% of World Production when Australian Production Disregarded
1967	45,690	54.8	-
1976	74,754	48.4	-
1977	80,490	35.2	52.1
1978	84,147	32.7	46.7

in the years 1977 and 1978; thus showing the near stagnation in its growth. Tables 6 and 7 (5, 23) show the present production and anticipated capacity in 1979 and 1983 for respectively (i) bauxite and (ii) alumina; the corresponding figures for Australia and other developed countries are also given; the buoyant growth of the industry in Australia contrasts with the faltering progress in the developing countries of the Caribbean and northern South America which traditionally were the main bauxite exporting countries until recently.

The bauxite refining capacity for the production of alumina for the export market has also grown at a much faster rate in Australia than in the developing countries; in 1965 a mere 25 % of the bauxite production in Australia was exported as alumina but this has risen (11) to over 68% in 1977. Australia today accounts for (12) about 25-31% of the total world production of alumina and bauxite and approximately 2% of the primary metal.

An International Bauxite Assciation has been formed to look after the interests of the bauxite exporting nations.

Table 6 - Bauxite Production & Capacity in the Developed and Developing Countries

Country	Production		CAPACITY	
	1977	1978	1979	1983
		X1000 tonnes		
DEVELOPING COUNTRIES				
Brazil	1035.0	1224.8	2856	8356
China ②	900.0	1100.0	900	900
Ghana	275.4	329.9	400	400
Guinea	11300.0	12064.6	13500	13500
Guyana	3344.3	3450.0	4390	4390
Jamaica	2013.0		15006	15006
India	1511.8	1282.4	1650	1650
Indonesia	1301.4	1007.7	1300	1300
Malayasia	616.2	615.1	750	750
Mozambique	2.0		5	5
Sierra Leonne	745.0	716.0	800	800
Surinam	4856.0	5288.0	7500	7500
Turkey	449.1	4449.1	530	635
DEVELOPED COUNTRIES				
Australia	26074.0	24300.0	28500	29245
France	2058.8	1977.8	1980	1700
Greece	2983.7	2630.0	4160	4660
Spain	14.0	10.0	10	10
USA	2013.0	1669.9	2150	2150
USSR	6700.0	6700.0	6415	8345
TOTAL WORLD	80489.8	84147.2	102154	112504

② The 1978 data in all case is from World Metal Statistitics, December 1979; the figures for China are not, however comparable with the production of the previous year from another source.

Table 7 Alumina Production & Capacity in the Developing Countries

Country	Production 1977	Capacity 1980	Capacity 1983
	X1000 Tonnes		
DEVELOPING COUNTRIES			
Brazil	372.0	388	1220
China	360.0	420	420
Ghana		30	60
Guinea	562.0	700	700
Guyana	277.0	330	330
Jamaica	2048.0	2855	2855
India	386.6	689	829
Surinam	1215.0	1300	1300
Taiwan	51.0	140	140
Turkey	168.4	200	240
DEVELOPED COUNTRIES			
Australia	6659.2	6940	7140
Canada	1060.8	1258	1258 @
France	1247.2	1320	1320 @
Japan	2045.4	2730	2730
Spain		400	400
U.K.	98.5	130	130
USA	6105.2	6929 @	7011
USSR	3350.0	3695	4545
@ Already existing			
WORLD TOTAL	30769.7	37137	41781

PRODUCTION OF ALUMINIUM:

Aluminium remained unknown to the engineering and commercial world until the dawn of the industrial age because its high chemical reactivity with oxygen forbade its occurrence in the native state. Aluminium was introduced to the world only after widespread application of basic principles of chemical thermodynamics and electro-chemistry to metal extraction. Hall and Heroult, independently showed in 1886, that the metal could be released from its chemical bondage through fused salt electrolysis of its oxide (alumina) dissolved in a molten high temperature electrolyte (the fluorides).

Resource Inputs for Aluminium:

The production of one tonne of metal requires the following material and energy inputs:

I. Fuel Oil ... 0.45 t

Caustic Soda . 0.08 t

Bauxite ... 4-6 t (depending on the alumina %)

This yields approximately 2 t of alumina.

II. Alumina ... 2.0 t

Aluminium Flouride ... 0.04 t

Cryolite ... 0.02 t

Carbon Anodes ... 0.6 t
(petroleum coke 0.55 t
pitch ... 0.11 t)

Cathode Lining

Electric Power ... 15,000-17,000 kWh

This yields one tonne of primary aluminium.

Because the smelting operation is essentially electrolytic, availability of uninterrupted supply of electricity is regarded as the most critical raw material resource. Aluminium smelters prior to

1940 were located near the cheap resources of hydro-electric power, notably in Norway and Canada. In the post-World War II period, bulk transport of alumina in large ocean carriers and substantial relative reductions in the price of electric energy as a consequence of smaller raw material cost (notably of energy based on natural oil), higher efficiency of conversion of thermal energy into electrical shifted the aluminium smelters nearer the centres of bulk consumption of the metal, often remote from the centres of bauxite/alumina production.

The post-OPEC world, recovering as it was from the shock of the sudden increase in the price of energy, saw an important transformation in the attitudes for determining the location of new smelters and sites where energy was cheaply available became the first choice. No doctrinaire approach was needed to bring about this psychological change in the managerial attitudes. Since most of the consumption of the metal continues to be in the developed countries of the North, such developing countries as could produce electric power cheaply were encouraged by the transnational governments and industrial organisations alike to establish the production of primary aluminium and export their primary metal for semi fabrication and further down stream fabrication operations in the developed countries. The OPEC countries themselves were the first to take advantage of the changed international scenario for the aluminium industry. As they did not face any problem of finding investment, aluminium smelters were expeditiously planned and executed in Bahrain, Dubai (UAE) and Iran and are in the process of being established in Venezuela in a big way. Though the Saudis are now understood to have given up their earlier plans for the establishment of aluminium smelters in view of their having acquired a share in the Bahrain smelter, Algeria and Libya continue to have interest in locating the industry based on imported alumina within their domains.

Similarly, countries with hydro-electric resources were encouraged to take advantage of the growing world demand for aluminium and to establish aluminium smelters, often based on imported alumina. Amongst those countries where smelters were established in this manner are Argentina, Brazil, Egypt and Ghana and Indonesia may emerge as producer of the primary metal in 1982. More than half of the World's smelter capacity is still based on hydro-electricity, but perhaps the United Kingdom is the only country to use nuclear energy for the smelting of aluminium.

In those energy rich countries where generation of new employment was not a matter of serious concern, whilst this approach did result in the partial diversification of their industry and exports, in real terms amounted to the export of energy, stored as the virgin metal, but the value adding down stream operations were still to be carried out in the countries of the North. This is a matter of serious concern as the international price of aluminium continues to be determined by the few transnational and highly vertically integrated aluminium companies. The production of primary aluminium in the countries of the Third World under their own managerial control and the entry of the metal in the world market is a matter of profound importance as it could eventually lead to the eradication of the hitherto producer determined pricing system for aluminium.

In the pre-1974 OPEC period, the aluminium production in the world rose by about 8% per annum but since then has averaged only 3%. In order to save the cost of imported energy, the Japanese industry decided to close down 500,000 t capacity of primary aluminium (13). Japan has now become importer of the metal from Australia; as Australia

produces, Japan cuts back her aluminium production (12).

The demand of energy (14) for the basic aluminium industry can be broken down as under:

Production Stage	Energy Requirement GJ/tonne of Al	MWh(Thermal) per tonne of Al	%
Mining & Shipping			10
Refining to Alumina	32	8.9	20-25
Electrolysis to metal			60-65
Electric Power	50	14-17 @	
Carbon Anode Contribution	16	4.4	

@ measured in MWh (electrical)

STRUCTURE OF THE PRIMARY ALUMINIUM INDUSTRY IN THE DEVELOPING COUNTRIES:

The primary aluminium industry in the developing countries has been established with, and often without, having integrated semi processing facilities in one or more of the following ways:

(i) Wholly owned by the transnationals of the aluminium industry as in some of the Latin American States, South-East Asia and in Western Africa.

(ii) With the transnationals having a minority holding but being managed by them or having a right to take away a portion of the aluminium produced at pre-determined prices.

(iii) Public sector undertakings established by the governments under the bilateral programmes of aid from the developed countries with the technology and machinery flowing from the transnationals or from the State managed aluminium industry of the countries with the centrally planned economic systems; such aid often incorporates clauses of long term commercial nature, but it is very difficult to know the terms of such assistance.

According to an estimate (15), out of a total of $ 17,000 million of Soviet aid during the 1954-78 period, 5.2% was for the aluminium industry. The Soviet assistance helped the aluminium industry in the public sector in India and in Turkey and is now assisting the industry in Algeria and probably the expansion of the Turkish plant. In a similar way, the French Government may assist the establishment of the aluminium industry along the eastern coast of India.

WORLD PRODUCTION AND CONSUMPTION OF ALUMINIUM:

Tables 3 and 9 show the production of aluminium during the 1968-78 period and the anticipated productions in the years 1980 and 1983 for the developing and the developed countries respectively. These Tables show that (i) by the year 1983, about 19% of the world aluminium production will come from the developing countries if all the planned capacities materialise; (ii) any noteworthy increase in the aluminium capacity is not planned in the energy importing countries like the USA and Japan who are the largest and the most important consumers of the metal; (iii) substantial increases in the production capacity are planned in the USSR and Australia; and (iv) as far as the developing countries are concerned, all countries presently producing aluminium have planned expansion of their capacities with the exception of Cameroon, Bahrain, Korea and Mexico but the most spectacular increases are planned for Venezuela.

CONSUMPTION PATTERN OF ALUMINIUM:

Despite the data on the consumption of aluminium being variously compiled in the different countries, a broad pattern of consumption could be shown in Table 10 the Table shows in particular that the pattern of consumption is quite different in the developing countries as typified by Brazil and India as compared with that of the developed ones. In the developed countries, the use of aluminium in the

Table 8 Production and Increases in Aluminium Production Capacity in the Developing Countries During the 1968-1978 Period

Country COUNTRY	P R O D U C T I O N			Consumption	CAPACITY	
	1968	1977	1978	1978	1980	1983
	X1000 tonnes					
Algeria						
Argentina	43 2	43	49	43	140	140
Bahrain	11 22	121	123		120	120
Brazil	43	167	186	247	258	476
Cameroon	55	55	41	3	55	55
China	100	210	190		261	347
Cuba				1		
Dubai					45	135
Egypt	2 000	82	100	32	160	160
Ghana	120	152	114	6	200	200
India	132	184	205	234	362	362
Indonesia						150
Iran		21	26		80	135
Korea	7 2	18	18	103	18	18
Mexico		43	43	76	45	45
Saudi Arabia						200
Surinam	48	58	57		66	66
Taiwan	22	39	50	99	93	93
Turkey	12 00	47	33	45	60	120
Venezuela	11	40	71		81	102.2
World Total	9239	14223	14643		17208	20207

1) Production started in 1974; 2) Production started in 1971;

3) Production started in 1975; 4) Production started in 1960;

5) Production started in 1975;

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Table 9 Production, Consumption & Future Capacity of Aluminium in the Developed Countries

Country	P R O D U C T I O N		Consumption	C A P A C I T Y	
	1977	1978	1978	1980	1983
	X 1000 tonnes				
Australia	248	363	135	315	495
Canada	982	1057	341	1053	1167 ②
France	410	391	533	460	498
Japan	1188		1655	1641	1641
Spain	212	212	236	416	416
UK	349	346	402	364	364
USA	4117	4358	4975	5852	5966
USSR	2200	2300	1830	2400	2830

② Present Capacity is 1053x1000 tonnes

transport sector is now becoming quite important, the impetus being provided by the desire to reduce the weight of the vehicle in order to optimise the fuel consumption. In contrast, the developing countries see aluminium as a conductor of electricity and as a vital necessity to bring about a social revolution. But it may be noted that the consumption pattern is typical of any country; dis-similarity exists even amongst the developed countries - for example, Japan shows significantly less consumption of aluminium for packaging when compared with that of the USA which is shown separately in Table 16.

Table 10 Sector-wise Consumption of Aluminium as a Percentage of the Total in Some of the Developed and Developing Countries:

Sector	Japan	France	Hungary	Brazil	India
Transport	20.1	34.9	8.0	19.0	11.0
Engineering	4.5	6.5	3.0	3.0	11.0
Electrical	10.2	17.6	22.0	26.2	50.0
Construction	36.2	11.4	10.0	18.0	0.3
Chemical	2.1	2.7			
Packaging	5.6	9.6	6.0	7.0	7.0
Domestic	6.8	6.9	7.0	20.0	18.0
Miscellaneous	2.8	Balance	44.0 @	7.0 @	

@ ... also includes export of semis

Data based on Metal Bulletin Handbook 1978 and that for Hungary from (1)

Table 11 Distribution of the Consumption in the USA According to Major Markets for Total Aluminium, Semis and Ingots

MAJOR MARKET	C O N S U M P T I O N Total X1,000 t	%	Semis %	Ingots %
Building & Construction	1,455	22.3	26.5	3.4
Transportation	1,384	21.3	15.7	46.0
Consumer Durables	520	7.9	7,1	11.8
Electrical	663	10.1	10.9	6.8
Machinery & Equipment	446	6.8	5.9	10.9
Containers & Packaging	1,422	21.7	26,6	0.4
Export	346	5.3	4.3	4.3
Total	6,541	100.0	100.0	100.0
Total Sectoral Consumption X1,000 t			5,336	1,205

The Table 11 shows the consumption in the USA for the year 1978 distributued according to the major markets and in terms of the consumption of semis and ingots for the same markets. It is seen that a bulk of the consumption (81.6%) passes through the semi fabrication stages. The corresponding figures for the other developed countries being 70.1% for Italy; 70.2% for Japan and 83.6% for the UK.

Since the generic term "semi fabrication" covers a variety of intermediate mechanical working stages, it may be of interest to have a general idea about the relative magnitudes of each of the constituting sectors as such an information could be useful in planning for the industry in the developing countries for the consumption of semis in the domestic markets as well as for the exports in the regional/inter-regional markets. It is a fortuitous circumstance that this kind of data is available for the US aluminium industry (16) and is presented in Table 12. There must necessarily

TABLE 12 Distribution of the Semi Consumption in the USA in 1978

Semi Stage	Total Consumption X1,000 t	%	SemiStage	Total Consumption X 1,000 t	%
Drawn & Welded Tube	99	1.8	Sheet	2,955	55.4
Properzi Rod & Bar	177	3.3	Plate	127	2.4
ACSR & Bare Wire	219	4.0	Foil	409	7.7
Insulated & Covered Wire	186	3.5	Forgings	53	1.0
Extruded Shapes	960	18.0	Impacts	10	0.2
Extruded Pipe & Tube	80	1.5	Powder	62	1.2

be significant variations from this pattern for the developing countries depending on the emphasis placed on particular uses of aluminium; for example the oil rich countries who have launched extensive housing programmes may have a large and exclusive demand for extruded sections; or countries like Brazil and India higher demand for continuously cast wire rods and bars, cables and conductors in view of their programmes of nation-wide electrification. Table 13 shows the distribution of the semis in the various major markets in the USA according to the data published for the year 1978 (16). Such a wide spectrum of the use of the semis anticipates the establishment of an industrial infrastructure encompassing a variety of industries, continuous market survey and the development of production technology. In most of the developing countries facilities/organisations to study their own market demands and then to develop the appropriate technology do not seem to exist at present. This probably accounts for the paucity of published or available data relevant to the planning of the industry exclusively based on the domestic/regional consumption for the developing countries.

Table 13 Distribution of Semis in Major Markets in the USA

Semi Stage	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Sheet	26.9	14.3	6.4	3.7	4.7	38.3	4.1
Plate	0.4	67.9	0.4	3.4	14.6		9.6
Foil	4.1	5.0	13.6	3.0	2.3	69.0	2.9
Extruded Shapes	58.3	23.3	6.3	4.8	5.4		0.8
Ext. Pipe & Tube	16.4	7.4	15.8	23.2	19.8		10.8
Drawn Tube	2.8	16.8	37.4	12.1	19.6	0.9	0.9
Welded Tube	2.5	2.5	50.5	4.5	40.0		
Rolled & Continuously Cast Rod & Bar	8.5	11.3	4.1	21.8	13.4		15.4
Bare Wire	28.0	8.6	6.5	10.8	31.2	8.6	25.8
ACSR &AAC				85.9			14.1
Insulated Wire				100.0			
Forgings	0.8	73.3	1.5	0.8	11.2		not reported
Impacts		28.6	4.8	14.3	28.6		

(a) Building & Construction
(b) Transportation
(c) Consumer Durables
(d) Electrical
(e) Machinery & Equipment
(e) Containers and Packaging
(f) Export

ALUMINIUM SEMI MANUFACTURES IN DEVELOPING COUNTRIES:

Irrespective of whether or not the developing countries have industries concerning the production of primary metal or semis within their domains, aluminium has made itself familiar in all the countries as seen from the figures of their imports of semis given in Table 14 (aluminium in finished products is not included); these figures invariably refer to the exports by the transnational aluminium companies in some countries of the North. In the absence of any data pertaining to the possible export of semis from the Soviet Union and East European countries, these figures may be regarded to represent a close approximation to their present annual consumption of the semis except for those countries which additionally produce aluminium semis from their own or imported primary metal, notable amongst them being Brazil, China, India, Iran, Korea, Mexico and Turkey.

The aluminium industry adds maximum value to the metal after semi fabrication though the increase may not be commensurate with the investment in machinery or the operating costs or even the gestation period in establishing the semi fabrication facilities. In terms of the international trade in the field of aluminium industry, the present scenario shows that (i) some developing countries export bauxite or alumina, i.e. products with none or little value adding operations, (ii) some of the developing countries import alumina from Australia for their primary aluminium production and may in future do so from other Third World countries, (iii) much of the primary

Table 14 Imports of Aluminium Semis by the Developing Countries 1978

	a	b	c	d	e	f	g
Algeria	5031	768	43	679	44	6971	0.4
Argentina	269	118	377			764	
Bahrain	152	2	47	62		263	
Bangladesh	333	591	9		303	1236	0.1
Brazil	2469	200	6282		57	9003	0.6
Burma	100			2021	278	2399	0.1
Cameroon	2243			3		2246	0.1
Chile	225	56	2707		83	3071	0.2
China	147	30	4		442	623	
Colombia	415		724	897	23	2059	0.1
Cuba	1156			827	38	2021	0.1
Ecuador	1153	583	223	125	78	2162	0.1
Egypt	2448	214	1	639	770	4072	0.3
El Salvador	1025		45		165	1235	0.1
Ethiopia	137		1	57	53	248	
Ghana	1532	43	84	158	9	1826	0.1
Guinea	1009	8	255	4		1356	0.1
Guyana	1		29		10	40	
Hongkong	996	51	338		3417	4772	0.3
India	12926	1534	1007		39	15506	1.0
Indonesia	2076	335	2125	1818	757	136 5	0.8
Iran	15223	2206	12152	8505	10865	48951	3.0
Iraq	1746	1211	2483	647	3978	10445	0.6
Jamaica	1317		715			2132	0.1
Jordan	702	17	167	1823	42	2751	0.2
Kenya	926	56	48	490	432	1952	0.1
Korea	2799	103	1837	4	26732	31457	1.9

Continued

Table 14 Continued

Country	a	b	c	d	e	f	g
Kuwait	1487	82	81	65	362	2077	0.1
Libya	1781	30	675	3441		5927	0.4
Malaysia	1532	32	606	1443	2670	6101	0.4
Mexico	4881		22242		833	27956	1.7
Morocco	1726	31	1	458		2216	0.1
Mozambique	50	139				189	
Nigeria	11396	6889	323	2230	184	21022	1.3
Oman	323		2	83	146	556	
Pakistan	272	16	9669		48	10005	0.6
Peru	352	11	175			538	
Qatar	285	15	60	1025	3	1388	0.1
Philippines	671	409	256		1470	2806	0.2
Saudi Arabia	7907	544	4797	5630	3079	21957	1.4
Singapore	5810	98	1395	154	1508	8965	0.6
Sri Lanka	226	1134			554	1914	0.1
Surinam	40		211			251	
Syria	1752	71	17	1490	2	3332	0.2
Taiwan	362	16	1131		2749	4258	0.3
Thailand	469	39	361	343	3921	5133	0.3
Tanzania	116	68		447		661	
Tunisia	2461	13	4	171		2649	0.2
Turkey	182	17		1628	13	1841	0.1
UAE	2633	638	177	382	394	4125	0.3
Uruguay	328					328	
Venezuela	3009	536	8833	5	1412	13795	0.9
Zaire	362	102		13		477	
Zambia	235			337		572	

Continued

Table 14 Continued

Total for the World (semi trade)	16,615,386 tonnes
Total imports of the Developing Countries as % of the World	19.7

The columns refer to the following sets of exporting countries:

(a) European Common Market: West Germany, Belgium, Denmark France, Ireland, Italy, Netherlands and United Kingdom
(b) Norway, Austria, Sweden and Switzerland
(c) Canada and the USA
(d) Finland, Greece, Yugoslavia and Spain
(e) Japan
(f) Total
(g) Total Imports as % of the World Trade in Semis

All figures in tonnes

Data refers to 1978 and is taken from WELTEINFUHRSTATISTIK 1978 uber aus Aluminium und Aluminium-Legierungen: Aluminiumhalbzueg-Verband der Fachvereinigung Metallhalbzueg e.V. Dusseldorf.

metal produced in some of the developing countries like Argentina, Bahrain, Cameroon, Dubai (UAE), Egypt and Ghana is exported without further processing; Brazil and Venezuela may emerge as major exporters of the primary metal within the 1980s, and (iv) almost a fifth to a quarter of the World consumption of aluminium semis is exported from the North to the countries of the South. The emerging situation is thus one of gross imbalance which becomes even more acute when the prices of bauxite and alumina are not fixed by the producing developing countries themselves or when trade agreements or loan repayments are linked with the price of the primary metal (not with that of the semis) in the developed countries. Since the imbalance can not be reduced through strict trading philosophy, other alternative approaches must be examined. In the realm of the aluminium industry, this can be done by carrying out the value adding semi fabrication in the developing countries of consumption and even of the primary metal otherwise exported as such to the developed countries. This

approach simultaneously generates new employment, raises the levels of skills and reduces the value of the imports. A global approach is necessary to solve this complex problem but the issues involved are concerned with the transfer of technology training of manpower and funds, not the least being the need to keep the technology always up to date and satisfying the quality requirements of the developed countries through research and developmental efforts or market surveys to ascertain the needs of the society. The development of the aluminium semis industry, particularly in the developing countries, - is a wide field for transfer of technology.

For the development of the semi-fabricating industry three possibilities may be considered:

- The cast-rolling technologies (wires and strips) which are using the molten metal of the smelters. The equipment is located near the smelters and may be considered part of them. Generally, the know-how and the technological assistance is provided by the big aluminium companies together with the assistance to build up the smelter.
- To establish modern sophisticated equipment with a huge output (especially with regard to different kinds of rolling). Such machines require highly educated technical staff and a lot of well-trained workers with technical background. This kind of fabrication is very susceptible to the quality of the primary and of the intermediate materials. In the majority the equipment is delivered by specialized equipment manufacturers in co-operation with a big aluminium company, the latter providing the know-how and technological assistance.

- A large number of small home markets would need also in the future to satisfy in a quick and elastic way their requirements. The further development and modernization of existing and still working old equipment which does neither require highly trained staff nor is it sensitive to the whole technical structure (infrastructure, primary and auxiliary materials, etc.) is advisable to yield better quality and a higher rentability. Such upgrading and modernization work is often not finding the necessary support by the big machine manufacturers and aluminium companies.

Energy Requirement of the Aluminium Semi Products Industry:

Unlike the primary metal extraction, the semi products manufacturing industry is not energy intensive. The approximate energy consumption at various stages is given below (22):

Production Stage	Energy Input GJ/tonne	MWh/tonne (thermal
Smelting alumina to hot metal	212	59 @
Smelter Casting	4.3	1.2
Remelt Cast Shops in Fabrication Plants	9.0	2.5
Secondary Smelting of Foundry Ingots	14	3.9
Rolling	24	6.6
Foil from Foil Stock	18	4.4
Extrusion	25	6.9

@ includes hydro-electric power converted to MWh (thermal) at a factor of unity and power from fossil fuel converted to MWh (thermal) at actual efficiency of the industry owned power stations or at 29.3% for the power purchased from the grid.

"Where the semis are made from primary aluminium of non-hydroelectric origin, nearly two-thirds of the total energy inputs, starting from bauxite, is consumed at the reduction stage and the remainder divided fairly equally between the production of alumina and fabrication." (22) Production of aluminium from scrap requires only 5% of the energy otherwise required.

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CHAPTER II

COUNTRIES OF THE MIDDLE EAST & EGYPT

The importance of the Middle Eastern countries was felt by the World in 1973-74 when the prices of the natural crude oil were suddenly raised, the impact of which was felt alike by both the developing and the developed countries. These years may well go down in the history of the world as having altered the pattern and pace of her industrial development. The flow of wealth into the region created a consciousness to invest the newly earned petro-wealth constructively to ensure continued flow of wealth when the oil resources have run out and to establish new industries in order to provide alternative employment and diversification of the economy. Massive house building programmes were also launched so as to take the newly found prosperity to every individual in the country. In recent months, Egypt has also emerged as an exporter of crude oil though on a very modest scale.

In view of the availability of vast quantities of natural gas and the gas which otherwise would have been flared, the energy intensive primary aluminium industry naturally claimed priority in the programmes of industrialisation of many countries in the region. In order to emphasize the importance of the Gulf Region and its potential for the aluminium industry, Yousuf Shirawi, the Bahraini Minister for Development and Industry was reported (23) to have said that the area was producing and flaring enough gas which could help to produce an equivalent of about seven million tonnes of aluminium which is about half the current world consumption. Although metallurgical grade bauxite is not found anywhere in the region primary metal industry was expeditiously planned in Bahrain, Iran and UAE(Dubai) as well as

in Egypt (based on hydro-electricity of the Aswan High Dam) and current productions at these plants is based on imported alumina, cryolite, fluorides and petroleum coke. As a consequence, the region has emerged as an exporter of the primary metal notably from Bahrain and Dubai. Though Saudi Arabia, Kuwait, Abu Dhabi, Qatar, Syria and Iraq were all at one time reported to be considering the setting up of primary aluminium smelters (24), it is now learnt (23,28) that Kuwait and Saudi Arabia, the latter having acquired a 20% share in the Bahrain smelter, have deferred indefinitely their plans for the smelters in order not to compete with one another in the region in the international market as well as to promote Arab unity. The establishment of the smelters would otherwise have been attractive on account of the availability of finance and low cost energy and the relative indifference to the consequential atmospheric pollution on account of the surrounding areas being mostly inhabited. These advantages are to some extent offset by their limited populations, scarcity of trained manpower, lack of good water resources and relatively small internal demand.

The first smelter in the region was established in Bahrain in 1971, followed by Iran in 1972, Egypt in 1975 and now Dubai (UAE) in 1979. Table 15 summarises the consumption of aluminium in some of the countries in the region (26). The present and anticipated production capacities of these smelters is 250% in excess of the regional demands and considerable quantities of aluminium would, therefore, have to be exported, although it is anticipated that the average per capita consumption of aluminium could reach a value of 2 Kg by 1980 in these countries (26). Nevertheless, there are various plans for the expansion of the smelter capacity in the Gulf countries to about 750,000 tpy by 1995 as also for the establishment of an alumina refinery in the region or outside. However, the aluminium futuristic scenario in the region is rather fluid and these figures reflect the ambitions of the region.

Table 15 Consumption & Production of Aluminium in Some Countries of the Middle East

Country	CONSUMPTION Total '1,000 t	Per Capita Kg	Production Capacity tpy
Bahrain	2	6.56	120,000
Egypt	24	0.62	100,000 rising to 166,000 in 1981
Iran	68	2.00	45,000; 120,000 anticipated in '82
Iraq	18	1.57	
Jordan	3	0.95	
Kuwait	5	4.76	
Lebanon	2	0.40	
Oman	1	1.83	
Qatar	3	11.90	
Saudi Arabia	12	1.42	
Syria	14	1.85	
UAE Dubai	11	14.12	135,000
Yemen-Aden	1	0.22	
Yemen-Sanaa	1	0.07	

There is little semi fabrication activity at the primary aluminium smelters - only the one in Egypt produces wire rods. Some independent semi fabrication activity has grown/is growing in the region during the last couple of years:

Bahrain — Wire rods, Extrusion and Powder;

Egypt — Wire rods, extrusion, foils, cable and conductors (see also p. 46-49)

Iran — 6 Extrusion Plants with 19,000 tpy in 1978, 4 plants reported to be under construction; Strip Casting and Continuous Rolling of Sheets; Foils; Wire and Cable 6,000-7,000 tpy.

Iraq — Rolling, Foil, Wire Rod, Cable and Conductor

Jordan	Rolling Mill
Kuwait	Extrusion, Cable and Conductor
Lebanon	Extrusion, Cable, Rolling
Saudi Arabia	Extrusion and Rolling
UAE Dubai	Extrusion, Cable and Conductors.

IMPORT OF ALUMINIUM SEMIS IN THE REGION OF THE MIDDLE EAST:

The figures of the imports of the semis vary a great deal from year to year; it is, therefore, difficult to present a generalised picture. The fluctuation is largely due to (i) the changing demands of house building activities and (ii) increasing production of the semis within the countries of the region. The bulk of their imports come from Europe and some modest amounts from Japan. The total imports of Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syria and the UAE in 1978 were a little over 98,000 tonnes (as shown in Table 14) including 8,215 from Japan - the structure of the imports from Japan is shown in Table 16. The amount of semis imported from the European Communities alone in 1977 was over 136,000 tonnes (Table 17). Imports of semis from Canada appear to be only nominal according to the data published by Statistics Canada for the year 1978-79; and also little from the USA on account of the distances involved except in the case of Saudi Arabia whose figures of imports in 1978 from the USA are available (16):

Sheet	872 t	Circles	158 t	Foil	375 t
Plates	51 t	Bare Wire	1562 t	Conduit	498 t
Rod & Bar	23 t	Conductor	1440 t	Angles	237 t
Pipe and Tube	462 t				

Total Semis 5680 t

Table 16 Structure of the Imports of Aluminium Semis from Japan 1978

Country	Plates Sheets Strips	Foils not exceeding 0.2mm	Bars & Rods Strips Circles	Miscellaneous	Total
					X tonnes
Bahrain		0.5		8	8.5
Egypt	770	0.6		6	776.6
Iran	395	236	1528	372	2531
Iraq	432	27	780		1239
Jordan				4	4
Kuwait	62	0.8	227	20	309
Oman	12				12
Qatar	1			8	9
Saudi Arabia	204	336	2306	203	3049
Syria			0.9		0.9
UAE	119	0.8	139	17	276

Data Supplied by Japan Trade Centre, London.

Table 17 Structure of the Import of Aluminium Semis from the Countries of the European Communities

Country	COMMODITY CLASSIFICATION								
	7602	7603	7604	7606	7608 + 7612	7612 Domestic	7601 + 7616	Total
							X tonnes	
Bahrain		354		111	1139	138	503	2245
Egypt	1974	1360	983		949	281	2359	8006
Iraq	1890	2009	802	2236	5700	146 820	5414	19017
Jordan	192		304		358	361	562	1777
Kuwait	2162	336	370	175	971	949	1126	6089
Oman & Qatar	286	1352			3869	404	779	6690
Saudi Arab.	10092	4390	697	300	45457	2874 3450	4466	71726

Table 17 Continued

Country	7602	7603	7604	7606	7608	7612	Domestic	7601	Total
Syria	960	492	612	350	830	150	342	1063	4799
UAE	3170	1328	123		7341	1513	573	1527	15720

Nomenclature: 7601 .. Ingots 7602 .. Bars and Profiles
7603 & 04 Foils 7606 .. Tubes
7608 & 10 Construction and Tubular Products
7612 Cables

Data from the Analytical Tables of Foreign Trade EUROSTAT 1977: Statistical Offices of the European Communities, Luxembourg.

B A H R A I N

Bahrain derives its name from the Arabic word "Bahar" which means the ocean. It is an archipelago of some 33 islands with a total area of 225 sq. miles surrounded by the Arabian Gulf. Bahrain is the oldest oil producing Gulf state and tradition is said to continue in the ancient crafts like weaving, pottery, dhow building and carpentry. Pearl diving is still carried out as the Bahrain pearls are claimed to be the purest owing to the presence of fresh water springs beneath the sea surrounding the islands. Fishing was a flourishing industry until very recently but the only fishing company has liquidated itself owing to indiscriminate dumping for land reclamation, having thus destroyed the breeding places of the fish.

The natural oil output is around 60-70 million barrels a year but the output is declining owing to the progressive exhaustion of the resources and is today insufficient to feed the only refinery which is now also fed on the imported Saudi crude. Owing to the large demand for consumer items, the balance of trade situation appears to be in the red. Concern for the future has led to diversification of both the industry and approach. Bahrain is foremost not only amongst the

Arab countries but also amongst the OPEC countries to have established the production of primary aluminium. This industry is now vital to the Bahrain economy as it accounts for almost 7% of the export earnings and employs about 2,000 persons in a total population of 250,000. The smelter capacity is expected to be raised from the present 120,000 tpy to about 170,000 tpy by 1982. Since the Saudi Government is now in partnership with the Bahrain Government in the Aluminium Bahrain plant, she has given up her own plans for the establishment of an aluminium smelter at Jubail along the eastern coast.

It is understood that in order to cater for the Gulf demand for semi products, [illegible] of a 40,000 tpy aluminium rolling mill for sheets and strips, jointly owned by Bahrain, Saudi Arabia, Kuwait, Iraq, Qatar, Oman and the UAE in association with the Doha based Gulf Organisation of Industrial Consultancy will commence in early 1982 to start production in 1983. The plant will use the new output from the proposed expansion of the ALBA plant. The feasibility report for the plant is understood to have been prepared by the VAW and the Uhde Company of West Germany.

In a similar measure of cooperation among the Gulf countries of the GCC, a [illegible] repair shop has been established [illegible] industry in Bahrain.

Semi Fabrication Aluminium Industry:

There is no semi production at the ALBA plant at present.

Bahrain Aluminium Extrusion Company (BALEXCO):

The Government of Bahrain commisssioned ALUSA/ALUSUISSE in 1975 to design and build an aluminium extrusion plant complete with the anodising facilities. The plant was commissioned in 1977 and is now in production. It is managed for the Government by the Alusuisse on a seven year contract. The present production is around 3,000 - 2,700 tonnes of extruded architectural sections, tubes and I-beams through 2,000 t Schloeman extrusion press with a capacity of 5,000 tpy/shift. The 27 tank anodising plant (33,000 amps) has a capacity of 2400 tpy which may be expanded to about 3,000 tpy. There is no die shop and all dies are presently imported as are the chemicals including the sulphuric acid. Sulphuric acid was at one time manufactured in the islands but the plant closed down some 25 years back.

At the managerial level several nationalities are represented- British, German, Swiss - and the work force is 180 with about 65% Bahrainians; most of the rest come from Philippines and a few from

India. With the expansion of the anodising plant, the strength of the work force will increase to about 200-210. BAIEXCO is also working under licence from the SAVA-ISA for the window systems.

Midal Cables

The plant is owned 51% by the Government of Bahrain and 49% by Olex Cables of Australia who also manage the plant. The plant produces ACSR & AAC conductors for overhead transmission according to the British Standards and the consumption of the aluminium component is around 12,000 tpy. All the production is exported to the Gulf countries, Saudi Arabia and Iran. The company also produces re-draw rods and about 4,000 t are exported annually to India, Malaysia, Pakistan and the Philippines. The plant employs about 40 persons but the climate affects the productivity in summer and warrants greater attention to plant maintenance. There are no immediate plans for the expansion of the plant.

The Bahrain Atomiser International Company:

Originally promoted as a foreign company, the Government of Bahrain now has 51% financial participation and the remaining by Eckart Werke of Nurenberg, West Germany which is known as the Breton Investments in Bahrain. The plant is based on German technology; the present production is around 3,000 tpy which will be raised to 6,000 tpy in May, 1980. The plant receives molten aluminium from ALBA and produces three grades of atomised powders: (i) + 400 micron, (ii) 400-60 micron and (iii) - 60 micron. The products are exported to Japan, Australia and Brazil. Local firms were said to have made enquiries for the use of the powder in industrial explosives and light weight concrete. The plant employs about 26 persons and will add

another five for the expansion. Since high humidity could cause physical but weak agglomeration, the plant works only one shift in the day time as the humidity is always high in the night.

It was understood that VAW and Uhde Company of West Germany had completed a study in 1976 for the possible setting up of an aluminium rolling mill in Bahrain but the plans seem to have been deferred (27).

E G Y P T

The Aluminium Company for Egypt, Nag Hammadi:

The Government owned smelter at Nag Hammadi was built with Soviet assistance and know-how with a present capacity of 100,000 tpy at an investment of E£ 100 million and its capacity is likely to go upto 166,000 tpy in 1981. Production was first established in October 1975. The plant is based on imported alumina and hydro-electricity generated at the Aswan Dam (perhaps most of the electricity produced at Aswan is consumed by the smelter). The present product-mix of the plant is as follows:

Ingots of 99.5-99.7% purity	... 60%
Slabs of 99.5% purity	... 20%
Billets ...	... 10%
Wire Rods (9mm dia.) ...	... 10%.

The plant produces electric grade aluminium through the boron treatment and alloys of 6063 type.

The Egyptian demand for 1980 is estimated around 32,000 tonnes; 30% of the indigeneous production of aluminium is exported against "conversion contracts" and 40% to the free market export. The only semi fabrication activity at the plant is that of the production of wire rods, the capacity of which is likely to be expanded to 20,000 tpy. The plant employs a total of 8,000 workers, engineers etc and has 130 experts. No research activity - market or product development -

has yet been established.

With a population of about 42 million (1979), the per capita consumption of aluminium at present is 714 g. The sector-wise consumption pattern was for 1974 as follows:

Hardware	1,000 t or 5.6%	Sheets	1,000 t or 5.6%
Utensils	5,200 t or 29.4%	Profiles	1,800 t or 10.2%
Pipes	1,000 t or 5.6%	Automotive	300 t or 1.7%
Cables	6,000 t or 33.9%	Foil	1,200 t or 6.8%
Miscellaneous	200 t or 1.1%		

Total 17,000 t

In 1974, 1940 tonnes of the total consumption of aluminium was imported. The situation for 1980 is estimated as follows by the government authorities in Egypt:

Commodity	Production	Consumption	Shortfall
	in tonnes		
Pipes and Profiles	14,900	25,500	10,600
Discs and Plates	2,400	6,000	3,600
Cables	22,000	26,000	4,000

Al-Saad Aluminium Company, Mostorod:

This company in the private sector is one of the modern industrial units and was designed by an Italian firm of consultants (MITRE). It is equipped with two extrusion presses - one of 3,000 t capacity and the other of 2,000 t. The plant produces a variety of extruded sections for domestic and export markets. Its other important facilities are:

(i) Melting and continuous casting facilities supported by rapid methods of chemical analysis for quality and composition control;

(ii) Two anodising lines - the second built by the company through own engineers;

(iii) Die making facilities; and

(iv) Training institute for its artisans and those of its customers.

There is no foreign collaboration now and the shop floor problems are sorted out by their own engineering staff. It is said to be the largest extruding unit in Egypt - the two others in the private sector both have 2,000 t extrusion press each. These companies are:

(a) The Arabic Company for Aluminium, Ismaillia.

(b) Alu Misr, Cairo.

The Helwan Company for Non-ferrous Industries & Military Products: Helwan, Near Cairo:

This is Government owned company and is also known as the "63 Military Plant". Its production in 1975 was as follows:

Foil	300 t	Irrigation Pipes	1,000 t
Sheets	6,000 t	Cables	3,000 t

A new project for hot rolling with a capacity of 80,000 tpy is now under construction.

The General Company for Metals; 5, 26th July Street; Cairo:

The Company produced 2,360 tonnes of aluminium products - 1,770 t of doscs and 590 t of cast ingots. A new project for the rolling of aluminium with a capacity of 8,000 tpy was understood to be on the way.

The Egyptian Copper Works; Hagar El Nawatia; Alexandria:

The production in 1975 was:

Utensils	790 t	Foil	860 t	Wire 69	690 t
Pipes	40 t	Profiles	80 t	Plates	4,160 t

A new project is underway for the production of 15,000 tpy of

continuously cast and simultaneously rolled sheets - probably using the Hunter Continuous Casting system from the USA and the rolling mill from France (28).

The Egyptian Electro Cables Company, Teret El Ismaillia Road Cairo:

The Company is engaged in the manufacture of cables and conductors. Besides, there seem to be several small scale units engaged in the manufacture of customer oriented products.

I R A N:

In order to promote economic development through planned growth of the manufacturing sector, Iran launched successive Five Year Plans and the fifth plan period ended up with the Islamic revolution and the overthrow of the Shah and his government.. Apart from laying emphasis on the growth of the dairy products industry, cold storage facilities, fishing and canning, manufacture of woolen and cotton textiles, the V Plan sought to increase the added value in the base metals and metal products industry at an average rate of 32% per year. It was anticipated that the domestic requirements of all grades of construction steels, structural steels, sheets, wires and cables will be met through indigeneous production.

With major emphasis on power generation, transport and communication, oil and agricultural industries, the plan sought to increase the production of capital and intermediate metal goods such as machine tools pressure vessels, industrial boilers etc besides setting the following targets for the production of various items leading to the increase of value adding component in the mechanical engineering field at a rate of 38% per annum:

Refrigerators	570,000	Water Evaporators	253,000
Gas Stoves	1270,000	Washing Machines	14,000
1,400 MVA Transformers	5,200	Water Meters	350,000

Passenger Cars	139,800	Buses	12,000
Trucks & Tankers	14,300	Vans	36,500
Diesel Engines	30,700		

These ambitious development schemes resulted in an increase of the consumption of aluminium to around 50,000-55,000 tpy and was expected to increase to 142,000 t by 1980, to 206,000 t by 1985 and to 300,000 t by 1990. As far as the resources for the aluminium industry are concerned, Iran's own bauxite deposits, being of low grade containing less than 50% alumina, are not considered suitable for the Bayer process of producing alumina. These deposits occur at Mahan and Zircan. Iran, therefore, seeks to import alumina from elsewhere, notably from India or Australia, for her production of aluminium metal.

Although having potential resources for the generation of electric power through the thermal route, the generation of electricity is not yet large enough to sustain the primary aluminium industry. Production of primary metal was started in September 1972 at Arak through the Iranian Aluminium Company with a rated production capacity of 45,000 tpy which was attained in 1974 but owing to power supply problems, the output in March 1977-March 1978 period the output was 22,600 t only. Expansion of the capacity to 120,000 t by 1981-82 was planned. The smelter was thus primarily intended to meet the domestic demand of the metal in the form of properzi rods, extrusion billets or remelt slab ingots.

In order to meet the anticipated shortfall in the domestic production of aluminium, the Iranian Government investigated the feasibility of establishing a second smelter in Iran which was found feasible at Bandar Abbas based on imported alumina and electric power from the local reserves of natural gas in technical collaboration with Alcan (11).

There is considerable semi fabrication activity in Iran; there are 6-8 extrusion plants besides the plants producing rolled sheets and foils, cables and conductors. The total production of the extruded sections in the first nine months of the 1977-78 period was 17,000 t and recorded a 6% growth rate. During the same period, the Government had granted licence for the establishment of new production capacity for about 12,000 tpy of cables and conductors. The impact of the recent Islamic revolution on the industrialisation programmes cannot yet be ascertained. According to the 1977 figures, the per capita consumption of aluminium was 1.68 Kg with the following other details:

Primary aluminium production	...	21,000 t
Import of Ingots	...	13,000 t
Imports of Mill products	...	17,000 t

I R A Q

It appears that there are some plans for the establishment of primary aluminium production at Basrah based on imported alumina. Semi fabrication facilities, primarily for the domestic market in the first place, have been established at Nasiriyah under the banner of State Comapany for Aluminium Semi Products with the following lines of production:

Rolling Mill		16,000 tpy
Foil	...	2,000 tpy
Wire Rod	...	10,000 tpy

There are two other companies manufacturing cables and conductors and other aluminium metal products.

J O R D A N

Arab Aluminium Company (ARAL) has planned to start the production of extruded sections in 1980 with an initial capacity of 6,000 tpy. The company intends to produce mainly profiles for window and door frames and will also be equipped with anodising facilities. It is also likely that an aluminium rolling mill may be established in foreseeable future in cooperation with Syria (27). Besides, there are about 10 small scale industrial units mainly engaged in the fabrication work.

K U W A I T

"From mud brick to jet age .... in 25 years" - so proclaims an information bulletin of the Government. Modern Kuwait is identified with oil and ranks sixth in the world oil production. This transformation of Kuwait into a modern metropolis has been brought through the initiative of the Government and the toil of expatriat labour force, the increase in whose numbers coincides with the onset of her transformation into a nation with highest per capita income. The industry-wise distribution of labour in the year 1977 is given below but the Tables 18 and 19 provide some information on the national statistics and the extent of expatriate labour.

NAME OF INDUSTRY	No. of Enterprises	No. of Persons
1. Crude Petroleum & Natural Gas	6	5,769
2. Stone Quarrying	13	942
3. Manufacturing	397	5,784
4. Textile Weaving & Apparels & Leather	1,646	6,049
5. Manufacture of Wood Products	635	4,855
6. Paper & Paper Products	38	1,719

7.	Chemical	33	6540
8.	Non-metaalic Mineral Production	130	4179
9.	Fabricated Metal Products	401	9154
10.	Other Manufacturing Industries	108	467
	Total	3407	40468

Table 18 Statistics of Population

	1957	1965	1970	1975	1980
Kuwaities X1000	114	220	347	472	650
Non-Kuwaitis X1000	93	247	391	523	701
Total Area Sq.Km		16000	17818		17818
Population density/ sq.Km	13	29	42	56	76
Per Capita Income K$			952	3440 (1977)	

One Kuwaiti dollar equals four US dollars

Table 19 Labour Force in Various Industrial Sectors and Its Distribution Kuwaities and Non-Kuwaities

Industry	1970		1975	
	Kuwaiti	Non-Kuwaiti	Kuwaiti	Non-Kuwaiti
Agriculture & Hunting	802	3258	3983	3531
Mining & Quarrying	1675	5496	1779	3080
Manufacturing	6109	25982	2258	22209
Construction	2188	31484	1756	30500
Electricity Gas & Water	2133	5119	2034	5237
Trade	7298	25715	6327	33232
Services	36826	67310	64265	102537
Transport & Communication	2362	9776	4567	11118

Table 20 Import-Export Trade in Metals & Semi Maufactures of Aluminium for 1977.

Commodity	Import	Export
	in tonnes	
Iron & Steel	689,929	178,389
Non Ferrous Metals	14,583	1,018
Manufactures of Metals	106,759	22,654
Aluminium Semis:		
Bars, Rods, Angles Shapes & Sections	9,431	168
Plates, Sheets, Strips	953	119
Foil	190	
Pipes & Fittings	173	13
Manufactures:		
Windows & Doors	142	406
Other Finished Structures	446	44
Insulated Wires & Cables	40,332	1230
Wires & Cables	1,175	52
Domestic Utensils	610	308

From Yearly Bulletin of Foreign Trade Statistics 1977 Volume 2, Ministry of Planning, State of Kuwait.

The manufacturing units are located in industrial areas at Shuwaikh, Shuaiba (where power stations and sea water distillation plants are located and now the new capacity is being expanded at Doha). The industrial horizon and the building activity seems to be expanding at a fast rate and new products are said to " appear in both the domestic and the export markets." Indeed with her oil wealth Kuwait can attempt to do what none else can do in a short period. She can import expert services, expatriate labour and machinery from anywhere in the World.

Aluminium Semi Manufacturing Industry in Kuwait:

There is no primary metallurgical industry in Kuwait. The figures available for the export-import trade for 1977 are given in Table 20 being the latest available. Aluminium semi manufacturing industry in Kuwait has been established by private capital with and without the participation of the Government. Though foreign collaboration is not sought, the practice followed is to hire the services of production personnel from both the developed and the developing countries with the former providing the senior personnel and the latter the bulk of manpower. One unit is already producing profiles for use in doors and windows whereas a second is in advanced stage of completion. A unit has gone in the production of power cables only a few months ago (November/Dexember 1979). Annual demand for profiles is estimated between 6500-8000 tpy and is rising at 20% annually for the past few years and that of insulated cables at 3000 t. There do not seem to be any plans for the establishment of semi fabrication facilities for rolled products or for bare conductors, foil or powder.

Arabian Light Metals Company:

The plant is equipped with a Farrel Extrusion press and has a production of 3600 tpy - almost half of the production is used in the domestic market and the other half is exported to neighbouring countries - Syria, Qatar, Gulf States, Saudi Arabia and Jordan. In both the domestic and the export markets it competes with products from Turkey, Taiwan and Korea. The anodising facilities are capable of producing a variety of colours on the surfaces and further expansion is planned. The company is now installing melting and casting facilities to manufacture extrusion billets from secondary aluminium.

The plant employs about 94 production people and the labour force would be expanded to about 130 on the execution of the present expansion plans. The company visualises a bright future for the aluminium

extrusion industry in the area as expansion of existing plants and the setting up of new plants has not kept pace with the increase in the demand of the products or with the diversification of the fabrication industry (profiles for furniture or for automobile bodies or the use of aluminium pipes in irrigation etc.).

There are no plans for the training of Kuwaiti labour within the industry because of the availability of cheap expatriate labour and trained manpower. It was indicated that in a small extrusion plant only 5% of the workforce need any specific technical training or knowledge. The expatriate labour confers certain advantages from a managerial point of view because (i) the labour flexibility is greater (than their European counterparts), (ii) their productivity is higher and (iii) they are amenable to any managerial decision. It was clearly indicated during the discussions that their experience with entrusting the management to established industrial houses was not particularly happy but they were very satisfied when they hired the services of the experts themselves directly. Presently, there are no facilities for the production of the dies which are imported.

Aluminium Extrusion Company (ALEXCO) at Sulibia :

This will be the second extrusion plant in Kuwait and is presently under construction. Its production facilities will include (i) a 2000 t capacity Lindeman extrusion press, (ii) anodising facilities, (iii) die maintenance and (iv) secondary melting and continuous casting. It will employ about 80 persons on a single shift operation basis.

Gulf Cables and Electricals Ltd:

This is a privately managed company with the equity participation of the government and has no collaboration with any international company.

S A U D I A R A B I A

With an eye on the diversification of her economic and industrial pattern, Saudi Arabia has shown particular interest in promoting metallurgical industries within her domains. She was actively considering the establishment of a 225,000 tpy smelter with integrated facilities for extrusion and rolling of 50,000 tpy of her own aluminium, by the year 1984. Having acquired financial interests in the smelter in Bahrain, Saudi Arabia has deferred her own plans for the smelter indefinitely with a view to promote unity in the Arab region; whether this decision would have any effect on the semi fabrication facilities planned with the smelter is presently not known. However, other independent semi fabrication facilities are progressively coming up.

Aluminium Products Company (ALUPCO): DAMMAN:

This is Saudi Arabia's first and most modern facility designed by AIESA(ALUSUISSE) who provided the entire basic and detailed engineering work as well as the project management and construction of the plant. The facilities consist mainly of the following;

Remelt & Casting Shop

Extrusion	...	Two press lines (1600 & 2500 t presses) with 5,600 tpy
Anodisation	...	Two lines; 4800 tpy
Fabrication Plant		800 tpy

Water Treatment Plant.

Aluminium Bars Factory at Riyadh was stated to be under construction in November 1978 for 6,000 tpy of rolled products.

Saudi Cable Company, Jeddah were to have started up their production with copper cables in 1979 and could take up the production of aluminium cables later. The company has 20% participation of Anaconda and Standard Oil Company, California.

UNITED ARAB EMIRATES (DUBAI):

The first metal from the Dubai Aluminium Company's smelter was poured in November 1979, making it the second country in the Gulf region to produce aluminium. It is anticipated that the smelter will help to diversify the economic structure of the country as well as to catalyse the establishment of semi fabrication and fabrication industries to meet the demands of the products in the region. However, much of the smelter output anticipated at 135,000 tonnes in 1981 is likely to be exported as primary metal. The technology for the reduction process was supplied by the National-Southwire Aluminium (USA). The plant has a captive power station based on gas turbines and generates 515 MW from 3,150,000 CuM/day of the natural gas. The alumina is imported from Australia.

Anticipating the local availability of the metal, the Al-Ghurair industrial group established Gulf Extrusion Ltd., which started production in 1978. The construction stage project management was entrusted to the British Smelter Constructions and the technical know-how was provided by Alcan-Booth Extrusions. The plant is equipped with a 1600 t, three column extrusion press supplied by Fielding & Platt; it takes 100 lb billets of 7 in. diameter. The billets can be pre-heated to 480 ^{o}C in a 750 kW induction furnace made by Banyard Metalheat; the heat treatment ovens are supplied by Mecatherm and Leeds and Northrupp. At full capacity the plant will produce 3,000 tpy of anodised architectural sections, some under licence from the Alcan Research & Development for their ANOLOK process. The Turner Engineering anodising plant employs a U-layout with three 11,000 amp sulphuric acid anodising tanks. The total work force will be 100.

The Dubai Cable Company working with the BICC is primarily designed for the copper cables but expects to produce overhead aluminium conductors as well.

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CHAPTER III

COUNTRIES OF NORTH AFRICA & TURKEY

(ALGERIA, LIBYA, MOROCCO, TUNISIA AND TURKEY)

Production of primary aluminium has been established only in Turkey but according to a survey (28) prepared for the Industrial Development Centre for Arab States in 1977, both Algeria and Libya have long and short range interests in establishing aluminium smelters; the report indicates anticipations for 200,000 tpy capacity by 1990 by Libya and of 140,000 tpy for Algeria by 1982 expanding to 280,000 tpy in 1990. Since their domestic demands are not large enough to consume the anticipated productions, much of the metal will find its way in the international market. Since bauxite is also not found locally, alumina will have to be imported and the production of the metal will exploit the locally available resources of natural gas for the generation of electricity. Against this situation, the production of primary metal in Turkey is neither able to meet the internal demands nor is able to satisfy the demands of the semi fabrication industry which has to depend on imports of primary metal. Despite this optimistic situation from the point of view of the semi products industry, there is no research and development activity in the field of aluminium technology. Whereas Turkey is now emerging as an exporter of the semis, Morocco is not far behind and is very actively persuing the establishment of semi fabrication facilities.

Presently, most of the requirements of aluminium and semis of this group of countries is met through imports, mostly from the European countries on account of their geographical proximity. Table 14 showed that these countries imported a total of 17,604 tonnes of semis in 1978.

A L G E R I A

ALUSUISSE has been assigned to undertake studies (market-, technical- and feasibility) for the establishment of rolling and extrusion plants in Algeria. It is anticipated that these studies will lead to the establishment of the semi products industries.

M O R O C C O

The figures of the imports of aluminium semis provided by the Ministry of Commerce and Industry are given in Table 21. Though the aluminium industry is in its infancy in Morocco, the country exported a little over 1,000 tonnes of aluminium products, semis and scrap in 1978 to Senegal, Mauritania, Libya, Gabon and France. Her imports of aluminium in all forms for the same year amounted to 5,196. The production of semis and the aluminium industry in general will get substantial boost with the production of extruded products commencing at the works of Ste' Aluminium Du Maroc at Tanger. The plant with a production capacity of 2,000 tpy was expected to become operational in September 1978 and in this process creating 150-200 new jobs directly (30).

CGE Maroc at Casablanca are planning to produce electrical cables and Manufacture Marocaine D'Aluminium at Mohammedia tubes foils and other articles of aluminium.

Table 21 Figures of Imports of Aluminium Semis in Morocco

Commodity	1976	1977	1978
			X tonnes
Bars and Profiles ...	2191	2492	1282
Sheet ...	2863	2715	1955
Tubes and Tubular Products ..	651	1170	386
Total	6336	7083	4280

T U R K E Y

Although Turkey has long been using substantial quantities of aluminium and has, amongst the developing countries, relatively high per capita consumption, the primary metal production commenced only in 1974 and is based on domestic bauxite. The primary aluminium smelter Etibank Seydisehir Aluminyum Tesisleri,Seydisehir is a state owned company. The technology, plant, equipment and know-how was supplied by v/o Tsvetmetpromexport of the USSR. It is an integrated plant. Its products include alumina, the excess production of which is exported, and aluminium ingots, billets, plates and foil. The internal consumption of aluminium has remained stable and indeed may have declined from the peak consumption in 1975 - the statistics of production and consumption are given in Table 22 (16). The internal production of primary metal can meet only half the domestic demand and the balance is met through import of ingots and billets. The import of mill products is relatively small and is compensated by the export of larger quantities, mostly to the countries of the Arab region. The demand of aluminium products during the year 1978 was (31):

Plates	22,600 t	Foils	4,100 t	Extruded	12,500 t
Conductors	13,100 t	Castings	12,450 t	Total	64,800 t

Table 22 Statistics of Aluminium Production and Consumption

	1968	1974	1975	1978
	in thousands of tonnes			
Primary Aluminium	-	-	18.0	39.0
Import of Ingots	13.9	55.4	57.0	
Import of Mill Products	5.5	3.3	3.3	
Export of Mill Products	-	24.3	3.3	
Apparent Consumption	19.4	34.4	75.0	64.8 +
Per Capita Consumption in grammes	545	818	1682	900 +

+ Data supplied by the Turkish Embassy in London.

This shows that about 80% of the total consumption of aluminium is through the semi products and in this respect the structure of the industry and consumption follows that of the developed countries.

Production of the aluminium semis was started in 1959/60 with the production of sheets and circles for the manufacture of kitchen utensils and was followed by extrusion using the facilities and technological expertise available with the extrusion presses originally installed for copper. Production of wire rods through extrusion or continuous casting with simultaneous rolling in Properzi type of machines was established in the late 1960s. During this period, the primary metal exporters provided technological advice on the processing of aluminium as part of the deal. This methodology was successful in putting the aluminium semi industry on firm foundations specially because of the experience already available with the copper industry. Now besides the state owned company, the other semi manufacturing industries are:

1. Nasas Aluminyum A.S. - plates and foil; with U.S. technology;
2. Aksan Metal Sanayi ve Ticaret A.S. - Aluminium profiles; with the help of Canadian technology.

There are in addition about 400 other manufacturers in Turkey with small to medium capacities who are organised by the Aluminium Producers' Association: Aluminyum Sanayicileri Dernegi, Gumussuyu, Istanbul. The combined capacity of these units is as follows according to an estimate:

Flat Products	50,000 t	Sections	50,000 t
Conductors	35,000 t	Castings	30,000 t
Foil	9,000 t		

Plenty of spare capacity is thus available in Turkey and the facilities could easily be utilized to export aluminium semis/products to other

countries where demands exist. This approach could contribute its share in boosting up the depressed economic situation of Turkey.

Rabak Elektrolitik Bakir ve Mamulleri A.S.:

This company manufactures flat products from own continuously cast slabs; ACSR & AAC conductors from own Properzi and Secim rods, aluminium alloy ingots and accessories for the overhead lines and also galvanised steel core wire. Their production figures for 1978 are:

Sheets	2566 tonnes
Conductors	6846 tonnes
Alloy Ingots	720 tonnes

Much of their equipment has been obtained locally and they employ about 450 persons.

As far as the Seydisehir Aluminium Complex in Central Anatolia is concerned, it is proposed to expand the alumina refining capacity to 260,000 tpy from the present 200,000 tpy and that of smelter to 120,000 tpy.

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CHAPTER IV

EAST AFRICAN COUNTRIES
(Ethiopia, Kenya, Mozambique and Tanzania)

From the point of view of aluminum consumption, the East African countries are most unfavourably located, far away from both the producers of primary metal and the important shipping routes. The nearest smelters are in India, Bahrain, UAE (Dubai) and South Africa with whom many countries of the world do not have diplomatic and trade links. Since there are continuing shortages of the metal in India in view of the expanding domestic markets and the metal from Dubai (which entered the world market only a couple of months ago) and Bahrain is purchased by bulk consumers, no producing company has ever felt the need to cultivate these markets. Whatever uses have been so far developed are in the essential sector which do not require any special motivation such as for domestic cooking utensils. Shipping delays, extended and uncertain deliveries have not created a favourable climate to promote the use of aluminium as irregularities in the supplies necessitate carrying of large inventories for long periods thereby the higher financial charges render the use of aluminium not particularly attractive.

Semi fabrication aluminium industry has been etablished in Kenya and Tanzania on a relatively small scale only in very recent years but the import of semis has never been significant as shown by the data presented earlier in Table 14. The data on import, local production and per capita consumption based on estimates is given in Table 23; only in case of Tanzania, however, is the latest data on census available and the 1978 population is reported as 17.55 million; in other cases the latest available data was used. It is now known that Mozambique has secured UNIDO assistance for advice regarding the establishment of aluminium industry in the country.

Table 23 Data on import and Production of Aluminium Semis in the East African Countries:

Country	Import from Table 42 Tonnes	Local Production Tonnes	Total Consumption Tonnes	Per Capita Consumption grammes
Ethiopia	248	n.a.	372 +	13
Kenya	1952	600	2552	183
Mozambique	189	n.a.	272 +	30
Tanzania	661	3700	4361	250

n.a not available;
+ assumed 50% more than the imports of the semis to take into account possible imports from other countries; on other source of information could be tapped.

K E N Y A

The demand for aluminium has been greatly varying between 329-660 tonnes/year during the period 1970-76 as shown below:

1970		608 t	1974	...	587 t
1971	...	383 t	1975	...	660 t
1973	...	329 t	1976	...	600 t

The prevailing uncertainty about the assured availability has definitely discouraged the growth of the aluminium market. According to the estimates prepared in 1976/77, the consumption could have gone up to 750 tonnes in 1978 and could go upto 1200 tonnes in 1983. The break up of the current demand based on the end use application is given below:

End Use Application	Estimated Consumption tonnes	% Demand	Present & Potential Demand on easy avalability of metal tonnes
Aluminium doors/windows	360	60.0	600-650
Irrigation Pipes	45	7.5	100
Transportation	75	12.5	250
Electrical Cables	100	16.7	
Miscellaneous	20	3.3	
Anticipated Export to Uganda and Zambia on the basis of 50% of their present imports			260

Extrusion Activity:

The following two organisations have either already established extrusion plants or are in advanced stages of the completion of their projects:

1. Booth Manufacturing Company, Nairobi to produce extrusions for aluminium doors/windows etc. They will produce 600 t of aluminium sections and 250 t of copper and brass in 1980.
2. Kenya Casements, Mombasa to produce extrusions for doors/ windows etc. They are procuring the machinery from C.A. Whittaker & Co. in United Kingdom - 300 t in 1980/81.

Rolling Mills:

Narcol Aluminium Rolling Mills Ltd. Mombasa.: have gone in production 1979/80 and intend to process 1200 t each of aluminium sheets and circles (36 inch dia. 22 gauge). These products wil be consumed by their own sister unit, Narshidas & Co Ltd., Mombasa. They have erected one hot and two cold rolling mills, 1.5 t capacity annealing furnace and a 1.5 t capacity melting furnace. The mills are manufactured by M/s Brightside Sheffield.

The technology is through Indian engineers.

Cables & Conductors:

East African Cables Ltd. Nairobi: The company seems to have been established by or is working in collaboration with the Delta group of the UK. No other details are known or supplied by the company.

The oldest fabrication unit is the Kalu Works Ltd, Mombasa for the manufacture of hollow-ware items. The other is the Mabati Ltd. at Nairobi.

T A N Z A N I A

Aluminium Africa Ltd. (ALAF) Dar es-Salaam.

ALAF was promoted in 1960 by the Chandaria group and the Government of Tanzania acquired majority interests in 1973 by investing additional funds but left the management in the hands of the same group. The company claims that it employs "simple and unsophisticated" production methods and aspires to promote technology, to develop skills and expertise within the country. The source of the know-how is from Indian expatriates but the nationals are being trained to replace them. The company imports slabs of secondary aluminium from Australia, has melting and semi continuous casting facilities for 2400 kg slabs, a two-high hot rolling mill, a four-high cold rolling mill and the installation of an extrusion press is under consideration. It has a capacity of 9000 tonnes but the production is substantially less even when exports to neighbouring countries is taken into consideration as shown below (the company exports to a unit in Kenya under the same management);

Year	Domestic in tonnes	Export	Total
1974	1828	1437	3265
1976	1809	1748	3557
1977	3255	535	3790
1979	3700	600	4300

Their exports were highest in 1976 and have now declined to about a third of the peak value. It is difficult to state whether this was due to decline of the demand in the neighbouring countries due to the disturbed political situation prevailing in most of Africa or due to the difficulties in procuring aluminium for conversion into semis. The company is now interested to carry out a market survey in the neibouring countries.

The company produces semis for domestic utensils which are manufactured by Metal Products Ltd, Dar-es-Salaam.

Tanzania Cables Ltd., PO Box 508, Dar-es-Salaam

The product mix and the figures of production are not known. However, Tanzania has ambitious plans to develop hydro-electricity to meet the increasing demands of the industrial and domestic sectors including rural electrification. Her hydro-electric potential is estimated at 1400 MW but so far only 262.5 MW have been harnessed. Nearly all the towns have diesel electric generators and the majority of villages is not electrified so that the power generated is mostly consumed in the urban areas which account for only 8% of the population. Tanzania's consumption of aluminium, already highest amongst the East African States could further increase with the implementation of hydro-electricity generation programmes and construction of national grids.

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CHAPTER V

COUNTRIES OF WEST AFRICA

(CAMEROON, GHANA, GUINEA, NIGERIA, ZAIRE & ZAMBIA)

This region is important for the aluminium industry because (i) two of the countries - Ghana and Guinea - are important exporters of bauxite/alumina and are members of the International Bauxite Development Association; (ii) two countries - Cameroon and Ghana - together produce about 177,000 tpy of the primary metal (21) from imported alumina using their hydro-electric resources - only a small fraction of which seems to have been so far harnessed and thus presenting attractive possibilities of implementation of the growth of the industry planned for the 1980s; (iii) Nigeria is a petroleum exporting country and is emerging as an important consumer of aluminium and (iv) plans for the establishment of the primary smelters are reportedly being examined by the Government of Zaire for two projects in separate associations with Alusuisse and Reynolds (at Bas Zaire and Banana-Caliendor) (32).

As shown earlier in Table 14, the six countries together imported about 27,500 t of semi aluminium in 1978 from the countries of the European communities, Canada, USA, Australia and Japan with Nigeria leading with 21,022 t.

C A M E R O O N

The production of primary metal has been established by ALUCAM which produces slabs for the domestic and the export markets. The Pechiney Ugine Kuhlmann group established a wholly owned subsidiary SOCATRAL (Societe Camerounaise de Transformation de L'Aluminium) which started to produce 30,000 tpy of laminated products for the domestic and export markets divided as follows:

Commodity	Domestic	Export	Total
Sheets	15,000	1,500	16,500 tonnes
Coiled sheets	-	10,000	10,000
Plates	1,600	1,900	3,500

SOCATRAL plans to increase their production to 40,000 tpy in coming years. The company finds the market expanding but experiences difficulty in raising new investment in proper time for the expansion. Socatral employs about 200 people and is said to play a big role in the economy of the country. The plates and sheets are sold through a network of distributers for conversion into roofing sheets and kitchen ware, thus generating considerable down stream employment. The exports are mainly concentrated to sister companies in West and Central Africa.

N I G E R I A

In Nigeria, both the Alcan and the Alusuisse have helped the government to establish semi-fabrication industry - the former with a capacity of 6,000 tpy of sheets and circles and the latter designed and constructed the extrusion plant for the Nigerian Aluminium Extrusion Company (NIGALEX) witn 3,000 tpy extrusion capacity along with anodisation facilities for 1,000 tpy. The Plant was erected in 1974 at Oshodi, 20 km. north of Lagos city. It has one 1600 t extrusion press and employs about 200 people. Alusuisse has a 20 % participation in NIGALEX and has an engineering operations contract with the Government.

G H A N A

Since aluminium is an energy intensive metal and its demand for consumption in the developed and the developing countries is growing

alike, it is often seriously considered that the developing countries with vast resources for hydro-electric power could take advantage of the world situation and develop primary aluminium industry on priority to meet the demands of the export trade. On a similar consideration, the oil and natural gas rich countries of the Arab region launched the aluminium industry and began to export energy stored in the metal. The advantage in establishing export based aluminium industry in countries with hydro-electric resource is that only the renewable energy is used in producing aluminium for export.

An important aspect of the industrial development in the Thirld World countries is to generate employment for the growing populations. In this context it may be necessary to ensure that the national resource is exported only after generating maximum possible employment and enhancing the value of the product through semi or complete fabrication, wherever possible. The case of the Arab oil producing countries is, however, different from others because of their constraints on account of their limited human resouces.

The Volta hydro-electric dam at Akosombo and its associated aluminium smelters were built in the 1960s ostensibly to promote regional industrial development through electrification and to produce aluminium for the export market, in order to provide foreign exchange and to create additional employment. A recent report critically analyses (33) the extent to which the two projects have contributed to the regional development and goes on to show that the benefits and the overall job opportunities, thus created, were far below the optimistic anticipations of the planners; infact the study has disputed every aspect of the implementation of the project. Apart from the aluminium smelter receiving electric energy at rates considerably below those prevailing in the other countries (both the developed and the developing), the report draws attention to what it calls "oddities"

of the development project; some of these are:

- Though Ghana exports bauxite to the United Kingdom, she imports alumina between 250,000 -300,000 t from Lousiana in the USA which in itself was processed from the imported Jamaican bauxite.
- The indigeneous primary metal is exported but rolled aluminium is imported for pans and pots and corrugated roofing sheets by the Ghana Aluminium Products which is a joint venture between the Ghana Government and the Alcan.

The Report also focuses attention on the political, social and economic aspects of the developing situation. In the absence of any other information on the aluminium industry in Ghana, the facets of the aluminium industry pointed out in the Report could not be verified from any other source. But the developing countries with population resources may consider the advisability of linking the production of primary metal with the production of semi fabricated products; particularly when considerable demand for the semis exists in the region.

After its start in 1972, the VALCO smelter produced 168,729 t of aluminium against the rated capacity of 200,000 tpy. According to Metal Bulletin (5th August 1980), VALCO paid taxes to the Government for the first time in 1979 after the five year tax holiday. Ghana has expressed desires for the establishment of an integrated aluminium industry and there are some indications that Nigeria may join Ghana in exploiting the bauxite deposits.

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CHAPTER VI

LATIN AMERICAN COUNTRIES OF SOUTH AMERICA

(Argentina, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela)

The eight countries of South America differ from one another in respect of industrial development and the availability of infrastructure to support rapid industrialisation. Countries like Argentina, Brazil and Chile could be regarded as semi industrialised and Venezuela is fast approaching in that direction as she has no constraints of financial resources on account of the availability of vast resources of natural oil. As far as the aluminium industry is concerned, bauxite is available abundantly in Brazil and Venezuela where it is being aggressively exploited and significant deposits of metallurgical grade bauxite are known to occur in Colombia (34), in others it is not found. Primary metal industry has been established in Argentina, Brazil and Venezuela, often with the participation of and by the transnationals of the aluminium industry; extensive semi fabrication activity exists in Argentina and Brazil and on a modest scale in Chile where the semi fabrication copper industry can easily adapt itself to the processing of aluminium should the need to do so arise. Other countries have semi fabrication activity on a small scale. These countries imported about 31,720 tonnes of semi fabricated aluminium (Table 14) from the industrial countries of the 'North' except the USSR, the figure cannot be taken to represent their present levels of consumption in view of their own semi- fabricated production and trade in the commodity within themselves.

Aluminium has bright future in Argentina, Brazil and Venezuela all of whom have established facilities for the production of primary metal and of the semis for the large domestic demands and also to meet the export demand. The relative figures of production, export and import of aluminium for the three countries are given below:

Item	Argentina	Brazil	Venezuela
		X 1000 tonnes	
Primary Production ...	54.5	205.5	74.0
+ Imports of Ingots ...	-	66.6	-
+ Imports of Mill Products	0.7	16.3	29.9
+ Recovery of Secondary Metal	8.8	54.2	11.0
Export of Ingots ...	8.3	-	31.0
- Export of Mill Products ...	9.4	4.3	-
Actual Consumption ...	66.8	331.2	74.0
Mid Year Population in millions	26.5	113.2	13.1
Per Capita Consumption Kg	2.273	2.682	5.136

Venezuela is in the happy position that on account of the oil wealth there is no difficulty in finding new investment for the aluminium semi products industry or for the primary metal production both of which have been planned in a big way for expansion.

A R G E N T I N A

Argentina is excellently placed with respect to the energy resources. She has (i) vast resources for hydroelectric generation of power, (ii) near self sufficiency in natural oil and expecting to become self sufficient by 1982-84, (iii) recently found an occurrence of 385 billion cu.m of natural gas and (iv) has access to the natural gas from Bolivia. She is, therefore, in the happy position to start energy-based metallurgical industries. Her production of primary aluminium at her Puerto Madryn smelter is based on imported alumina from Australia or South Africa and the hydro-electricity generated several hundred miles away in the Andes region. At present 63% of all the electricity generated in Argentina is through the combustion of oil, 23% of natural gas, 2% nuclear and a mere 6% is hydro-electric; in future the pattern will change to 73% hydro-electric, 15% nuclear and 12% from fossil fuels (35).

Although there is no semifabrication activity at Puerto Madryn, there are a number of large and small semi manufacturing units. Amongst the larger units are (i) CAMEA S A with technology from Alcan, (ii) Kaiser Aluminio S A (KASA) and (iii) Financiera Platense S A (FIPLA). Their installed capacities are:

	CAMEA Production 78-79	CAMEA INSTALLED CAPACITY	KAISER INSTALLED CAPACITY	FIPLA INSTALLED CAPACITY
	Xtonnes			
Extrusion	3,500	8,000		
Rolled Products	9,000	13,000		
Foil	3,000	4,000	xxx	
Rod	xxxx			19,000
Total		25,000	15,000	19,000

Regarding CAMEA as typical of the three, some information about it could be of some interest. The total employment in CAMEA'S industrial complex is 1,600 persons including those in the collapsible tube plant, conversion plant, foil conversion and anodising plants but in 1978 CAMEA was not operating at full rated capacity.

Amongst the medium sized plants are Talleres Rivadavia Industrias Metalurgicas with a total production capacity of 3,000 tpy of sheets, extruded products, bars and rods and Industrias RAB with 2,000 tpy of sheet and plate. In addition there are about 8 plants producing extrusions and sheets with annual production capacities of 400-6000 tpy each.

The entire production of semis goes to the domestic markets.

Argentina is now known to be planning for export based, 140,000 tpy aluminium smelter in the far south at Rio Gallegos or Puerto Santa Cruz. The plant is initially likely to be based on natural gas or coal but will later switch over to hydro-electric power, the resources of which are presently estimated at 6,000 MW in the region. This aluminium complex could also have bauxite refining facilities as well as facilities for semi products but details are not known for the present.

B R A Z I L:

In order to introduce Brazil, the following excerpts are taken from an advertising message from Brazil published in the Time (36): "It is the fifth largest country in the World, seventh in population, eighth in the western world in terms of Gross National Product .... Hydroelectric potential is amongst the largest in the world, aggregating about 209 million kilowatts. The vast mineral reserves include iron ore, uranium, huge amounts of bauxite, plus gold, tin, copper, manganese and tungsten. Then there's steel (Brazil is the twelfth largest producer of steel ingots in the world). Petrochemicals, automotive products (tenth largest), aeronautical equipment (second in the western world in the General Aviation sector) and ship building are also highly developed. ..... To make sure there will be no energy shortage, a number of hydroelectric plants are rising. One of them, Itaipu, rated at 12,600 MW, will be the largest in the world, about one third larger than Grand Coulee, in the USA. ... The third and the fifth units, Paulo Afonso and Tucurui, are also in Brazil."

"The country has 31,000 km of rail roads, 1.4 million km of highways (of which about 85,000 km are asphalted) and one of the largest air service networks in the world. Three domestic and international airlines fly about 270 thousand hours a year, covering 172 million km. They carry some 8 million passengers, 135 thousand tons of freight and 5,000 tons of airmail."

Annual capita income is US$ 1639, and has been growing at an average rate of 5.7% eversince 1972. That's a good level of income. It might be asked how a country can industrialise as fast as Brazil

is doing, producing more and more mass consumption goods, if its per capita income is only that of a developing country?

"But the fact is that Brazil is really not just a single country. Indeed, it never could be, in view of its continental dimensions. If we take just the South East and South, from Minas Gerais down to Rio Grande do Sul, we get what is equivalent to whole vast country richer than even Spain, Israel or Ireland .... a country extending for 1,462,656 sq. km.

"So in that region, we are really talking an entirely different idiom in terms of commerce, education, purchasing power, population growth.

"It is a region inhabited by a whole middle class that has arisen in the last 15 to 20 years, and keenly interested in political stability and social progress. And it's these people we are introducing to you as your leading partner of half the planet".

The other side of the coin shows that 90% of the Brazilian production of minerals consists of just four minerals - iron ore, pyrochlore, manganese and tin (37). The mineral sector which had recorded rapid growth during the boom period of economic activity in the 1960s and the early 1970s now seems to have slowed down. Inflation was stated to be running at 65% (38). The growth of the mineral product fell to 0.9% in 1976 from the peak performance of 42% in 1974 and finally declined by 4.7% in 1977 but again showed an increase of 6.6% in the January-November period of 1978. Nevertheless, the performance of the non-ferrous sector has been excellent throughout as the production and consumption of all non-ferrous metals increased in 1976 (39):

Metal	Percentage Increase in	
	Production	Consumption
Aluminium	20	22
Copper	17	23
Lead	12	18
Zinc	5	9
Tin	16	10
Nickel	18	18

Since the rate of growth of consumption outstripped that of production, the Brazilian industry's index of overall dependence on foreign minerals jumped (37) from 60% in 1976 to 70% in 1977, despite (i) the considerable increase in the production of primary aluminium, (ii) intensive substitution of copper by aluminium and (iii) increased production and better pricing of tin in the export market. The trend of continued dependence on the imports of non-ferrous metals seems to have continued in 1978. According to Análise (37), the "possibility of reducing this dependency in the short run is remote because many of the projects involving the domestic production of minerals of high economic value that are lacking in Brazil are proceeding at a very slow rate, a rate that is hardly compatible with their strategic importance. It is also recognised that companies occasionally benefit by importing from their parent firms at overstated prices". The publication (37) attributes this paradoxical situation to "powerful foreign groups ... keeping their investments in the sector on a very modest scale; ... some in fact reduced their activities in Brazil to a minimum ..." Despite the immense hydro-electric potential, Brazil continues to rely on imported energy - both oil and coal -62 % of the imports are of crude oil.

Table 24 Production and Consumption of Aluminium and Import of Semi Manufacture in Brazil:

Year	Production including Secondary	IMPORTED Primary	Semis	Total	Per Capita
	in	tonnes			Kg
1960	14,973	15,015	5,570	35,558	-
1970	64,147	27,433	13,112	104,692	1.1
1975	141,945	78,804	15,575	236,324	2.4
1978	235,597	60,435	14,737	310,769	2.6
1979	291,896	51,816	27,293	371,005	2.9
1980(p)	306,743	48,088	22,239	377,070	3.0

Source: Anuario Estatistico ABAL 1980
(p) - Preliminary

Amongst the developing countries, Brazil shows the highest per capita consumption of aluminium. Table 24 records the growth in the consumption of aluminium over the years. The sluggish increase in the consumption of aluminium after about 1977 is attributed to the slowing down of the building activity and the electrification and tele-comminication programmes and significant working down of the stock-piles, principally of rolled aluminium and of packaging foil.

The **Associação** Brasileira do Aluminio ABAL (Rua Oscar Freire, 379-14 andar, Conj 142 CEP 01426, Sao Paulo) estimated that the demand for aluminium would have reached 327,000 t for 1979 against indigeneous production of the primary metal at 246,000 t. ABAL visualises a bright future for aluminium in Brazil because of (i) continuing increase in the demand of cars/buses/trucks and (ii) the need to develop hydro-electricity grids (41). The Brazilian consumption of aluminium in 1978-80 was distributed in different sectors as follows:

Sector	% Consumption		
	1978	1979	1980(p)
Civil Construction	23.8	23.4	23.8
Transportation	17.4	18.0	19.2
Electrical	24.8	23.2	21.5
Consumer Items	14.4	14.3	14.6
Machinery/Equipment	4.1	4.1	4.1
Others	15.5	17.0	16.8

The Primary Metal Industry:

The Brazilian aluminium production is in the hands of both the nationals and the transnationals. The existing and the proposed plants are shown in Table 25 but Table 26 gives figures for the production capacity and consumption of semis for 1978 (40). It appears that the primary aluminium produced by ALUNE will be supplied to Fabrica Aluminio SA at Igarassu for down stream operations (41).

Table 25 - Primary Aluminium Smelters in Brazil (39-41)

Plant	Location	Capacity	Expansion
Existing			
Alcan (a)	Saramenha, Munic, Ouro Preto	50,000 with semis	
Alcan (b)	Araty-Munic de Candeias	28,000 with semis	58,000 (1982)
CBA +	Munic Mairinque, Sorocaba -SP	67,000 with semis	120,000 (1982)
Alcominas ++	Munic de Pocos de Caldas -MG	60,000 ingots only	90,000 (1982)
Under Construction or Proposed			
ALBRAS	Barcarena	320,000 ingots only for 1987	
Valesul Aluminio SA	Santa Cruz-RJ	86,000 for 1982	
Alune (Alcan) +++	Pecifee, PE	110,000 ingots only for 1990	

(a) Aluminio do Brasil; (b) Aluminio do Nordeste SA
\+ Cia Brasileira de Aluminio ++ Companhia Mineira de Aluminio
+++ Aluminio do Nordeste SA
Source: Anuario Estatistico 1979 page 15

Table 26 Installed Capacity, Production and Consumption of Semi Manufactured Aluminium in 1980 (Preliminary)

Types of Products	Capacity	Production	Consumption
	(in thousand tonnes)		
Rolled Plates & Sheets	146.0	100.6	101.7
Foil	27.0	19.6	19.6
Extruded Section	104.4	83.8	85.1
Cables & Conductors	96.0	65.5	65.1
Powder & Paste		5.8	12.9
Foundry & Forge		58.1	56.2
Destructive Uses		12.0	12.0
Others		1.0	0.7

Table 27 Consumption of Semis in Different Major Markets in 1978 in Brazil

Major Market	Plates & Sheet	Sheet	Extruded Sections	Cables & Conductors
		X 1000 tonnes		
Civil Construction	29.6	0.1	41.9	-
Transportation	11.2	0.2	10.3	-
Electrical	1.4	0.8	3.2	63.8
Consumer Products	31.2	0.2	8.5	0.2
Packaging Materials	9.6	13.6	0.9	-
Machinery & Equipment	4.0	0.6	3.5	1.0
Total +	88.0	16.3	63.9	66.1
Powder & Paste	6,600 tonnes			

+ also includes consumption listed as "others" not otherwise classified with other items;
Source: Anuario Estatistico 1979 page 18.

Table 27 gives the breakdown of the consumption of semis in terms of the major markets according to their end use in 1978. The following preliminary figures released for sectoral consumption of semis by ABAL for 1980 show that the pattern and quantum of consumption has not much changed during the period:

Major Market	Plates & Sheet	Sheet	Extruded Sections	Cables Conductors
		X 1000 tonnes		
Civil Construction	32.3	0.0	51.8	0.0
Transportation	13.6	0.6	12.4	-
Electrical	2.1	1.1	4.4	63.9
Consumer Products	36.0	0.5	10.9	0.2
Packaging Materials	12.5	16.1		
Machinery & Equipment	4.6	0.9	4.0	1.0
Total	101.7	19.6	85.1	65.1
Powder & Paste ...	12,000 tonnes			

SEMI FABRICATION :

Semi fabrication facilities have been established and planned in a big way, the larger facilities being with the primary producers and often in foreign collaboration or ownership - notable amongst them being those with Alcan, Reynolds and Alusuisse. The installed capacity is not fully utilised but the figures for 1980 released by ABAL are:

Nature of Semis	Capacity Installed	Production	% Utilisation
	Tonnes		%
Plates & Coils	146,000	106,000	68.9
Sheets	27,000	19,600	72.6
Extrusion (Total of 33 presses)	104,400	83,800	80.3
Cables & Conductors	96,000	65,500	68.2
Powder & Paste		5,800	

Production in 1980 increased over that in 1979 in all the sectors except that of cables and conductors - the decline of this sector is due to the slowing down of the national electrification work; the growth rate for others being:

Plates and Foils	...	10.7% over 1979
Sheets	...	8.9% over 1979
Extrusion	...	7.7% over 1979

There are a number of cable and conductor companies working in collaboration with well known international companies such as the BICC, Reynolds or the Pirelli. In view of substantial anticipations of nationwide programmes of electrification, all the production of cables and conductors is meant for domestic consumption. Pirelli has an engineering centre involving about 30 engineers and high level technicians for aluminium cables and conductors.

With the implementation of the present plans for the aluminium industry, Brazil would emerge as a leading exporter of the primary metal and the semis. Much of the Brazilian export of semis in 1980 went to the other developing countries of the region. A great future awaits the aluminium industry in Brazil in the late 1980s.

C H I L E:

Chile, the country usually associated with copper, has neither any known deposits of bauxite nor any production of primary aluminium. The semi fabrication industry of copper is fairly well developed in terms of tonnages processed and the availability of engineering skills and expertise. Since many of the applications of aluminium where aggressive growth has been recorded in recent years are those where aluminium has substituted copper, there is no particular incentive

in promoting such uses in Chile which continues to use copper as the use of imported aluminium does not seem to offer any significant economic advantages. This seems to be particularly important in view of the widely fluctuating fortunes of copper in the international market in the recent past.

Elsewhere it has been said that the aluminium semi industry easily grows from the experience and machinery already available for copper. In Chile some of the leading semi fabricating industrial units for copper are using their facilities to produce rolled and extruded components cables and conductors of aluminium for the local and the export markets.

Chile imports all her rather modest requirements of aluminium for domestic consumption either as semis or as manufactured products. The principal areas of consumption are in the construction industry (profiles, bars and sheets), domestic utensils and foils, electric conductors and telephone cables. The total demand of the metal is estimated at 8,000 t in 1980, growing at about 8% annually specially in the construction sector.

C O L O M B I A

The National Planning Department of the Government of Colombia and the Federacion de Industrias Metalurgicas (FEDEMETAL) have provided the following estimates of the consumption of aluminium:

1978	...	23,741 t
1979	...	25,000 t
1980	...	24,800 - - 28,000 t

A few medium scale production units for extrusions, sheets and foils, wire rods and wires have already been established with capacities varying between 3,000 - 6,000 tpy. Two of these companies were established with foreign participation: Aluminio Reynolds Santo Domingo S.A. with minority national holding of 43.5% and the Aluminio Alcan SA

with 51.2% national holding. These two companies account for almost 80% of the installed capacity for semi fabricated products. Notable amongst the smaller units are Munal and Industrias del Acero Ideace y Vernig together contributing 16% of the installed capacity. Besides, there are fabrication units to produce manufactured goods.

The sectoral consumption of semis is as follows:

SECTOR	FABRICATIONS		ELECTRIFI-	OTHERS	TOTAL
	UTENSILS	BUILDING	CATION		
SEMI					
Sheets	4,800			7,200	12,000 t
Profiles		2,700		4,050	6,750 t
Wire			6,050		6,050 t
Total					24,800 t

The growth rate visualised for sheets is 8.5% and 10% for profiles.

Whilst there is no production of primary metal, Colombia is said to be endowed with deposits of bauxite.

E C U A D O R

There is no production of primary aluminium in Ecuador but the Government is keen to promote rapid industrialisation of the country. As a first step, it has encouraged the establishment of the aluminium semi and fabricated products industry within its domains and a company has been operating for the manufacture of cables and conductors and has connections with Phelps Dodge Corporation. The following companies are producing semis:

CEDAL CEM, Latacunga - shapes and pipes for construction and irrigation.
FISA S.A., Guayaquil - "
METALES ELABORADOS
TITAN S.A, Guayaquil - corrugated aluminium

The growth of the Gross Domestic Product occurred at an average rate of 9.2% over the 1970-78 period but the mining se tor recorded the highest average rate of 45.4% and the other sectors at slower rates: manufacturing at 10.3%, transport at 7.3%, electric power at 11.6%, and construction at 5.5%. The relative magnitudes of the various economic sectors constituting the GDP in 1978 were:

Sector	Year 1978	Year 1976	Sector	Year 1978	Year 1976
Agriculture	19.7	21.5	Trade	12.4	11.5
Manufacturing	17.9	15.8	Transport	5.9	6.0
Public Sector	7.5	8.2	Mining	10.4	11.5
Construction	5.1	5.4	Others	19.7	18.8
Electric Power	1.4	1.2			

In the absence of any domestic production of primary aluminium, the country imported various types of aluminium semis to meet the demands of the local fabrication industry for domestic consumption; these were:

Commodity	1978	1975
	in tonnes	
Bars ...	528	1554
Plates, Flats (Unworked)	199	244
Circles ...	676	342
Strips worked and unworked	85	45
Shapes and Pipes	49	125
Misc bars & Shapes	84	72
Structural Elements	112	71
Bars & Shapes for use in Construction	202	7
Total	1935	2460

Aluminium semi products industry has been established in Ecuador in a small way and the products include shapes and pipes for construction and irrigation and corrugated aluminium sheets.

P E R U

Semi products aluminium industry for profiles, bars, tubes, plates sheets and discs has been established in Peru for the size of her domestic market. The 1979 production and that estimated for 1980 is given below:

	1979	1980
Profiles including tubes	2306	2957 tonnes
Sheets and discs	1157	2224 tonnes
Plates	16	19

These are processed from imported aluminium and in 1979 5400 tonnes of metal was imported besides semi products consisting of plates, tubes, sections and foil. A number of small fabrication units for consumer items have also been established.

U R U G U A Y

The size of the Uruguayan market is estimated to be around 3,500 tonnes of aluminium in final products by Alcan Aluminio del Uruguay and much of this is met by the production from the said company; the range of Alcan Uruguay products cover foil (400 tpy), sheet (2,000 tpy), extrusions (1,000 tpy), electrical cables and conductors (1,000 tpy). For the 1978-83 period, the company has estimated that growth in aluminium consumption will occur at 5% a year. In addition to Alcan, there are three other industrial units manufacturing mostly sheet and circles and some quantity of tubes .

The total installed capacity in the different sectors of semi abrication in Uruguay is as follows:

	1980	1981
Plates & Foils	2,500	2,800 t
Extrusions	3,400	4,200 t
Cables	3,000	3,300 t

The present and anticipated consumption figures are:

	1978	1980	1985
Plates & Foils	1,065	1,320	1,500 t
Extrusions	1,100	1,700	1,700 t
Cables	485	1,200	1,500 t
Total	2,660	4,220	4,700 t

V E N E Z U E L A

The Venezuelan Guayana Corporation (CVG) of the Government of Venezuela is responsible for the development of the aluminium industry in Venezuela, initially through imported bauxite and alumina and later through the exploitation of the indigeneous bauxite deposits and of the hydro-electric potential of the Caroni River. ALCASA and VENALUM are the two aluminium smelting projects:

Aluminio del Caroni SA (ALCASA): The capacity of its smelter is 120,000 tpy but it is presently running at about 112,000 tpy. It is in joint ownership with Reynolds International Inc who also manage the project. The latest available information+ suggests that the Venezuelan Government has replaced Reynolds as a majority share-holder with the Venezuelan Investment Bank (FIV) holding 72.1% of the holding; earlier the FIV having alleged that Reynolds have not provided

+ The Metal Bulletins dated 20th July, 3rd February and 17th February o 1981 and of 31st December 1980.

adequate technical and administrative support to Alcasa's expansion phases III and IV. Subject to the availabilty of finance, Alcasa has ambitious programme of expansion to 190,000 tpy by 1983 and to 320,000 by 1986.

Industria Venezolana de Aluminio SA (VENALUM): Production was first established in 1978 with a capacity of 150,000 tpy, the present capacity being 280,000 tpy. This plant is owned by the CVG - 25%, Fondo de Inversiones de Venezuela - 60% and the remaining by a consortium of Japanese companies. The plant produced 112,500 t in 1979, 222,100 t in 1980 against the targetted production of 268,00 t. The targetted production was, however, not achieved because, paradoxical as it may sound, Venezuela is also facing energy problems as could have obliged it to cut back production in 1981 to about 245,000 t. The energy shortages were caused by the delays in the execution of the massive Guri Dam hydro-electric scheme.

Venezuela's first alumina plant - Interamericana de Aluminio CA (INTERALUMINA) is scheduled to become functional in 1983 with a capacity of one million tpy and later to expand to 1.5 million tpy by 1985. Large high quality bauxite deposits in Pijiguaos near Orinoco river in Western Guayana, estimated at 500 million tonnes will provide impetus for the establishment of an integrated aluminium industry. The first bauxite mining project, BAUXIVEN, is, however, likely to be postponed; the mine was expected on stream in 1982 to produce four million tonnes at full capacity for supplying it to Interalumina. Until Bauxiven comes into being, Venezuela will be dependent on imported bauxite.

The figures of the production of the primary metal, consumption and the per capita consumption for the 1970-79 period are as follows:

Year	Production X1,000 t	Consumption X 1,000 t	Per Capita kg
1970	22.7	11.6	1.1
1975	58.0	34.7	2.8
1978	75.3	67.1	5.1
1979	208.6	56.8	4.2

Venezuela is dependent on the import of the semis whereas she exported 31,000 t of virgin metal as ingots in 1978, 29,000 t of semis were imported (16). The present capacity for rolled products is only about 40,000 tpy and the national 1981-1985 plan is said to mention a project to bring onstream a 100,000 tpy rolling mill in 1982.

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CHAPTER VII

THE BAUXITE COUNTRIES OF SOUTH AMERICA

(Guyana, Jamaica
and Surinam)

J A M A I C A

Although Australia and Jamaica together account for some 42% of the world's Bauxite production, in Jamaica there is neither any production of the primary metal nor does there appear to be any significant semi products industry. Nevertheless, the consumption of aluminium in the country is high relative to the consumption in developing countries. The Jamaica Bauxite Institute supplied the following figures for the imports of aluminium (the figures were supplied in March 1980 and could refer to 1979 or 1978):

P r o d u c t s	tonnes
Unwrought Aluminium	1724
Wrought Bars, Rods Angles, Shapes and Sections, Wire	478
Strips	1946
All kinds of Foil	220.4
Powder & Flake	382.5
Tubes & Pipes, hollow bars	668.6
Tubes & Pipe Fittings	1.5
Pre fabricated buildings	117.6
Structures and parts of structures	156
Casks, drums, cans etc	712.5
Stranded wire excluding insulated wire & cable ...	356.6
Grill netting etc	2.7
Domestic Articles	113.5

Sanitary Ware for Indoor Use	...	...		6
Travel goods	...	...	...	57
Bolts & nuts	...	...	...	15.5
Miscellaneous	...	...	...	183
Total for the year	...	...	...	5449

Per capita per annum consumption on 2.1 million population 2.594 Kg.

(Reference may also be made to Addendum I)

G U Y A N A

Although the first commercial shipment of bauxite was made in 1917, full scale commercial exploitation of the bauxite deposits commenced in 1952 and the first alumina plant was commissioned in 1961. The Government of Guyana is presently considering plans for the establishment of an aluminium smelter with two pot rooms with an approximate capacity of 74,000 tpy for the purpose of increasing the value of exports from its natural resource based industries. The Government will eventually be interested to establish semi aluminium industry as well. As a first step an Upper Mazaruni Development Authority has been set up to develop hydro-power potential of the Mazaruni river valley which is estimated to be 3,000 MW.

Aluminium processing industry is presently confined to the (i) production of corrugated sheets from imported sheets and (ii) production of heavy domestic cooking utensils in foundry using available scrap. The latter is understood to be a very small operation run by the Guyana National Engineering Corporation, Georgetown - Aluminium Products of Guyana, 2-9, Lombard Street, Georgetown.

There are few small operations of fabricating aluminium window frames, doors, shop fronts etc from imported extruded shapes. The following data shows the import of aluminium over the 1975-79 period:

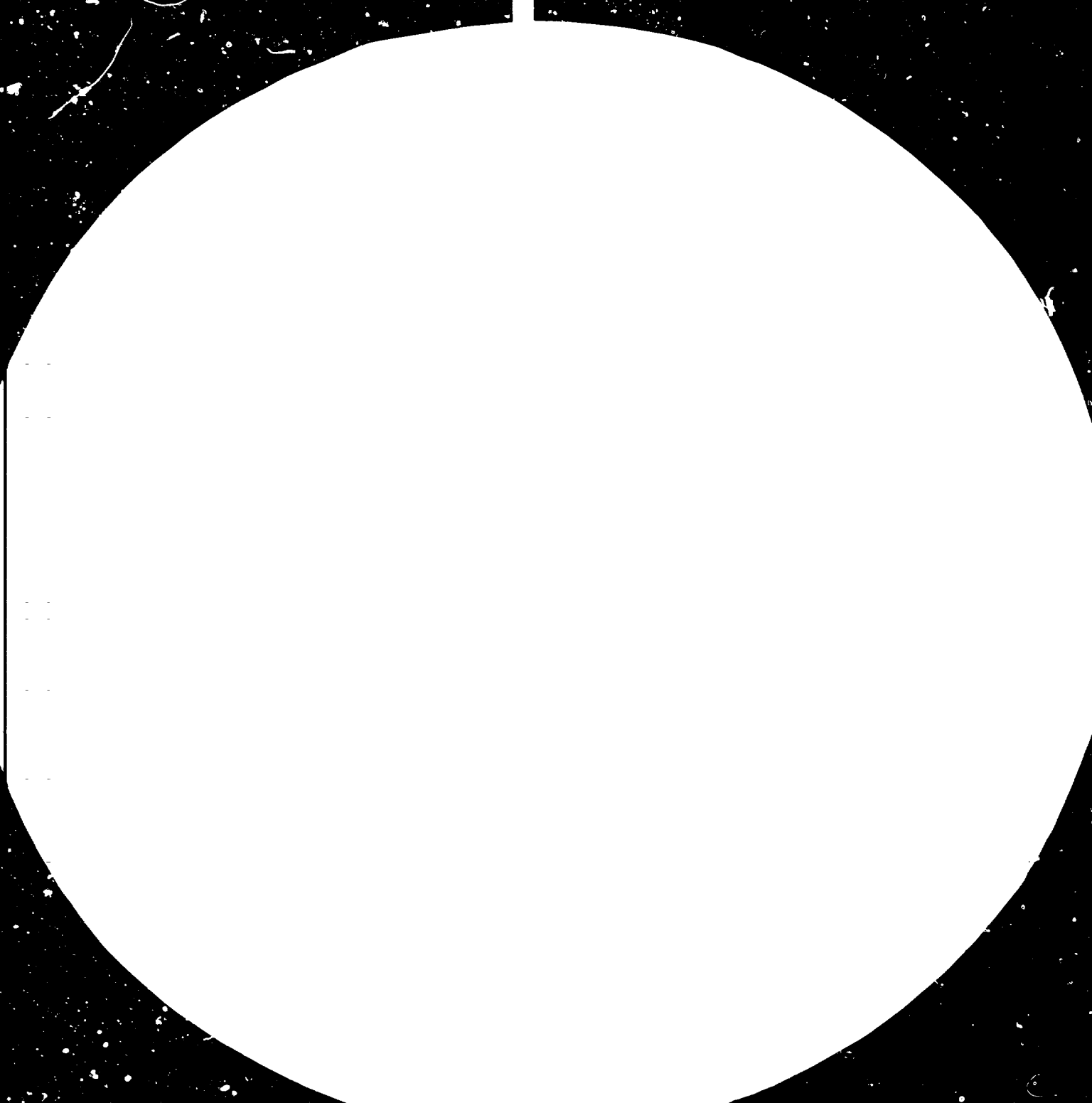
Item	1975 tonnes	1979 (Jan-Oct.)
Aluminium Wire	0.5	3.8
Bars and Rods	24.6	12.3
Corrugated Sheets	36.3	-
Flat Sheets	454.5	79.1
Wrought Plates and Sheet	419.6	449.0
Foil thickness upto o.2 mm	51	21.3
Tubes and Pipes	5.7	7
Tube and Pipe fittings	47.7	0.2
Frames of Industrial Prefabricated Buildings	18.3	220.3
Cables	10.3	negligible
Domestic Articles	60.5	14.5
Indoor Sanitary Wares	2.3	n
Nails and Bolts	16.1	2.2
Travel goods	19.3	
Other Articles	132	20.9

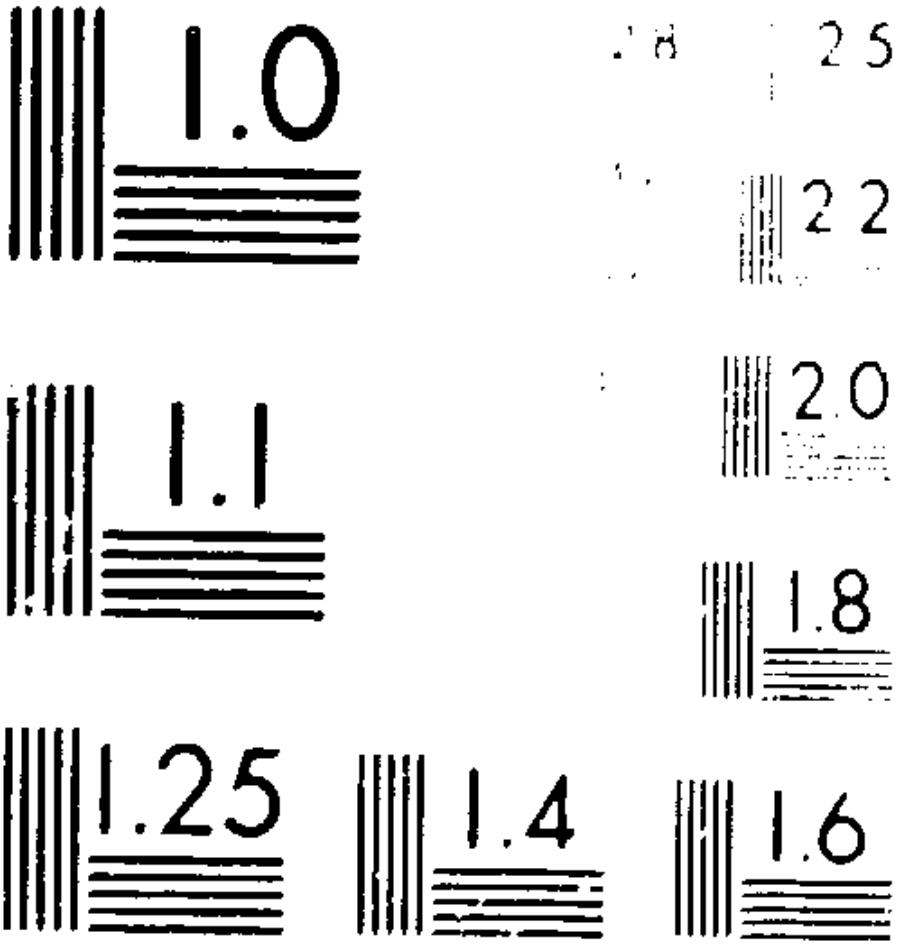
Data Supplied by Bauxite Industry Development Co. Georgetown

Per Capita Consumption on 0.9 million population 1.442 Kg

S U R I N A M:

Bauxite production is crucial to the economy of Surinam and the World Bank estimated that in 1970, it not only accounted for over 90% exports but also 30% of the Government revenue, 31% of the GDP and 20% of the total private investment. The production of bauxite and alumina is in the hands of (i) Suriname Aluminium Co. (SURALCO) which is a wholly owned subsidiary of ALCOA and (ii) N V Billiton Maatschappij Suriname, but the former alone produces primary metal. All the primary metal is exported but Surinam imports the semis for her requirements. Surinamsche Aluminium Fabriek Everhard (SAFE)




1.0
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

in Paramaribo is producing aluminium windows doors, shutters etc for the local market and for export to the Carribean region. It is learnt that SAFE has put up an aluminium rolling mill/ extrusion press for profiles.

The Government of Surinam has no direct financial participation in the foreign controlled bauxite concessions operated by SURALCO and Billiton, although it has an option to take up a quarter of the share holding of the latter. Plans for the expansion of the industry are in hand and the Government plans to go ahead with a bauxite and aluminium project in the west of the country in a concession once enjoyed and intended for exploitation by the Reynolds Metals.

Hydroelectric power resources are being developed in conjunction with the bauxite mining.

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CHAPTER VIII

THE CENTRAL AMERICAN REGION

(Mexico, El Salvador & Cuba)

From the point of view of the aluminium industry, Mexico, El Salvador and Cuba are sandwiched between the bulk producers of the metal - Canada and the USA on one side and the emerging giants of the aluminium industry- Brazil and Venezuela. For reasons of their geographical location, it would always be relatively easy to import aluminium metal from their closer neighbours, some of whom have spare capacities for the primary metal than from the far off countries like Australia or the Gulf smelters. The imports of Mexico (along with of Costa Rica and Panama which are not covered in the survey) and the other developing countries of the North American continent are given in Table 28 (16). Mexico emerges as the single largest importing country in the region for aluminium ingots and semis. Whilst figures for the USA exports to El Salvador are not separately available as they are for Mexico they are expected to be included in the figures for "other countries"; no trade between Cuba and the USA is, however, anticipated. The total quantities of the semis imported by Cuba, El Salvador and Mexico from the countries of the 'North'except the USSR are (reproduced from Table 14):

Cuba ... 2021 tonnes; El Salvador ... 1235 tonnes

Mexico ..27,956 tonnes - the share of the USA being 23,233 tonnes;

The national statistics of the production of semis and consumption for Mexico along with Nicaragua and Panama are given in Table 29 . The import figures for other countries may be of interest in the planning of the semi industry in the region covered by this study.

Table 28 The 1978 Figures of the Import of Aluminium Ingots & Semis by Mexico, Costa Rica and Panama

Commodity / Country	Mexico	Costa Rica	Panama	Others
		X 1000 tonnes		
Total Including Ingots	46,250	1287	1166	4822
Total Semis	23,233	1081	389	2824
Sheet and Circles	8,998	71	102	375
Plates	353	1.4	1	95
All kinds of Foil	839	28	186	730
Rod and Bar	8,485	963	1.8	307
Cables and Conductors	2,160	7.8	94	380
Electric Conduit	35	0.5	-	16
Other pipes and Tubes	990	9	3.6	335
Angles and Shapes	1,167	-	-	323
Powder	208	0.5	1.8	14

Table 29 Statistics of Aluminium Production and Import and of Semis for Mexico, Nicaragua and Panama for 1978, (16)

	MEXICO	NICARAGUA	PANAMA (1977)
		X 1000 tonnes	
Primary Production	47.5	-	-
Import of Ingots	36.2	0.6	1.1
Import of Mill Products	31.2	1.0	0.3
Recovery of Secondary	12.6	-	0.6
Export of Mill Products	4.2	0.9	0.4
Consumption- actual	124.2		
Mid Year Population in millions	64.7	2.4	1.8
Per Capita Consumption in Kg	1.727	0.227	0.409

M E X I C O

Mexico produces both aluminium metal and semis but also imports them in substantial quantities. The existing primary metal smelter, Aluminio SA de CV with plants at Veracruz has a capacity of 70,000 tpy which is likely to be expanded to 90,000 tpy in the 1980s. The plant is owned by ALCOA but another with a capacity of 70,000 tpy was planned to start production in 1979 by the Mexican Government along with the participation of the Jamaican Government (32). In the field of semis, CONDUMEX SA is Mexico's largest manufacturer of electric cables and conductors and uses 6,000 tonnes of aluminium annually. It is managed by Mexicans who hold majority interests but the technology and know-how was obtained from Anaconda Wire & Cable Company as well as from Pirelli both of whom hold minority financial interests in the company. The machinery was obtained from various European and American equipment suppliers such as Niehoff, Watson, Vaughan, and Syncro. There is practically no import of aluminium cables in Mexico but some of the indegeneous production is exported to a few other developing countries. Condumex operates a subsidiary company INTEIMEX which can provide a number of services on the use of aluminium, including training of cable jointers. The company employs about 1000 people and produces a variety of cables and conductors. The other important cable and conductor manufacturers are Conductores Monterrey, CONELEC IUSA LATINCASA and Phelps Dodge.

There is considerable installed capacity for the production of semis. The two large units are owned by the ALCAN and the Reynolds groups, each with capacities of about 15,000 tpy for plates, sheets, extrusions and foil. Besides, there are a few medium sizes semi production units with capacities varying between 2-4,000 tpy but the domestic demands for the semis exceed their production capacities at present.

EL SALVADOR AND THE CENTRAL AMERICAN REGION

A number of the countries in the Central American Region - El Salvador, Costa Rica, Nicaragua and Guatemala - have planned for the establishment of aluminium semi products industry for their domestic and regional markets. In view of the rather small domestic markets in each of these countries, the industry could gain by regarding the region as a common market but understanding between neighbouring governments has to precede this kind of understanding.

Aluminio de Centro-America SA at San Salvador in El Salvador produces extrusions and pipes with a capacity of about 2,500 tpy; 55% of the production is for architectural sections, 25% for irrigation pipes and the rest for miscellaneous applications. The company was originally established as ALCOA de Centroamerica but ALCOA retired its ownership in January 1977 and the plant is now a locally owned operation; the services and technology and know-how is from ALCOA,; the extrusion press is of Schloemann make with the accessories from Oilgear. The products are marketed equally in El Salvador, Costa Rica, Nicaragua and Guatemala and are now entering the Panama and the Belize markets. The company employs about 180 persons.

The other industrial units in the region are:

(i) Aluminios Industriales SA (ALINSA), Guatemala established in 1976 for cables and conductors.

(ii) Aluminios Extruidos, SA (ALUMEX) Nicaragua established in 1975 presently inoperative as the property is said to have been confiscated by the Government.

(iii) Aluminios Nacionales SA Costa Rica (ALUNASA) is presently under construction under a contract awarded by Corporacion Costarricense de Desarrollo to an Italian firm - Tecmo Hunter Engineering. The ALUNASA is also receiving assistance in management from the USA and Canada. The company will produce circles, slugs for impact extrusion, industrial foils and irrigation tubes for the local and the regional markets.

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CHAPTER IX

EAST & SOUTH-EAST ASIA

China, Indonesia, South Korea, Malayasia, Philippines, Singapore & Thailand

The region covers the most populous countries of the world but amongst these countries, primary aluminium industry exists in South Korea and China; in China the estimated capacity of 300,000 tonnes is substantially less than her domestic demand. However, the neighbouring countries - Taiwan, Japan and Australia - have large aluminium primary smelting and semi fabrication capacities; their figures of production, import and export are summarised (16) in Table 30. The seven countries - China, Indonesia, South Korea, Malayasia, Philippines, Singapore and Thailand import fairly large quantities of semi aluminium products, besides producing some in their own countries from imported primary or domestic secondary metal. Their figures of import etc are summarised in Table 31 for the year 1978; whereas Table 32 gives the structural distribution of their imports of the semis. It will be noted that most of their imports are from the USA or Japan except for Singapore. It is at times difficult to reconcile statistical figures collected from different sources but the figures are purely indicative and are not intended for any quantitative evaluation.

I N D O N E S I A:

Despite the establishment of bauxite mining on commercial scale, alumina and aluminium smelter industries have not yet been established

Table 30 Bird's eye Status of Aluminium Industry in Taiwan, Japan and Australia for 1978 (16)

	PRIMARY			SEMI-PRODUCTS	
	Domestic Production	Import of Ingots	Export of Ingots	Import	Export
	X 1,000				
Taiwan	50.4	47.6	0.36	7.3	7.4
Japan	1061.5	740	54.6	26.8	148.2
Australia	266.4	0.2	76.3	3.6	4.8

Table 31 Import of Semi Fabricated Aluminium Products by Countries of East and South-East Asia in 1978:

Importing Countries	Imports from Table 21 (a) tonnes	USA (b)	Canada (c)	Japan (d) tonnes	
		(Exporting Countries)			
China	623			5147	+
Taiwan	4258	1315	6	4916	
Hongkong	4772	431	12	5448	
Indonesia	13668	2144		6467	
South Korea	31474	43	941	29945	
Malayasia	6101	679		3964	
Philippines	2806	303	18	2807	
Singapore	8965	1560	8	2750	
Thailand	5133	382	15	4425	

+Figures for China cannot be taken as indicative.

Reference for column (b) is16; for column (c)43 ; for column (d)44 ; and for column (a)45 .

Table 32 Structure of the Imports of Semi Products (excluding powder) in 1978 by countries of East and South-East Asia from Japan, USA and Canada (16, 43-55)

Exporting Country	Sheet Circles Plate in tonnes	Foil	Rod & Bar	Wire Cable &	Tubes & Angles in tonnes
Imports by China:					
Japan	414	4588		1	27
Imports by Taiwan:					
Japan	1308	2042	101	1060	177
United States	737	147	107	267	42
Imports by Hongkong:					
Japan	2531	1660	375	335	251
USA	105	85	2	97	134
Imports by Indonesia:					
Japan	4050	1828		303	14
USA	342	12		1578	224
Imports by South Korea:					
Japan	12108	613	14955	849	467
USA	42	1			
Canada	941				
Imports by Malayasia:					
Japan	444	1238	732	1449	47
USA	12	67		154	446
Imports by Philippines:					
Japan	80	1795	475	107	177
USA	45	17	18	150	30
Singapore Imports:					
Japan	1185	859	173	61	349
USA	399	170	22	39	20

Table 32 Continued

Exporting Country	Sheets Circles	Foil	Rod & Bar	Wire & Cable	Tubes & Angles
Imports by Thailand:					
Japan	939	425	2783	185	24
USA	36	26	273	35	6

in Indonesia (48). The following primary smelters appear to have been planned to start production in the 1980s:

- ALCOA Project at Kalimantan with a capacity of 200-250,000 tpy in association with Yoshida Kogyo and the Alcoa of USA.
- Indonesia Asahan Aluminium Company with plant at Kuala Tandjung (Asahan) with capacity of 75-225,000 tpy by the Government of Indonesia in association with the Japanese producers.

The latest consolidated figures of aluminium consumption refer to year 1975 and show that the secondary recovery of aluminium has become an important industry in Indonesia but its sudden emergence in 1973 is baffling:

	1975	1973	1972
		tonnes	
Import of Ingots ...	6984	2630	272
Import of Mill Products ..	20226	21587	12970
Recovery of Secondary Aluminium	147478	138952	- ≠
Total Aluminium Consumption	174688	163169	13242
Mid Year Population in million	132	126	123
Per Capita Consumption gm	1318	1318	91

≠ reported for the first time in 1973.

According to the information provided by P T Indo-Extrusions (PTIE), the total installed capacity in Indonesia for extrusions (excluding properzi rods) is 4,500 tpy and the annual consumption 4,800 tonnes - the difference being met by imports; the annual growth rate over the 1973-79 period averaged 10% for the consumption of aluminium but the rate envisaged for the 1980-85 period could be between 8-15% and would depend on the emergence of the middle class society oriented towards consumption of materials and manufactured products - "the rich being too few to have any volume impact and the poor cannot afford to buy the product at all". Since Indonesia has natural oil and gas, suitable deployment of resources could catalyse the growth of the middle class society. Against this background, the aluminium industry seems to have a bright future because of the domestic resources of bauxite and energy along with a large domestic market.

PTIE (Index Aluminium) were established with COMALCO Ltd of Australia holding 45% share in the capital and the management contract. Their latest figures of production are 1,400 tpy of extrusions, against a capacity of 2,500 tpy, and 1,250 tpy of roofing sheets (out of total domestic consumption of about 2,500 tonnes per annum). The growth of aluminium roofing sheet market is forecast at 7½% but would certainly depend on the relative costs of other available materials - cement asbestos sheets and galvanised iron sheets. They also have anodising facilities for their full extrusion products output. The company employs about 300 persons and intends to expand its activities in 1983-84 with the installation of another extrusion press.

S O U T H K O R E A:

The economic transformation of Korea, which began in the year 1962 and increased her GNP from $ 90 per head to $ 1480 in 1977 was based on industrial development but now seems to have slowed down. During this period the consumption of all the non-ferrous metals increased and the total aluminium market rose to 100,000 tonnes in 1978 against a domestic primary production of 20,000 tonnes a year. The estimates of future consumption (46) visualise a 20% growth rate but these were chalked out during the boom period of economic activity; the anticipated consumption of aluminium and copper are given below:

Metal	Consumption in 1978	1979	1981
Copper	70,000	90,000	140,000 tonnes
Aluminium	100,000	120,000	181,000 tonnes

The consumption of aluminium in the major markets was distributed as (46) in the years 1971 and 1978 and the shift in the pattern of consumption shows the growth of engineering industries during this period:

Market	1971	1978
Total Consumption	15,000	100,000 tonnes
Percentage Distribution of Consumption:		
Kitchenware	45	12
Construction	23	32
Automobiles	3	12
Electric Cable	19	15
Aircraft Industry	--	11
Canning	--	11
Miscellaneous	10	7

The sharp increase in aluminium consumption has been attributed to (i) South Korea winning several large construction contracts in the oil rich Middle Eastern countries, (ii) 149% increase in the number of car owners between 1971 and 1978 and (iii) starting up of new industries like manufacture of air crafts besides automobiles and the use of use of sophisticated food canning industries.

The earlier projections of increasing the domestic production of primary metal now seem to lie in a state of inanimation on account of the high prevailing energy costs. It has been reported that South Korea instead is now interested to establish primary smelters jointly with other countries/parties in order to be assured of future supplies of aluminium; South Korea is said to have opened a dialogue with the Government of Malayasia to financially participate in a 90,000 tpy capacity smelter in the east Malayasian state of Sabah to be based on energy from the off-shore natural gas deposits, jointly with the Aluminium Pechiney of France.

In the semi processing sector Choil Aluminium has plans to build continuous casting facilities at its Yung-san plant to 15,000 tpy and coil capacity to 36,000 tpy against the present production of rolled products of 5,500 tpy. Another major semi-fabricator is Yulsan Aluminium and has similar plans to increase the capacity of production of semis but this plant envisages to export 50% of the additional capacity. In the extrusion sector, Namsun Light Metals have capacity for 6,000 tpy; Pyongang Steels of 4,000 tpy and Yulsan Aluminium of 2,800tpy but installation of three additional presses was expected to raise its total capacity to 10,000 tpy in 1979 (46). The impact of cutting down of the plans for the primary metal production on the semi fabrication industry is not known.

C H I N A

China has massive bauxite reserves estimated at 1,000-1,250 million tonnes though the presently workable reserves could only be 150-300 million tonnes. The demand for aluminium is variously estimated between 3-400,000 tonnes a year; only half of which is possibly met through domestic production. China reportedly has about 13 smelters with a total estimated capacity of more than 300,000 tpy. An unique feature of the Chineses smelters is that they are of relatively small capacity when compared with the smelters elsewhere in the World. The largest is at Fushun (Liaoning) and the rest are small to medium size, such as the 25,000 tpy smelter at Lanchow (Kansu). Other smelters are the Shandong Aluminium Plant, Zhengzhou Aluminium and the Guizhou Aluminium Plant. Main fabrication plants are the Northeast Light Alloy Fabrication Plant and the Southwest Aluminium Fabrication Plant.

China started her aluminium industry in the early 1950s. The main equipment and technology employed for the production and fabrication of aluminium were introduced from abroad. Since then the industry has followed the tradition of building these plants in separate entities only with a few exceptions, according to the information conveyed by the government sources. China is capable of producing a large assortment of semi aluminium products covering sections, rounds wire rods, sheets, tubes and forgings. Aluminium products are mainly produced to satisfy domestic consumption, of which a quarter is consumed as conductors for the transmission lines. A foil plant is being established.

As China presses for industrialisation, improves her transportation system, expands her network of electric transmission lines and embarks upon massive construction programmes, she will require ever increasing amount of aluminium. Western observers anticipate a 10% growth rate in the consumption of aluminium and increasing gap between domestic production and consumption. Official Chinese sources consider

that the present production can meet roughly 80% of the demand. In view of this, China is considering the establishment of two or three large complexes to meet the increasing demand.

For the foreseeable future, China will need to import aluminium in sizeable quantities. In recent months it has shown interest to acquire western technology to boost the production of aluminium. Already some Japanese producers, amongst them being Nippon Light Metals and Sumitomo Aluminium, have sent delegations to China for technical discussions on the subject. Alusuisse has also undertaken technical feasibility studies for the establishment of extrusion and rolling plants in China.

THE PHILIPPINES

The Metals Industry Research & Development Centre, Manila provided the following information about the aluminium semi products industry which is reproduced from their communication:

"Local fabricators use both primary and secondary metal, both indigenous and imported. With regard to research and development, very few industrial enterprises, apart from the multinational corporations, employ technologists in the running of the company. Some of these firms purchased know-how from abroad and usually make some arrangements for continuing technological support. Many enterprises, because of resource limitation, have no technologists in their employ. Others do not even appreciate the advantages of industrial research, or of allied technical services, so that they continue adopting age-old techniques and do not realize the importance of modern technological assistance. This is not to suggest that all these companies are at a stage where they require new products or

processes. In most cases, however, they are in need of standardisation of raw materials and of guidelines relating to processes and products. But those firms undertaking research activities gear their efforts towards expansion, quality improvement of products, cost reduction and, sometimes, the development of local substitutes for expensive imported supplies.".

"Jobbing plants employ selling on a direct basis, in as much as their customers go directly to factories to place their orders. Independent fabricators, specially the bigger firms usually maintain their own sales force and establish a network of regional dealership and distributership. Smaller firms channel their wares to numerous hardware outlets located in market centers."

The major users of aluminium cables and conductors are the National Power Corporation and the National Electrification Adminstration but most government projects are being financed by either the U S Aid, World Bank or the Asian Development Bank. All the wire and cable requirements are purchased through international bidding and almost always won by foreign companies. Another source estimated that the Philippine cable industry produces 1,500-1,800 tpy of aluminium cables against a large consumption which is met through imports. There are about 16-18 cable manufactures of which six can be considered major manufacturers with complete basic facilities to produce major types of cables and conductors. Most of such units have foreign collaborators; e.g. the Far East Wire and Cable Corporation acquired know-how from Japan's Showa Electric Wire and Cable Company through a technical licensing agreement. This company employs 170 persons, with five management personnel and ten engineers

The consumption figures for aluminium are given below (16) and show that the per capita consumption of aluminium has not grown during the last 5-7 years:

	1978	1973	1968
Import of Ingots tonnes	8707	10884	9342
Import of Mill Product	2426	6167	1814
Export of Mill Product	3447	2812	362
Consumption	17687	14240	10793
Mid Year Population	45.9	40.1	34.7 million
Per Capita Consumption gms	364	364	318

M A L A Y S I A

The Government of Malaysia are seriously considering ambitious programmes for the establishment of some 400-500,000 tpy capacity for the production of primary aluminium in association with transnational aluminium industry and Korea's Hyundai group in order to meet the anticipated shortages of the metal in the region, Japan and Korea. The two aluminium projects, if approved, are to be located, one at Labuan in Sabah, and the other at Bintulu in Sarawak. Both plants will be based on imported alumina from Australia [illegible] and the required electric power will be generated from the off-shore natural gas. Aluminium Pechiney are now understood to have submitted a report recommending the establishment of a 180,000 tpy smelter in view of the likely constraints of the power supply. The second smelter is being established in collaboration with Reynolds Aluminium Corporation.

Semi-Products Aluminium Industry:

The aluminium semi products industry in Malaysia was pioneered by the Alcan Gruop through the establishment of Alcan Malaysia Berhad, at Petaling Jaya, Selangor in 1963; the Company is now known as the Aluminium Company of Malaysia Berhad. The plant then had a capacity to manufacture from imported aluminium 2,000 tpy of plates, flat sheet in commercial purity and alloy grades, corrugated roofing sheet, circles and slugs. Since then the plant has periodically undergone expansion as under:

- 1966 - first rolling mill installed,
- 1968 - second strip rolling mill added raising sheet products capacity to 3,000 tpy;
- 1970 - embossing mill installed for flat and corrugated sheet;
- 1971 - extrusion press with a capacity of 2250 t complete with anodising facilities commenced production;
- 1978/79 - major expansion of extrusion and anodising facilities undertaken with the installation of a 2150 t press made by UBE of Japan along with computerised die making equipment.

In the 1980s, the company will install sheet rolling facilities and an an aluminium foil plant with respective annual capacities of 24,000 tonnes and 6,000 tonnes.

The Malaysian Government and the Malaysian Industrial Development Berhad encouraged the Alcan Group through inducement under the Pioneer Industries(Relief from Income) Ordnance and long term loan to expand their activities in 1969. The company underwent structural change in 1975 and is now 54% Malaysian. The production figures indicate continuous growth of the company:

Year	Sheet	Extruded	Total	
1969	3259	-	3259	in tonnes
1971	3300	535	3835	
1974	5616	2731	8347	
1978	5395	2392	7787	

The Company has entered the export market as well and has exported its products to Thailand, Hongkong, South Vietnam, Singapore, Pakistan and Sri Lanka.

Wire & Cable Manufacturers:

There are six cable and conductor manufacturing units at Butterworth, Kuala Lumpur, Petaling Jaya, Selangor, Johore Bahru and Malacca. Although one of them also produces wire rods, the requirement of others are met through imports. The annual consumption of aluminium wire rods at Malayan Cables Berhad is 1,650 tonnes for the AAC and the ACSR conductors. All the other units are of similar capacity. The annual demand of wire rods is, therefore, currently estimated at 10,000 tpy. The production capacity of the units is not, however, sufficient to meet the demands of the country and their National Electricity Board imports some of its requirements. Two of the six units manufacture paper insulated power cables as well and the technological know-how for them was obtained from Japan and Taiwan.

COMALCO(Australia) has bought 44% share in Malaysia's largest aluminium extrusion plant - Federal Aluminium Sendirian Berhad with the Federal Cables, Wires and Metal Manufacturing Company. Federal Aluminium's annual production comprises of about 2,070 tonnes of mill finished, 1,300 tonnes of natural anodised and 165 tonnes of colour anodised extrusions. They also produce about 600 tonnes of remelt aluminium billets. The Company had procured the extrusion press from Japan and the expansion plans cover upgrading the tool making facilities. The company has entered the export market as well with about 40% production being exported.

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CHAPTER X

COUNTRIES OF THE INDIAN SUB-CONTINENT

(Bangladesh, Burma, India, Pakistan & Sri Lanka)

Of these countries - Bangladesh, Burma, India, Pakistan and Sri Lanka- of near-identical historical and cultural backgrounds, only India has large deposits of metallurgical grade bauxite, a sizeable primary and semi products aluminium industry. Aluminium consumption has, however been established in the remaining four countries as well; they meet their requirements through the import of aluminium ingots, semis and finished products and are partly supported by domestic secondary aluminium. Their imports of semis (excluding that of India which aims at self sufficiency) from Table 14 for the year 1978 were as follows:

Bangladesh	1236 tonnes
Burma	2399 tonnes
Pakistan	10005 tonnes
Sri Lanka	1914 tonnes

In these four countries, the aluminium industry is in its early formative stages of growth.

B A N G L A D E S H

According to the estimates of the Department of Industries (Engineering Directorate), Government of Bangladesh, the demand of aluminium products in 1979-80 could be:

Aluminium Cables and Conductors	8,000 tonnes
Various domestic sectors	10,000 tonnes

The Department regarded that aluminium would discharge an important role in the national reconstruction programmes but the present per capita annual consumption is about 100 gm.

The aluminium sheets and circles are distributed to about 46 industrial units manufacturing utensils with a total installed capacity of about 2,600 tpy; additional units are likely to be further licensed raising the installed capacity to 3, 000 tpy.

P A K I S T A N

Whilst there a large number of industrial units manufacturing domestic utensils, there appears to be only one company engaged in the manufacture of cables and conductors; Chowdhury Cables are now considering the installation of a rod rolling mill in association with a foreign company. The Ministry of Finance, Planning and Development, provided the following figures of import of aluminium in 1978-79:

Ingots	4451 tonnes	Foil	1416 t
Bars & Rods	1983 tonnes	Powder	13 t
Pipe Tube Blanks etc	147 tonnes	Gas Cylinders	201 t
Wire & Conductor	3574 tonnes	Plates	430 t
	TOTAL ...	12,115 tonnes	

S R I L A N K A

At present there is no industrial unit with facilities to produce rolled and extruded products. ACME Aluminium Co. are known to be

producing aluminium foil (capacity unknown). Kelani Aluminium Cables Ltd., are in the process of being established as a joint venture with COMALCO (Asia) of Australia. This unit is expected to go in production in late 1981/early 1982 and will be based on imported secondary aluminium. The company will produce 3,000 tpy of extruded sections and 2,000 tpy of roofing sheets; their other activities will be anodisation and roll forming. They expect to generate employment for about 200 persons. Aluminium sheets and extrusions are extensively used in Sri Lanka for the manufacture of bus bodies besides the use of imported circles for the manufacture of hollow wares for domestic use. At present there are about 2-3 small scale industrial units manufacturing domestic utencils.

The value of imports of aluminium and semis for 1978 were:

Aluminium Wire	Sri Lanka Rs in units of 100,000	64	384,000 US $
Wrought Bars	"	640	3844,000 US $
Plates Sheet and Strip	"	2,005	12042,000 US $
Foil (not exceeding 0.2mm)	"	451	2709,000 US $
Extruded Sections	"	228	1730,000 US $
Casks Drums etc	"	158	950,000 US $
Other miscellaneous items	250 tonnes		

In view of the general invitation extended by the Sri Lanka Government for foreign investors, aluminium industry seems to be poised for rapid growth.

Pakistan and Saudi Arabia will build an aluminium extrusion plant in Lhandi, near Karachi. An aluminium and Cu cables plant is planned to be established in the Azad Kashmir province.

I N D I A:

With reserves of high grade bauxite, presently estimated at over 2,000 million tonnes, large deposits of non-metallurgical grade coal and vast potential for the generation of hydro power which is substantially untapped as yet, India is very favourably placed with regard to the raw material resources necessary for the establishment and growth of primary metal industry. Unlike the primary metal industry in some developing countries, India meets most of the demands for other material inputs such as caustic soda, petroleum coke, cryolite and other fluorides through domestic production. Though the present installed capacity of the smelters is 335,000 tonnes, full capacity production has not been established due to the acute shortfalls in the anticipated quantum of power generation for the last two/three years. This has resulted in large imports of aluminium during the last two years (1978 and 1979) and the same situation is likely to prevail in the present year.

As in many other countries, the establishment of aluminium fabrication and semi fabrication industries preceeded that of primary metal industry. Alcan established a subsidiary unit, Indian Aluminium Company Ltd (INDAL) at Belur, near Calcutta and commenced production of rolled sheets in 1941. Primary metal was produced by them at their smelter at Alupuram, near Alwaye in the State of Kerala in 1943.

Recognising the pivotal role of aluminium in enhancing the national economy through its use in the electrification programmes, the Government of India included the aluminium industry in the core sector of the industrial development programmes. The commitment of the Government to encourage indigenous production of aluminium provided considerable fillip for the establishment of new industrial units and the expansion of the existing ones not only for the primary metal industry but also for semi fabrication.

The four presently operative smelting companies each have different sources of know-how, technology and with the exception of Balco some financial participation of their principals as well:

1. The Indian Aluminium Company Ltd., (Indal) - A private company with Alcan collaboration; total capacity of the three smelters 96,000 tpy; the individual smelter capacities being 16,000 tpy for Alupuram (Kerala) Smelter, 2,000 tpy for the Hirakud (Orissa) Smelter and 60,000 tpy for the Belgaum Smelter.
2. The Hindustan Aluminium Corporation (Hindalco) - Smelter at Renukoot (Mirzapur) with a capacity of 105,000 tpy in collaboration with Kaiser Aluminium & Chemical Corporation USA.
3. Bharat Aluminium Company (Balco) - a public sector company with smelter at Korba (MP) 100,000 tpy with collaboration from the USSR; the alumina plant with Hungarian collaboration.
4. The Madras Aluminium Company (Malco) - 25,000 tpy smelter at Mettur Dam in collaboration with Montecatini (Alumetall) of Italy.

By and large the setting up of the above smelters has been carried out with foreign consultancy, design and engineering of the projects. Almost always, important equipment, plant and machinery have been imported on the advice of the collaborator as well as through global tenders. In more recent years, the Metallurgical & Engineering Consultants Ltd. (MECON) are emerging as a leading consultants for aluminium technology and have recently concluded a collaborative agreement with Alusuisse for technology and design. Besides, the National Industrial Development Corporation (NIDC) and Engineers India (EIL) have also acquired acknowledged capabilities in the field.

Table 33 Production, Import and Consumption of Aluminium in India

Year	Installed C capacity	Production	Import	Total
	t o n n e s			
1974-75	210,000	126,551	2,608	129,239
1975-76	250,000	187,000	5,068	192,339
1976-77	275,000	208,000	9,000	217,538
1978-79	335,000	213,000	33,000	246,729
1979-80	335,000	180,000	75,000	255,000

The per capita consumption of aluminium comes to about 400 g annually.

Future Demand and Expansion of Aluminium Production Capacity:

Demand for aluminium is expected to grow at 10% per annum and would rise to 650,000 tonnes in 1988-89. The production capacity of the existing plants is expected to marginally increase by about 20,000 tonnes. However, in order to bridge the gap between demand and production, two types of schemes are being considered: first, to increase the production of the primary metal through the setting up of new facilities and second, to produce and export alumina with buy back arrangements for the metal. In late 1980, the Government

sanctioned the establishment of aluminium complex (National Aluminium Company, NALCO) in Orissa comprising of (i) a bauxite mine at Panchpatmali with a production capacity of 2.4 million tonnes per year of bauxite, (ii) an alumina plant with production capacity 0.8 million tonnes per year atDamanjodi, and (iii) an aluminium smelter with production capacity of 218,000 tpy at Talcher to be fully served by a captive thermal power plant. NALCO is expected to reach full production capacity according to the following time schedule, commencing from 1982:

Bauxite Mine	63 Months
Alumina Plant	70 Months
Smelter	81 Months

NALCO has entered into an agreement with Aluminium Pechiney of France for technical assistance. Engineers India Ltd has been appointed as the prime Indian consultants for the bauxite mine, alumina plant and s smelter. Similarly, India is reported to have "noted favourably" the economic aspects of a 800,000 tpy alumina plant to be set up in Andhra Pradesh with Soviet collaboration; the proposal seems to have been approved in principle. The Soviet design organisations have provided three variants for the plant; one using Soviet equipment, another using Indian equipment and a third, a mix of Indian and Soviet equipment.

Consumption of Aluminium:

If the shortfalls in the production of aluminium on account of the power shortages is ignored, the installed capacity has been ahead of the domestic demands because the planned capacity had also included a certain quantum for exports. The production, consumption and the imports of aluminium are given in Table 33; in the figures of consumption, secondary aluminium is not included but there is a sizeable secondary aluminium industry mostly in the small scale sector.

Table 34 Sectorwise Consumption pattern of Aluminium

Year	1951	1960	1969	1977
Total Consumption (X1,000 tonnes)	11	47	140	205
Sector of Use	Percentage Distribution			%
Electrical	20	41	48	52
Household & Commercial	53	24	28	20
Transportation	6	13	8	12
Canning & Packaging	10	11	8	7
Building & Construction	2	1	2	3
Miscellaneous	10	10	6	6

PRODUCTION OF SEMIS:

Most of the modern facilities for the semi-fabrication of aluminium are with the primary producers of the metal. Considerable capacity exists with smaller industrial organisations particularly in the field of aluminium sheets and circles, wire rod rolling or continuous casting with simultaneous rolling as in the properzi type of machines. The annual production of semis is given in Table 36. Production and consumption of aluminium semis was constrained in 1979 due to shortage of metal and that of foil on account of industrial unrest.

Table 35 Sectoral Distribution of Semis

Semi-Product	1977	1979-80	1982-83	1988
		X1,000 tonnes	Forecast	
E.C. Rod	114	135	190	
Rolled Products	65	46	64	
Extrusions	14	20	30	
Paste and Powder	2	2	2	
Foil		9	14	
Castings	17	17	20	
Others	8	46	50	
Total (other than Secondary)	220	275	370	545

Table 36 Extrusion Presses with Their Installed Capacities

ORGANISATION	PRESS CAPACITY TONNES			INSTALLED CAPACITY TPY.
	800-900	1200 1250	2500 3000	
Hindalco, Renukoot	900	1250	-	5,000
Indal, Alupuram	1,000	1200	3300	5,000
Jindal, Bangalore	800	1250	-	1,200
EMC, Calcutta	-	1200	-	600
Patel Aluminium, Bombay	-	1200	-	600
Gujarat Extrusions	-	1200	-	600
Alucoin, Jaykaynagar	-	1250	-	1,000
Indo-Swe, Pune	800	-	-	1,000
Balco, Korba	800	-	2500/ 3150	10,000
Malco, Mettur Dam	-	1250	-	2,000
Mahavir Aluminium, Bhiwadi	- production in March 1982.			3,500

Extruded Products:

Extruded products are being produced in various shapes and sections in India for a variety of applications. The present and the proposed units along with their capacities are listed in Table36 . There is a good demand for sections in high strength Al-Mg-Si and Al-Mg-Cu-Si alloys which require higher extrusion press capacities in the range 2,000-2,500 tonnes. The utilisation of capacity was quite high in 1977 & 1978 in which years the production was 17,630 and 15,968 tonnes respectively. There appears to be sufficient capacity to meet the present demand but permission has been granted to several parties to put up new units, which if all implemented, could raise the extrusion capacity very substantially. One of such units is likely to be Sudarshan Extrusions who have consultancy from Alesa/Alusuisse. Two units with a capacity of 12,000 tpy could go into production by the year 1982.

Rolled Products (Excluding Wire Rods):

At present only two (Hindalco and Indal) of the four main producers of the primary metal are manufacturing rolled products along with about 12 small secondary aluminium rollers. The total installed capacity and production was as follows:

Organisation	Installed Capacity	Production 1977	Production 1978
Hindalco, Renukoot	20,000	18,727	20,002
Indal	33,000	22,838	23,592
12 Secondary Rollers	18,500	1,745	3,378

Rolling facilities at Balco, Korba are expected to be commissioned at any time now. Since the anticipated demand for rolled products is expected to be around 234,000 in 1983-84, the Government has granted permission for additional 47,000 typ capacity. In addition the facilities available with Alucoin (3,600 tpy) were recommissioned in 1979 by Balco after a lapse of several years.

F o i l:

There are two units which produce aluminium foil with a total installed capacity of 5,500 tpy; their aggregated productions in 1977 and 1978 were 5,972 and 4037 tonnes respectively. An additional unit is expected to be put up by the Andhra Pradesh Industrial Development Corporation, Hyderabad with the involvement of Alesa/Alusuisse. It is learnt that the Government has granted other licences as well for the establishment of new units in the private sector; when implemented the total installed capacity in India will be about 22,000 tpy.

The primary metal smelting and semi fabrication facilities have generated employment for 18,000 persons within their own organisations.

THE CABLE & CONDUCTOR INDUSTRY IN INDIA:

The cable and conductor industry appeared on the Indian industrial horizon in the early 1960s when the establishment of the industry was greatly encouraged by the Government of India through the Directorate General of Technical Development (DGTD). Many of the large units were then established, often with foreign collaboration from UK, USA, Germany and Japan. Simultaneously, the Government encouraged the

development of small scale cable and conductor industry in order to spread out the industry throughout the country and to generate larger employment. It is noteworthy that the small scale ur ere all established not only with Indian know-how but also used . machinery made with the country. The Government also extended patronage to these units by reserving the manufacture of conductors up to 19 strands for the small scale sector. All the small scale units are registered with the Development Commissioner, Small Scale Industry, Ministry of Industry and presently number about 170. They have an installed capacity of over 85,000 tpy on single shift basis. On the other hand, the larger industrial units numbering about 47 fall within the purview of the DGTD and have a capacity of over 128,700 tonnes. Due to the shortage of aluminium, the units are operating at about 50% of their rated capacity. The production figures supplied by the Indian Electrical Manufacturers Association are given in Table 37. Most of the machinery required even by the larger units is now manufactured in India, in some cases under licence.

EXPORT AND IMPORT OF ALUMINIUM SEMIS FROM AND TO INDIA:

India occupies an unique position in South Asia as she has already established the primary metal industry and has ambitious programmes of its expansion and because the other countries in the region (Burma, Bangladesh, Nepal, SriLanka, Pakistan and Afganistan) together have considerable demand for aluminium. It is noteworthy that despite the recurrent power shortages affecting the output of her aluminium smelters, India has been able to export some aluminium in the form of semis. These figures are shown in Table 38.

Table 37 Import and Export Figures of Aluminium & Semis (India)

IMPORT 1975-76	IMPORT 1977-78	ITEM	EXPORT 1975-76	EXPORT 1977-78
tonnes			tonnes	
4, 41	5,499	Ingot	7,238	599
139	87	Unwrought NES	2,968	290
82	29	Unwrought Alloys	2	17
551	2,164	Bars & Rod	2	285
-	-	Bare Conductor	4,595	9,710
370	512	Aluminium Wire NES	72	26
348	47	Bars and Rods	64	1,285
7	3	Circles	0.5	587
334	450	Plates and Sheet	15	651
62	12	Foil for Tea Chest	145	501
138	345	Foil	327	704
86	107	Powder & Flake	15	136
375	92	Tubes & Fittings	66	214
7,333	9,231	TOTAL	15,408	15,004

CONCLUSION

Since the functional uses of aluminium are closely associated with "Development", the demand for alumuminium in the developing countries will continue to grow as their standards of living rise and populations grow. Though all these countries may not be resource-wise suitable for starting the primary metal production industry, the establishment of semi production industry on imported primary or secondary metal shall be advantageous to them in a number of different ways. At comparable levels of GDP, the per capita aluminium consumption is several times higher in the developed countries than in the developing countries like Kuwait or Saudi Arabia. This difference could be understood because the GDP index does not reflect the ability of any country to sustain or generate a variety of industrial development through its own efforts for its domestic or export markets. In conjunction with the positive balance of trade situation, the GDP index does indicate the ability of any country to be able to make financial investments in industry. Another inadequacy relates to its inability to take into account the human resource situations as the availability of the professionally qualified engineers and technicians is as vital for the success of any programme of industrialization as are the availability of market and the capacity of the people to buy maufactured goods.

Industrialisation has been universally accepted as the means to expeditiously achieve improvements in the standards of living and modernisation of the life styles of the people in the Third World countries. The success of these efforts is uniquely dependent on the availability of electric energy which provides the motive power to drive the machinery. In this task, the metal aluminium is destined to play an indispensable role through its use as a conductor for the transmission of electricity.

The availability of a network of transportation systems is another infra-structural preludes to industrialisation as well as for modernisation of agriculture and rural life. The transportation systems in most of the developing countries are far from being adequate even at the present level of economic development and may have to be developed on priority basis to facilitate movement of raw materials and processed goods. In recent years the use of aluminium in place of steels in automobile and railway coaches (apart from aircrafts) has recorded high growth rates because any reduction in the dead weight of the vehicles through the use of aluminium (in place of steel) improves the tonne-km/litre performance of the vehicle. Though aircraft industry is not likely to be established in any big way in most of the developing countries in the near future, automobile coach building industry exists in some of them and others offer good prospects for its establishment.

The classification of the society into rural and urbanised industrial groups represents orthodox (and perhaps archaic) and divisive views. Rapid economic development in the countries of the 'North' has been accelerated by regarding farming, including dairy and dairy products, animal husbandry and poultry breeding, as industry. The metal aluminium has been found to play an important role in regenerating and revitalising the agro-based national economies of many countries through its multifarious uses in dairy farming, grain storage silos, irrigation pipes, rural electrification etc. It is a common feature with many developing countries that aluminium was introduced to them through its use in the domestic cooking utensils on account of its relative cheapness but is only now making inroads as an engineering material or for its uses in residential or office blocks in high-rise buildings.

The engineering metal manufacturing sector has so far acquired some degree of economic importance and maturity in only a few countries studied for this report - Argentina, Brazil, China, India, Korea, Singapore, Turkey amongst them and a few others are making serious efforts in that direction whilst it may be, according to the published information, practically non-existent in others. Since the engineering, including in chemical equipment, applications of the metal account for about a tenth of the consumption of aluminium in the developed countries, this sector represents a potential area of growth in the developing countries. So far, the nature and diversity of the established industries in only nine of the Third World countries

resembles with those of the developed ones and these are: Algeria, Argentina, Brazil, Colombia, India, Korea, Kenya, Mexico and Peru.

Though the building sector takes a large portion of the consumption of the metal in some of the countries of the 'North', this sector is not likely to become significant in most of the Third World countries because only upper middle class affluence permits its use in residential buildings. In some countries it may offer an additional incentive as it replaces the need to import wood for the same purpose.

The non-functional uses of aluminium in the Third World countries can follow only after industrialisation and modernisation of agriculture have ushered prosperity - a climate necessary for the sustenance of consumer market society.

Unlike the other metallurgical industries based on iron and steel or copper, aluminium owes its present status entirely to the efforts of the few industrial organisations in the countries of the 'North' with two different types of economic systems; they have not only developed the techniques of refining bauxite and of smelting the alumina into the primary metal to their present techno-economic levels but have also developed the technologies of semi fabrication, surface treatment or the manufacture of consumer products and concurrently carried out intensive market promotion activities, design and product acceptability drives and professional engineering advice to product manufacturers. Aluminium industry has, therefore, become a highly vertically integrated technological business and international technology transfer is controlled by the few who have the technology. In order to cater for their "domestic" markets in the North some of these interests established/assisted the bauxite mining, alumina

and metal production industries in some of the developing countries but not of semi production which would have considerably enhanced the value of their exports besides creating additional employment. Only when the aluminium consumption summates to large tonnages has the semi fabrication industry been established in the developing countries by the primary producers of the metal in the private or public sectors in financial and technological collaboration of the oversea aluminium companies. Disregarding the consumption of aluminium semis produced in their own countries, the developing countries imported 15.7% of the production of semis in the countries of the North excluding the USSR; at the same time bulk of the primary metal was exported from a number of them (Bahrain, Cameroon, Egypt, Ghana and now UAE - Dubai). A reversal of this trend in the export/import situation could at once generate additional employment in the developing countries and increase the value of their exports.

At a time when much of the primary production and its availability in the free market is in the hands of a few giants of the aluminium industry, an independent semi fabricator faces an uphill task; he must have large resources to cushion his entry in a fiercely competitive industrial arena; must do his own product development, seek acceptability of his products and provide a technological back-up to his customers who use his products to produce manufactured items. This complex situation has forced many semi fabricators in the developing countries to adapt themselves in one or more of the following ways:

(i) to concentrate on the production of just one type of product which commands a large market;

(ii) seek integration with the finished products industry including surface treatment, colour anodising and fabrication;

(iii) provide training facilities to the technicians of the fabricators in technologically less intensive down stream areas; or

(iv) base their industry on secondary aluminium. This approach is seen most notably in the rolling of sheets on small scale for the production of circles for domestic utensils.

Against the background of the complexities arising out of the vertical integration of the aluminium industry and technology, it will be appreciated that the semi fabrication industry for small domestic and regional demand can survive fierce international competition only when its interests are protected and demand is simultaneously created on a number of fronts by building up internal and regional markets.

The aluminium semi fabrication industry is neither energy nor as much capital intensive as the primary metal industry. Being amenable to relatively small scale operation, it can be advantageously established in a number of developing countries to meet their own national and intra-regional demands such as now seems amongst the Arab countries, united as they are in terms petroleum resources, cultural heritage and language. The establishment of semi production industry is expected to achieve a number of national goals simultaneously. It would generate (i) additional direct and indirect employment; on the basis of the presently available trends 1,000 tpy capacity creates 50-60 new jobs directly; (ii) decrease the value of imports as now the metal would be imported as ingots and the value adding technological operations would be carried out within the country of consumption and

(iii) increase the value of exports in case of those countries who are presently exporting primary metal.

Though the metal has been shown to play a vital part in the programmes of economic reconstruction, the confidence of the enterpreneurs in the future of the industry will grow when they are assured of governmental support for the protection of domestic industry against transnational competition as well as in the standardisation of designs and products.

The interests of the semi products aluminium industry in the developing countries could be served through a UNIDO Workshop on the subject when individual countries could (i) present their national experience and priorities, (ii) highlight their achievements and expertise which could be transferred amongst themselves for mutual advantage, (iii) identify areas where the UNIDO participation and assistance could help them to accelerate the pace and quality of development and (iv) evolve a policy towards international cooperation in the field of aluminium technology development programmes.

Since technological research and development activity is presently restricted to a few countries of the North, continuing purchase of latest technology by the developing countries from commercial or pseudo-commercial organisations in the developed countries and continued payments of royalties, fees etc over long periods of time can impose financial burdens on the infant primary or semi products industry and thus retard its growth. Further, the consultancy services provided by transnational organisations could be subjective and not in the best commercial or national interests of the developing countries; this is more likely to happen in case of those developing countries who have an adverse balance of trade situation or lack financial resources for new investment and do not have

their own technocrats to analyse the oversea recommendations critically. It is felt that the UNIDO could bridge this gap by establishing an International Aluminium Technology Development & Industry Promotion Centre for the Developing Countries. This approach is not alien to the UNIDO's programmes of assistance as the organisation (UNIDO) has already provided such assistance to R & D organisations in a few developing countries . Such a Centre can study the complexities of the market demands including their local and regional variations, carry out research into product acceptability and utilisation including design, develop appropriate production technology encompassing semi and finished engineering components, assist in the transfer of technology and training of man-power, render advice on product improvement and quality assurance to standards evolved for the developed countries and act as a centre for the dissemination of information on aluminium alloys and technology and their utilisation.

From the point of view of the aluminium industry, the developing countries can be grouped as under:

(a) those endowed with large bauxite deposits: Brazil, China, Colombia, Ghana, Guinea, Guyana, India, Indonesia, Jamaica, Malaysia, Mozambique, Philippines, Tanzania, Turkey, Surinam and Zaire;

(b) those endowed with large potential for the generation of hydro- or thermal electricity: all the oil or natural gas producing countries, Argentina, Brazil, Cameroon, China, Ghana India and Zaire.

(c) where the primary metal industry has been established: Argentina, Bahrain, Brazil, Cameroon, China, Egypt, Ghana, India, Iran, Korea, Mexico, Surinam, Turkey, UAE(Dubai) and Venezuela;

(d) where the primary metal producers have substantial semi fabrication facilities as well: Brazil, China, India, Korea, Iran,

Egypt, Mexico and Turkey; and

(e) Where semi fabricators - independent or those linked with transnational organisations exist: Argentina, Bahrain, Bangladesh, Brazil, Cameroon, China, Chile, Colombia, Ecuador, Egypt, Algeria. El Salvador, Ghana, India, Iran, Iraq, Indonesia, Kenya, Korea, Kuwait, Malaysia, Jordan, Mexico, Morocco, Nigeria, Pakistan, Philippines, Saudi Arabia, Sri Lanka, Tanzania, Thailand, Turkey, Uruguay and Venezuela.

The semi products industry has an assured future in the developing countries as the industry is the harbinger of prosperity.

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REFERENCES

1. The Economic Uses of Aluminium Based on Hungarian Experience: Bokor A, Domony A B, Varga I; UNIDO Report; August 1979.
2. U S Department of Energy: Annual Report to the Congress 1978 Vol 3.
3. Energy Handbook: Van Nostrand Reinhold Co. New York.
4. Commodity Conflict: Rangarajan L N; publisher: Croom Helm, London.
5. World Industry Since 1960: Progress and Prospects; Special Issue of the Industrial Development Survey for the Third General Conference of UNIDO, Delhi, February 1980.
6. Aluminium in Developing Countries: Aluminium, September 1975.
7. Aluminium: Eucle, Gregory and Mosae publishers: Richard D Irwin, Chicago; 1945.
8. Sunday Times, London 27th February 1980.
9. Satpathy S; Report Submitted to the UNIDO for the Indian Part of the Study on the Status of the Aluminium Industry in India - Growth-Application and R & D.
10. J Zambo: Bauxite and the Alumina Production: UNIDO Conference Bauxite-Alumina- Aluminium; Budapest May 1978.
11. Metal Bulletin Monthly: November 1978, 25.
12. Metal Bulletin 26th October 1970.
13. Financial Express: London 11th October 1979.
14. Making the Most of Materials: Science Research Council UK 1979.
15. Financial Times, London 4th March 1980.
16. Aluminium Statistical Review 1978; Aluminium Association Inc
17. Domony, A: Magyar Aluminium, Budapest, 1966, 3, 3, 63.
18. G Callaaili: Aluminio, Milan 1978, vol 57, p 93.
19. Kumar R. NML Technical Journal; National Metallurgical Laboratory Jamshedpur India; Silver Jubilee Issue 1976.
20. Kumar R: Report on the First International Conference on the Aluminium Transformation, Puerto Madryn, Argentina submitted to UNIDO Vienna 1978.
21. Hufnagel W. Aluminium 1978, 54(6), 403-406.
22. Same as refernce 14 cited above.
23. Metal Bulletin Monthly: October 1978, 57.
24. Kumar R Personal discussions in Kuwait
25. Morocco News Summary May 1978; Embassy of the Kingdom of Morocco.

26. Future of Aluminium Industry in the Middle East and North Africa: Report of CONSULTEX summarised in Metals Bulletin Monthly April 1979; 29-31
27. Metal Bulletin Monthly Supplement, November 1978.
28. Singh R & Mowafy S Development of Arab Aluminium Industry: Industrial Development Centre for the Arab States March 1977; then located in Cairo but now reported to have moved to Baghdad.
29. Metal Bulletin Monthly, February 1980
30. Morocco News Summary, May 1978; Embassy of Morocco in London.
31. Data Supplied by the Embassy of Turkey in London.
32. World Aluminium Survey, 1977; Metal Bulletin
33. Hart, D. The Volta River Project: Occasional Papers on Appropriate Technology, University of Edinburgh; March 1979; Also published in International Relations; May 1978 Volume 6 number 1.
34. Recursos Minerales de Colombia: Report of the Geological Survey Institute, Colombia
35. The Economist, London January 1980
36. Time - The Weekly News Magazine, 14th April 1980,
37. ANA'LISE 78/79 - Profile of Brazilian Economy, Abril-Teceditoria Ltd., Sao Paolo.
38. Rohter L: Reporting in the Observer or the Sunday Times in the last Quarter of 1979.
39. Metal Bulletin Monthly: April 1979.
40. Anuario Estadistico Da Associacão Brasileira do Aluminio, 1978.
41. Metal Bulletin: 18th September 1979
42. Metal Bulletin: 24th August 1979.
43. Statistics Canada, entries for December 1978, Table III
44. Exports of Commodity by Country, December 1978; Japan Trade Centre, London
45. Welteinfuhrstatistik 1978: über Halbzeug aus Aluminium und Aluminiumlegierungen: Aluminiumhalbzeug-Verband; Düsseldorf
46. Metal Bulletin Monthly: September 1979, 11.
47. Business Times (Malaysian) issues dated 8th & 17th August, 3rd October, 15th December 1979 and 2nd February 1980

ANNEX I

DIRECTORY OF SOME SEMI FABRICATION

ALUMINIUM INDUSTRY IN DP.C.

I. COUNTRIES OF THE MIDDLE EAST

1. BAHRAIN

1. Aluminium Bahrain (ALBA) Ltd., Jubail; Bahrain. (Nc semi fabrication activity)
2. Secretary, Ministry of Industry & Development, Government House, PO Box 235, Manama; Bahrain.
3. Midal Cables Ltd., PO Box 5939; Bahrain.
4. Bahrain Atomisers International Company, PO Box 5382, Manama Bahrain.
5. Bahrain Aluminium Extrusion Company (BAIEXCO), Bahrain.

Some of the Small Scale Fabrication Units:

1. Gulf Aluminium Factory, PO Box 285, Bahrain
2. Bassam Aluminium Factory, PO Box 177, Bahrain
3. Al Nisr Aluminium & Metal Fabrication Company; Bahrain.
4. Matric Aluminium, Pearl Bahrain Building, PO Box 968, Bahrain.

II. E G Y P T

1. The Aluminium Company for Egypt, 50, Shere Abdul Khalak Sarawat, Cairo; Telex 92640
2. Al-Saad Aluminium Company, 41 Abdel Khalak Sarawat Street, Cairo

   Cairo Telex 92640

   and the Factory at Mostorod, Near Cairo)
3. Director, Central Adminstration for Technical Affairs, The General Organisation for Industialisation, 6 Khalil Agha Street, Garden City, Cairo

   Telex 389

4. The Helwan Company for Non-Ferrous Indusries & Military Products, Helwan, Near Cairo.
5. The General Company for Metals, 5, 26th July Street, Cairo.
6. The Egyptian Copper Works; Hagar El Nawatia, Alexandria
7. The Egyptian Electro Cables Company, Teret El Ismaillia Road, Kilo 4.5 Mostorod, Near Cairo.
8. Arabic Company for Aluminium, Ismaillia.
9. Alu Misr, 4, Wisa Wassel Street by Kobri el Gamma, University Bridge, GIZA; Cairo.
10. Nile Aluminium & Plastic Company Ltd., 23, El Maadi Road, Misr el Kadima, PO Box 56, Giza, Cairo

III. I R A N:

1. Iranian Aluminium Company (IRALCO) PO Box 31, Arak.
2. Admirality Manufacturing Company; 82, North Kakh Avenue, PO Box 12-1238; Tehran. (Power Cables).
3. Ahwaz Pipe Mill Company; Takhte Jamshid Avenue; PO Bos 1963; Tehran. (Cables)
4. Alm'co Company Ltd., Fourth Floor; Toosi Building; Roosevelt Takhte, Tavous Cr; Tehran. (Aluminium Fabrications)
5. Aloran Company; Industrial Estate; Ghom. (Extrusions)
6. Aluminium Rolling Manufacturing Group; TCE Building; Halef Street; Hafez Avenue; Tehran. (Cables, Aluminium Sheets).
7. Alum Pars Company; 116, Mirdamad Avenue; Pahlevi Boulevard; Tehran. (Sheet and Foil)
8. Alumroll Company; Behrouz Building; Galoubandak Avenue; Bouzarjometru West; Tehran (Extrusions)
9. Alumtek Corporation; 1/441 Takhte Jamshid Avenue; Tehran. (Extrusion)
10. Alupan Company; 167 Avenue Abbas Abad; Pasha Crossing; PO Box 1098; Tehran. (Extrusion 5,000 tpy, additional extrusion press and anodising facility was planned for 1978-79 period.
11. Cablist Company Ltd., 5th Street, Dowlat Abat Street, Tehran. (Electrical Cables and Wire)
12. Chipal Company; Arak Industrial Estate; Arak. (Extrusions)
13. Donyaye Felez Company; Eisenhover Avenue; Tehran. (Extrusions)
14. Dural Company, 62, Avenue Mohammad Reza Shah, Tehran (Extrusions, Doors and windows)
15. Ghezel Hessar Mfg Company, 345 Avenue Pamenar, Tehran (Fabrications)
16. Guivar Company, Damavaud Avenue, Tehran. (Profiles and Tubes)

17. Iko Cable Works Iran Ltd., 21, Foroughi Avenue, Tehran (Cables)
18. Iran Alotube Company Ltd., Rasht. (Tubes)
19. Iran Bayka Cable Mfg Co., Kharim Khan Zand Avenue; Tehran (Cables)
20. Iran Mess Company, Opposite Bank Tehran, Pamenar Avenue, Tehran (Roll Products)
21. Iran Roll Company, 75, Ferdowsi Avenue, PO Box 14-1347, Tehran (Foil)
22. Kodasht Company, Arak Industrial Estate, Arak. (Extrusions)
23. Metal Containers Ltd., Ghazvin (Aluminium tubes)
24. Navrad Aluminium Co., 261 Avenue Hafez, TCE Building, Tehran (Sheets)
25. Pars America Industrial Company; Aluminium Building, Shah Avenue, Tehran. (Aluminium Cables, Profiles and Pipes)
26. J J Teernstra, Abbass Road, Koucheli Nilifar 15, Tehran. (Fabrications)

IV. I R A Q

1. State Company for Aluminium Semi Products, Nasiriyah
2. Wires and Electrical Cables Mfg. Company; Khan El Pasha Building Samawal Street; Baghdad.
3. Aluminium Metal Products Company, 101-103 Tel Mohammad, Baghdad.
4. Director General, State Enterprises, Nasiriyah
5. Technical Manager, State Organisation for Engineering Industries; PO. Box 3093 Baghdad

V. J O R D A N

1. Arab Aluminium Company, Amman.
2. Al-Taj Aluminium Company, PO Box 7066 Amman.
3. Eagle Aluminium Factory, King Talal Street, Amman
4. Far East Industrial Company, PO Box 1147, Amman
5. Hans Aluminium Company, PO Box 1197, Amman
6. Jordan Aluminium & Copper Mfg Company, PO Box 107, Amman.
7. Jordan Aluminium Factory Company, PO Box 678, Amman
8. Jordan Aluminium Manufacturing Company, PO Box 5003 Amman
9. Mahmoud Nasser Factory, Al Wahdat, Amman
10. Zamanon & Co., PO Box 987 Amman.

VI. K U W A I T

1. Ministry of Commerce and Industry, Government House, Kuwait

2. Arabian Light Metals Company, PO Box 2230; Kuwait

3. Gulf Cable and Electrical Industries Kuwait

4. Aluminium Extrusion Company (ALEXCO), Sulibia, PO Box 168
   Sherq Khaled ben Waleed Street, telephone 416609
5. Ruhyee Aluminium PO Box23483 Kuwait
6. Al Waleed Trading Establishment; PO Box 5112, Kuwait.
7. Aluminium Industrial Company, PO Box 2353; Tel 811977.
8. Bubian Industrial & Trading Co., PO Box3862; Tel 435195
9. Ahladi Aluminium; PO Box 5817; Kuwait
10. Al Khalid Aluminium. PO Box 5777; Tel 812309
11. Kuwaiti Copper & Aluminium Factory; PO Box 3937; Tel 814419.
12. Pacific Aluminium Company; PO Box 3289; Tel 823988

VII S A U D I A R A B I A

1. Aluminium Products Company (ALUPCO); PO Box 2080; Damman
2. Aluminium Bars Factory; PO Box 2350; Riyadh
3. Saudi Basic Industries Corporation (SABIC); PO Box 5101; Riyadh
4. Saudi Aluminium Factory; PO Box 3468; Riyadh
5. Saudi Industrial Establishment for Aluminium; PO Box 5874;
   Riyadh (Aluminium Fabrications)
6. National Aluminium Company; PO Box 2792; Riyadh
7. Middle East Aluminium Factory; Damman
8. Hana's Metal Works Establishment Factory PO Box 842; Riyadh

VIII U N I T E D A R A B E M I R A T E S (DUBAI)

1. Dubai Aluminium Company Ltd; PO Box 3627; I
2. Al Boudoor Building Material Co.; PO Box 1394 (corrugated Sheet)
3. Arabian Aluminium Co Ltd; PO Box 550
4. Dubai Cable Co.; (DUCAB) PO Box 11292
5. Gulf Extrusions; PO Box 1; (aluminium Extrusions)

ABU DHABI

1. Abu Dhabi Aluminium Factory; PO Box 685 ; Abu Dhabi.
2. Alain Aluminium Company; PO Box 1030; Alain
3. Arabian Gulf Aluminium Company; PO Box 4169; Abu Dhabi.
4. Golden Aluminium; PO Box 4382; Abu Dhabi.
5. Gulf Aluminium Factory; PO Box 133; Abu Dhabi.
6. Hillco; PO Box 2387; Abu Dhabi
7. Hishami International Company; PO Box 2389; Abu Dhabi
8. Sciale; PO Box 3049; Abu Dhabi.

OMAN

1. Akif & Bros; PO Box 489 (Aluminium Fabrication); Oman
2. Oman Aluminium Company; PO Box 84; Muscat
3. Oman Aluminium Factory; PO Box 712 RUWI (Muscat) (Fabrication)

QARAR

1. Arabian Construction Engineering Company; PO Box 1277; Doha.
2. Binali Aluminium; PO Box 75; Doha. (F ~ication)
3. Doha Aluminium Factory; PO Box 1038; Doha. (Fabrication)

LEBANON

All Companies engaged in Fabrication only (except 5 to 8)

1. Ajax Aluminium Industry; PO Box 3783; Beirut.
2. Aluminium of Lebanon; PO Box 4782; Beirut.
3. Florid Aluminium; PO Box 11; Hazmieh
4. Intex SARL; PO Box 4255; Beirut.
5. Liban Cables SAL PO Box 6008; Beirut.
6. Middle East Cable SAL PO Bos 11-7769; Naameh.
7. Sciale SAL; PO Box 4782; Jamhour; Beirut.
8. SIDEM (Ste' pour l'industrie des Metaux); PO Box 2912
   (parent company Pechiney Ugine Kuhlman; corrugated aluminium sheet and extrusions)
9. Ste' Stal SAL; PO Box 1962 Beirut.

II. COUNTRIES OF NORTH AFRICA AND TURKEY

A L G E R I A

1. Ministere de l'Industrie Lourde, Immeuble le Colisee. Rue Ahmad Bey de Constantine; Alger.
2. Union Siderurgique Arabe, Cheigas; Alger.
3. Ste Nationale de Siderurgie; Kouba.

M O R O C C O

1. Ministry of Commerce and Industry, Rabat.
2. Bureau de Recherches et de Participations Minieres (BRPM), Charia Moulay Hassan, Rabat.
3. Ste' Aluminium Du Maroc; Quartier Industrial; Tanger
4. CGE Maroc; 68, Bd de la Resistance; Casablanca.
5. Manufacture Marocaine D'Aluminium, Rue Fatima-Zahra; Mohammadia,.
6. ALU_Coquilles, 12, Rue Zinab Ishak; BP 20708; Casablanca.
7. AFOMA (Affiniere et Fonderie du Maroc); Km 9, 300 Route de Zenatas Ain Sebbaa, BP 2563; Ain Sebaa.
8. FOMETA; 32 Rue de la Schlueht; Casablanca.
9. SAMAB-MAROC; 97, Boulevard de Grande Ceinture (Ain Sebaa) BP 2588; Casablanca.
10. SIMEF; Km 10, Route Ain Chkef; BP 41A; FES.

T U R K E Y

1. Etibank Seydishhir Aluminyum Tesisleri; Seydisehir.
2. Nasas Aluminyum A S. Sirkeci Emirler Sokak; Istanbul
3. Aksan Metal Sanayi ve Ticaret A S. Bankalar Cad. Karakoy; Istanbul.
4. Aluminyum Sanayicileri Dernegi Gumussuyu; Bag Odalari, Asli Han No. 24/6, Taksim Istanbul (Aluminum Producers' Association)
5. Rabak Elektrolitk Bakir ve Mamulleri A S; Inonu Caddesi No. 90/5 Dersan Han, Taksim, Istanbul.
6. Turk-Kablo A S; Gumussuyu Caddesi 69/1, Taksim, Istanbul
7. Otomat Sanayi Aluminyum Profil ve Makine, Imalati Anonim Sirketi; Karakoy; Persembepazar; Caddesi No. 25-27. Istanbul.
8. Fenis Aluminyum Sanayi ve Ticaret A S; Yeni Kemeralti Cad. Karakoy; Istanbul.
9. Etibank General Management (Murgul Bakir Isletmesi Mussesesi, Cihan Sokak 2; Sihhye; Ankara.

III. COUNTRIES OF EAST AFRICA

K E N Y A

1. Narcol Aluminium Rolling Mills Ltd.; PO Box 80872; Mombasa.

2. Booth Manufacturing Company; PO Box 30057; Nairobi
3. Kenya Casements; PO Box 90132; Mombasa.
4. Narshidas & Company Ltd., PO Box 80872; Mombasa.
5. East African Cables; Nairobi. (E Linfoot - Managing Director)
6. Kalu Works Ltd; PO Box 90421; Mombasa.
7. Mabati Ltd., PO Box 46934; Nairobi.
8. Permanent Secretary, Ministry of Commerce and Industry PO Box 30430; Nairobi.
9. There are about 8 fabrication units:

Ideal Casement	Dominion Engineering
James Warren Engg Co. Ltd.;	Morris & Company
Swanan Sing & Company	Neci Ltd.;
Mackenzie (K) Ltd.;	

T A N Z A N I A

1. Aluminium Africa Ltd.; (ALAF) PO Box 2072; Dar-es-Salaam.

2. Metal Products Ltd.; PO Box 2332; Dar-es-Salaam (Fabrications;

3. Tanzania Cables Ltd.; PO Box 508; Dar-es-Salaam.

IV. COUNTRIES OF WEST AFRICA

C A M E R O O N

1. ALUCAM (Camerounaisede de L'Aluminium Pechiney Ugine, BP 1090 Douala.
2. ALUCAM BP 54 EDEA
3. ALUBASSA; PO Box 192; Douala.
4. SOCATRAL (Societe' Camerounaise de Transformation de L'Aluminium) BP 198; Douala.

5. Syndicat des Industries du Cameroun; BP 673 Douala.

G H A N A

1. Volta Aluminium Company (VALCO) Tema.
2. Ghana Aluminium Products (Alcan) Tema (Semi Fabrication)

N I G E R I A

1. Alcan Aluminium of Nigeria, Port Harcourt
2. Nigerian Aluminium Extrusions; Lagos.

Z A I R E

1. LATRECA, Lubumshahi. (Having connections with SA des Usines of Belgium for sheets strips and extrusions of unspecified capacity)
2. Bureau detudes du President; Kinshasa.

Z A M B I A

1. Metal Fabricators of Zambia; Luanshya. (having connections with Indeco Industrial Holding, Phelps Dodge for ACSR Conductors and Cables).

V. LATIN AMERICAN COUNTRIES OF SOUTH AMERICA

A R G E N T I N A

1. Camea; Avenue Belgrano 884, Buenos Aires.
2. Alambrica Saic Sanatamarina y Herrera, Moron, Buenos Aires.
3. CAMET; Buenos Aires. (manfacturing sheets)
4. CIMET SACI; Combet 2501, Jose Leon Suarez FCBM; Buenos Aires.
5. Luis Costa; Calle Pilegrini 442; Buenos Aires. (sheets)
6. Albano Cozzuol; La Plata. (500 tpy extrusions)
7. Espinoza Hermanos SA; Aveninda Pavon 6848; Buenos Aires.
8. Fabrica Militar De Vainas Y Conductores Electricos ECA; Carlos Fiorito 950; Avellaneda; Buenos Aires.
9. FLAMIA SA; Aveninda Montes de Oca 1440; Buenos Aires.
10. Hijos De Ciriaco Greco; Constitucion 2702; Buenos Aires.
11. Kaiser Aluminio SA (KASA); Florida 234; Piso 1; Buenos Aires.
12. Marimoc SA; Rosetti 1192; Buenos Aires. (350 tpy sheets)
13. Metral SRL; 1587 Calle Montevideo; Buenos Aires. (400 tpy extrusions)
14. Pell Hermanos; Lavalle 534; Buenos Aires. (Sheets)
15. Pilar SA; Rosario; Santa Fe. (600 tpy sheets)
16. Industrias Pirelli SAIC; 25 de Mayo 444; Buenos Aires.

17. Bertisch Pinkas; J L Cantillo 4199; Buenos Aires (600 tpy sheets)
18. Financeira Plantense SA FIPLA; Aveninda Argentina 6801; Buenos Aires.
19. Industrias RAB SA; Minero y Sidero- Metalurgica Industrial y Comercial Rabsa; Rio Cuarto 1964; Buenos Aires. (2000 tpy Sheet and Plate)
20. Talleres Rivadavia de Industrias Metalurgicas; Avenue R S Pena 943; Buenos Aires. (3000 tpy sheets, extrusions bars and rods)
21. Talleres Tam Lupini Y Stevanc SAIC; D Taboda 974-9; Buenos Aires. (600 tpy extrusions)
22. COPEDESMEL (Comision para el Desarrollo de los Metales Livianos) Junin 1060, 5 piso, 1113 Buenos Aires;
23. KICSA Industrial Y Comercial SA (Kaiser Aluminium Technical Services Inc; Florida 234; Buenos Aires.

B R A Z I L

1. CIA Mineira de Aluminio, ALCOMINAS; 50-10-11 Rjorge, 15 Ramais; Sao Paolo.
2. CIA Brasileira de Aluminio SA; 70A Riachuelo; Rio de Janeiro.
3. Aluminio Extrusao SA E Laminacao ASA; Rua Alvao Alvin 31; 16 ander; Rio de Janeiro.
4. Aluminio Industria SA AISA; Avenida Paulista 1938, Caixa Postal 30638, Sao Paolo.
5. Metalurgica Brasileira Ultra SA; Rua Barao do Tiete 115; Caixa Postal 7218; Sao Paolo.
6. CONSIDER. Conselho de Não-Ferrosos e de Siderurgia, Esplanada dos Ministerios; Brasilia DF.
7. Fios E Cabos Plasticos do Brasil SA, FICAP; Avenida Suburbana 4930; Rio de Janeiro.
8. Kaiser Aluminio do Brasil SA KABL; Avenida Sao Joao 473, Caixa Postal 176; Sao Paolo.
9. Phelps Dodge do Brasil Conductores Electricos SA, 996, Peixito - Gomide; Sao Paolo.
10. AISA Aluminio Industria Ltda; Sao Paolo.
11. Alcominas Companhia Mineira de Aluminio; Minas Gerais.
12. Alfema SA Industria e Comercio; Sao Paolo.
13. Alubeta SA Insumos Basicos para Siderurgia, Sao Paolo.
14. Aluminio Empresa SA Industria Metalurgica; Sao Paolo.

15. Aluminio Traja Ltda. Sao Paolo.
15. Aluminio Royal SA; R Grande do Sul
16. Aluminio SA Extrusao e Laminacao ASA Pernambuco.
17. Aluminio Trofa Ltda.; Sao Paolo.
18. Alusud Aluminio do Sul SA; Santa Catarina.
19. Anil Aluminio Nacional Industria Ltda. Sao Paolo
20. Arno SA Industria e Comercio; Sao Paolo.
21. Artefatos de Aluminio e Embalagens-Ardea SA; Sao Paolo.
22. Carlos Augusto Meier SA Aluminio Economico, Rio Grande do Sul.
23. Ciana-Companhia Nacional de Aluminio, Mias Gerais.
24. Clemente Irmaos SA - Aluminio Ironte, Ceara.
25. Companhia Brasileira de Aluminio-CBA Sao Paulo.
26. Construcoes Electricas Eltec SA; Sao Paulo
27. Eluma SA Industria e Comercio/Divisao Isam; Sao Paolo.
28. Estamparia Cravellas SA; Sao Paolo.
29. F Conte SA Industria e Comercio; Pernambuco.
30. Furukawa Industrial SA Produtos Electricos; Sao Paolo.
31. Laminacao de Metais Clemente SA; Sao Paolo.
32. Pirelli SA CIA Industrial Brasileira; Caixa Postal 7163; Sao Paolo.
33. Termomecanica Sao Paolo SA; Sao Paolo.
34. Alcan Aluminio Do Brasil SA Caixa Postal 30.553 CEP 01000 Sao Paolo. Plant at Ouro Treto (MG) for sheet and plate - 24,000tpy; Foil 8,000 tpy; Extrusions 12,000 tpy; Rod 20,000 tpy; Wire and Cable 15,000 tpy; Paste 800 tpy.
35. Aluminio Industria SA (AISA); Pindamonhangaba. Alusuisse plant with a capacity of 12,000 tpy of extrusions, Rod, Wire and Tubes.
36. Alcan Aluminio do Brasil plant at Pindamonhangaba for 25,000 tpy sheet.
37. CIA Brasileira de Aluminio SA; Plant at Soracaba for sheet, Foil Extrusions and Wire combined capacity 16,000 tpy.
38. FAE SA Industria E Comercio de Metais; Plant at Sao Bernado do Campo for Extrusions 1,000 tpy.
39. Forest SA Fabrica de Conductores Electicos; Plant at Guarulhos; Cable 1,000 tpy.
40. Philips Cable Ltd; Plant at Brockville - Other plants at Rimouski Dartmouth, Scarborouh, Sentinel and Vancouver; having connections with BICC.
41. Reynolds Aluminium Company of Canada Ltd; Plant at Cap de la Madeleine for sheet; Plant at Rexdale for foil; at Weston for Coils; Combined capacity 30,000 tpy.

42. Reynolds Cable Company Ltd;, (REYCAB); Plant at Malbele for rods and cables and the plant at Ashawa for bars and tubes.
43. Zimmcor & CO.; Plant at Lachine for Extrusions.
44. Pirelli SA Companhia Industrial Brasileira, Alameda Barao de Piracicaba 740, Sao Paolo.

C H I L E

1. Manufacturas de Cobre SA (MADECO), Ureta Cox 930; Santiago de Chile. (cables and conductors)
2. Industria de Aluminio SA (INDALUM) Aysan No. 244, Santiago de Chile. (Extrusions and roll products)
3. Cobre Cerrillos Sociedad Anonima COCESA; Camino a Melipilla 6307; Santiago de Chile.
4. Fantuzzi Hijos Y Cia, Camino a Melipilla 8455; Santiago de Chile. (Sheets and circles)
5. Director Ejecutivo, Centro de Investigacion Minera Y Metalurgica Avenue Parque Institucional 6500, Santiago de Chile.

C O L O M B I A

1. Alambres Industriales SA at Barranquilla for rods and wires.
2. Aluminio Alcan de Colombia SA; Plant at Yumbo (Cali); Sheets 3,300 tpy, Extrusions 2,600 tpy
3. Aluminio de Colombia (Reynold), Santo Domingo; Plant at Barranquilla for sheet Foil and Extrusion; Combined Capacity 4,000 tpy.
4. Aluminio Munal Plant at Cali for Sheets and Circles.
5. Aluminios Industrias Vernig; Bogota for Extrusions and tubes.
6. Fabricas Colombianas de Materias Electricas SA; Plant at Cali for wire and cable.
7. Industrias de Cobre y Aluminio (INCOAL) Plant at Medellin for 100 tpy wires.
8. FEDEMETAL; Federacion Colombiana de Industrias Metalurgicas; Carerra 14 No. 37-15; BOGOTA.
9. Ministerio de Minas; Centro Administrativo Nacional(CAN)Bogota.

E C U A D O R

1. Cables Electricos Ecuatorianos CA (CABLEC) Plant at Quito for wires and cables.
2. Ministerio de Industria, Comercio e Integracion, Leon Mara y Roca; Government of Ecuador; Quito
3. Cedal C E M; Latacunga (shapes and pipes)
4. Fisa S A; Guayaquil (shapes and pipes for construction and irrigation)
5. Metales Elaborados Titan S A; Guayaquil. (corrugated alum.)

Besides, there are about 8 industrial units manufacturing finished products. Those located at Guayaquil are CILGAS SA, Laboratorios HG SA, IMSA, DUREX and Industrias Durimetal SA and those at Quito TESA, IDE CIA LTDA., and Fabrica de Aluminio UMCO SA.

P E R U

1. Direcion General de Industrias; Ministry de Industria, Comercio Turismo e Integracion, Calle Oeste, Corpac, LIMA
2. Fabrica de Aluminio & Metales SA FAMSA, General Orbegoso, 241 Brena. (Fritz Bayer M - Executive President) General Orbegoso 241 LIMA 5.
3. CIA Industrial del Cobre SA; La Oroya
4. Industrias de Cobre SA; Baquijano y Carrillo 683, Lima.
5. Metales Industriales de Peru SA; Carretera Central Km 3. ATE.
6. Fundicion de Metales Bera Del Peru S A Av. Materiales 2915 Lima. Casilla 6220; Lima 100
7. Industrias Krevasa; Domingo Orue 938 Lima 14; ; Casilla 1268 Lima 100.
8. Sociedad Industrial Articulos de Metal; Mario Canepa S A; Casilla 199 Lima .

U R U G U A Y

1. Alcan Aluminio del Uruguay SA; Plant at Montevideo.
2. Arricar Labat Oddone SA (Alosa); Plant at Montevideo for sheet and circles.
3. Fuaye, SA; Plant at Montevideo for sheets and tubes
4. Helguera y Morixe SA Plant at Montevideo for sheet.

V E N E Z U E L A

1.

1. Alcan de VenezuelaSA; Edf. Torre LKM, Avenida Romulo Gallegos; Caracas (Telx 25538)
2. Aluminio del Caroni SA; Edf. General de Seguros, Chuao, Caracas (Telex 25394) Mantanzas plant 40,000 tpy for sheet and foil established by CVG jointly with Reynolds
3. Alambres y Cables Venezolanos CA (ALCAVE); Plant at Maracay for wire and Cable; connections with Phelps Dodge; Plos Palos Grandes, Caracas.
4. Aluminio Industrial del Venezuela; Plant at San Martin (Miranda) for extrusions, sheet and plate,.
5. Aluminio Reynolds de Venezuela SA; Plant at Maracaibo for extrusions 8,000 tpy; Centro Comercial la Piramide, Caracas; Telex 22846
6. SA Venezolana de Aluminio Caracas for extrusions
7. Alcan de Venezuela SA; Plant at La Victoria for extrusions 3,000 tpy.
8. Corporacion Venezolana de Aluminio CA; Edf Gran Avenida; Plaza Venezuela, Caracas; (Telex 22846)
9. Impact CA; Edf Meneven Av Fco de Miranda; Los Palos Grandes Caracas (Telex 23456_
10. Swiss Aluminium Company Ltd; Callo Veracruz; Las Mercedes.
11. Aco SA; Edf Aco, Avenida Pedro Leon Torres, Barwuismeto.
12. Aluminium Industrial Plant de Venezuela, Zona Industrial, Calle 139, Moracaibo; Estado Zulia (Telex 61159)
13. Venalum Industria Venezolana de Aluminio; Puerto Ordaz;
14. CA Fundiciones y Manufacturas de Metal; Avenue Milan; Esq. Boston La California Sur.
15. Savena SA Venezolana de Aluminio; Calle la Floresta 28; Prado de Marca; Carascas.

VI. THE BAUXITE COUNTRIES OF SOUTH AMERICA:

G U Y A N A

1. Guyana Mining Enterprise Ltd.; PO Box 27, Mackenzie.
2. Bauxite Industry Development Co. Ltd., 71 Main Street; Georgetown.
3. Guyana State Corporation, 45-47 Water Street, Georgetown.
4. Guyana National Engineering Corporation - Aluminium Products of Guyana, 2-9 Lombard Street, Georgetown

J A M A I C A

1. International Bauxite Association; 67 Knutsford Boulevard, PO Box 551, Kingston
2. Jamaican Bauxite Institute; PO Box 359, Kingston 5.
3. Jamaican Manufacturers' Association; Kingston

S U R I N A M

1. Surinaamsche Aluminium Fabriek Everhard, Paramaribo.
2. Suriname Aluminium Company (SURALCO); Van't Hogerhuysstraat 55, Paramaribo.
3. N V Billiton Maatscheppij Suriname; Mr Dr J C de Mirandastraat 55, Paramaribo.
4. Carib Metal Works, PO Box 51, Falmouth
5. Plan Bureau, Paramaribo.

VII T H E C E N T R A L A M E R I C A N REGION

M E X I C O

1. CONDUMEX SA, Apdo. Postal 87-057 Mexico 14 DF
2. Aluminio SA de CV, Veracruz.
3. Conductores Monterrey SA; Monterrey.
4. Alcan Aluminio SA; Tulpetiac.
5. ALCOMEX SA; Mexico City (ALCOA connections for 4,000 tpy extrusions & tubes)
6. ALUMEX de CV Puebla for extrusions
7. Aluminio SA de CV plants at Mexico, Jalapa veracruz for sheets and plates having ALCOA connections.
8. Cuprum SA; San Nicolas de los Garza; extrusions

9. Laminadora Mexicana de Metales, Mexico City for sheet and strips.
10. CIA Nacional de Extrusiones SA De CV, Guadalajara; 2,000 tpy extrusions.
11. Phelps Dodge Pycsa SA Puebla for cables and conductors (having connections with Phelps Dodge International & Conductores Monterrey
12. Tubos y Perfiles de Aluminio Hall Sri de CV; plant at Toledo for extrusions.
13. Reynolds Aluminium SA; Tialnepantla
14. Secretaria de Patrimonio y Fomento Industrial; Government of Mexico, Insurgentes sur 552, Mexico DF.

E L S A L V A D O R

1. Aluminio de Centro-America; Apartado 404; San Salvador

2. Ing y Lic Manuel Enrique Hinds, Ministerio de Economica, San Savador)
3. Departmento Agropecuario e Industrial, Banco Central de Reserva de El Salvador, San Salvador.
4. Director General de Estadisticas y Censos, Calle Arce 953, San Salvador.

GUATEMALA

1. Aluminios Industriales SA (ALNISA); Carretera al Pacifico Km 28-½; Amatitlan.

NICARAGUA

1. Aluminios Extruidos SA (ALUMEX) PO Box P-37 Managua

COSTA RICA

1. Aluminios Nacionales SA; Avenida 5, Calle 1-3; San Jose.

VIII. E A S T & S O U T H - E A S T A S I A

I N D O N S I A

1. P T Indo-Extrusion (PTIE); Index Aluminium; PO Box 207, Bandung or PO Box 26/Kby Jakarta.

2. Indonesia Asahan Aluminium Co. Plant at Kuala Tandjung
3. ALCOA Project at Kalimantan.

S O U T H K O R E A

1. Korea Non-Ferrous Metal Smelting & Refining Association; Room 301 Dong Shin Building, 139-1 Ahnkook-Dong Chongnu-ku; Seoul.
2. KORALU (Primary Aluminium Smelter); The Hankook Ilbo Building, 14, Chunghak-Dong Chongnu-ku, Seoul. Plant at Ulsan.
3. Hankook Kaiser Aluminium Company Ltd., 18-27 Mookjung-dong, Chungnu-ku, Seoul
4. Hang Yung Aluminium Industries Co. Ltd 267 Juang Dong. Inchon.
5. Sunhak Aluminium Company Ltd.; 342 Chimsan-dong Bak-ku, Taegu (Seoul)
6. Choil Aluminium; Yung San
7. Yulsan Aluminium
8. Namsun Light Metals
9. Pyongang Steel

P H I L I P P I N E S

R o l l i n g

1. Asian Aluminium Amalgamated Inc., 93 Mayon Street, Valenzuela Metro Manila (2,000 tpy, started production in 1969, employs 11 persons)
2. Hooven Comalco Industries, Cainta, Metro Manila having 58" wide cold rolling mill, commenced production in 1977 with 885 persons Arnulfo Paca is the Vice President.
3. Quality Aluminium Corporation, Plant at Bo, Florencio, Ubando, Bulacan. 600 tpy, started production in 1962. Honorata Talao - G M,
4. Reynolds Phils Corporation; Plant at Dasmarinas, Cavite; 15,000 tpy, started production in 1977 with 434 persons;

E x t r u s i o n

5. Hooven Comalco Industries; extrusion and cold rolling plants total capacity 6500 tpy started production 1955.
6. Jalwindor Manufacturers Incorporated; 292 Roosevelt Avenue; Quezon City; 2160 tpy; started production 1970; Employs 66 persons.

7. Permaline Metals - Plant at Bo Parang, Marikina, Metro Manila; started production in 1977;
8. Reynolds Phils Corporation - plant at E. delos Santos Avenue, Mandaluyong, Metro Manila; 3,270 tpy, employs 44 persons, started production in 1962.

9. United Aluminium Fabricators, 1128 Quirino Highway, Quezon City; 3,600 tpy, started production 1967, employs 118 persons;

Cables

10. American Wire & Cable Incorporated; South Superhighway; Paranaque; Metro Manila; 480 tpy; started production in 1956 with 467 persons;

11. Far East Wire & Cable Corporation plant at Bo Talor, Las Pinas, Metro Manila; 1,000 tpy; started production in 1973; employs 183 persons;

12. Phelps Dodge Phils Incorporated; Pioneer Street, Mandaluyong, Metro Manila; 2,880 tpy; started production in 1968 employs 378 persons;

13. Philips Wire & Cable Incorporated; Bo Talipapa; Caloocan City; 1,000 tpy; employs 190 persons;

14. Metals Industry Research & Development Centre; 5th Floor; Ortigas Building, Ortigas Avenue, PASIG, Metro Manila.

M A L A Y S I A

1. Alcan Malaysia Berhad, Petaling Jaya; Selangor.
2. Federal Aluminium Sdn Berhad., Plot 226; Prai Industrial Complex PO Box 118, Butterworth; Province Wellesley.
3. Pony Metal Works
4. Dah Yung Steel Manufacturing Co., 19 Jalan Empat, Jalan Chan Sow Lin; Kualaumpur.
5. Malayan Cable Berhad; 10 Jalan Tandung, Petaling Jaya; Selangor.
6. Universal Cable (M) Berhad; 14 Jalan Gajah, Larkin Industrial Estate; Johore Bahru; Johore.
7. Central Cables Sdn Berhad PO Box 313; Malacca.
8. Federal Power & Telecommunications Berhad; 114 Jalan SS2/4 Petaling Jaya; Selangor.
9. Federal Cables and Wire Manufacturing Metal Berhad; PO Box 70, Butterworth; Penang.
10. Furukawa Electric Cables (M) Sdn Bhd., 13th Floor, WISMA MPI, Jalan Rajah Chulan; Kuala Lumpur.

C H I N A

1. Wai Han Guang - Chief Engineer in Aluminium Metallurgy, Department of Non-ferrous Metallurgy, Ministry of Metallurgical Ind. Beijing.
2. Chen Dai, Deputy Director, Beijing Non-ferrous Metal Project & Research Institute.
3. Long Xiang, Professor North-East Institute of Technology
4. Huang Guan Xai, Vice Chief Engineer, Fushun Aluminium Plant
5. Hou Tie, Vice Chief Engineer, Shandong Alumina Plant.
6. Xi Shu Tian, Vice Chief Engineer, Zengzhou Aluminium Co.
7. Pan Shu Lu, Vice Chief Engineer, Guizhou Aluminium Company
8. Wang Meng, Vice Chief Engineer, Northeast Light Alloy Fabrication Plant.
9. Jiang Ming Kuan, Chief Engineer, South East Aluminium Fabrication Plant.

S I N G A P O R E

1. Aluminium Pioneer (PTE) Ltd; Jalan Pabrik, Jorong Town 22, Singapore.
2. Allied Aluminium (PTE) Ltd; 6, Fan Yoong Road, Singapore 2261.
3. Aries Aluminium Company; 1A-2A, Block 1, Depot Road, Singapore 2261.
4. Sigma Metal Company Ltd; 3, Jalan Pesawat, Singapore 2261.
5. YKK Industries (PTE) Ltd; 11, International Road, Singapore 2261.
6. Yong Tai Loong (PTE) Ltd; 105 Neythat Road, Singapore 2262.
7. Yoong Tat Metal Works, 14/16 Chang Charn Road, Singapore 0315.

T H A I L A N D

1. Thai Metal Works Co. Ltd; 181 Linchee Road, Bangkok.
2. Phelps Dodge Thailand Ltd; PO Bos 11-58, Bangkok.
3. Alcan Thai Co. Ltd; Dusit Thai Office Building, 1-3Rama IV Road, Bangkok.
4. Siam Electric Industries Co. Ltd; 297 Suriwongse Road, Bangkok.

IX. C O U N T R I E S O F I N D I A N S U B C O N T I N E N T

B A N G L A D E S H

1. Bangladesh Aluminium & Iron Mfg. Co, 108 Tejgaon Industrail Area, Dacca.
2. Dacca Aluminium Works, 17, Iman Ganj, Dacca.
3. Shalebin Industrial Corp., 157 Tejgaon Industrial Area, Dacca.
4. Khurshid Industrial Corporation, 314, Industrial Area, Dacca
5. Bangladesh Aluminium Manufacturers' Association, 3 D C Roy Road, Opposite Mitford Hospital, Dacca.
6. Rahim Metal Industries, 26 Mitford Road, Dacca.
7. Hardio Glass, Aluminium, Enamel & Silicate Works 8 Hatkola Rd. Dacca.
8. Atcha Brothers Ltd., 17 Mitford Road, Dacca.

P A K I S T A N

1. Chowdhury Cables Ltd.; Lahore.
2. Pakistan Cables Ltd.; B 21, Sind Industrial Trading Estate, Manghopir Road, Karachi.
3. Pakistan Metal Industries,; D 76, SITE, Mauripur Road; Karachi.
4. Pakistan Aluminium & Industrial Works, Jahangir Kothari Building; Bunder Road, Karachi.
5. Pakistan Aluminium Factory & Metal Industry; Masoon Shah Road; Multan.
6. Ministry of Finance Planning & Development, Government of Pakistan; Islamabad.

S R I L A N K A

1. ACME Aluminium Company Ltd.; 186 Vauxhall Street; PO Box 970 Colombo.
2. Kelani Cables Ltd; PO Box 14; Wewuldewa, Kelaniya.

I N D I A

Government Departments Concerned with the Aluminium Industry:

1. Secretary, Minsitry of Mines & Metals, Shastri Bhawan; New Delhi.
2. Secretary, Directorate General of Technical Development, Non-Ferrous Metals Directorate, Udyog Bhawan, New Delhi.
3. Vice-President. The Planning Commission; Yojana Bhawan, New Delhi.
4. Development Commissioner, Small Scale Industry, Ministry of Industry, Nirman Bhawan, New Delhi.

Associations of Aluminium Industry:

1. Indian Electrical Manufacturers Association; 501 Kakad Chambers; 132, Dr Annie Besant Road; Bombar 400016.
2. Cable and Conductor Manufactuers Association; Man Sarowar, Nehru Place, New Delhi.
3. Indian Non-Ferrous Metal Manufactuers' Association C/O The Bombay Chamber of Commerce, Mackinon & Mackenzie Building, Ballard Estate; BOMBAY 40 00038.

Primary Smelters with Semi-Fabrication Facility:

1. Bharat Aluminium Company Limited, Punj House; 18, Nehru Place; New Delhi.

2. Bharat Aluminium Company Ltd., Korba (MP),

3. Indian Aluminium Company Ltd., PO Box 361, Calcutta.

4. Indian Aluminium Company Ltd., Belur, Near Calcutta.

5. Indian Aluminium Company Ltd., Sambalpur, Orissa.

6. Indian Aluminium Company Ltd., Alwaye, Alupuram, Kerala.

7. Indian Aluminium Company Ltd., Taloja, Maharashtra.

8. Indian Aluminium Company Ltd., Belgaum.

9. Hindustan Aluminium Corporation; Century Bhawan, Dr Annie Beasant Road. Bomaby 40 00 25.

10. Hindustan Aluminium Corporation, Renukoot, District Mirzapur, UP.

11. Madras Aluminium Company Ltd., Mettur Dam 636402; Salem District.

12. Aluminium Corporation of India Ltd (presently under Balco management,) Jaykaynagar, Near Asonsol.

Other Semi Manufacturers:

1. Electrical Manufacturing Company Ltd., 136, Jessore Road, Calcutta 70 00 55.

2. India Foils Ltd., Kamarhatti (Bengal) having British Collaboration)

3. Jindal Aluminium Ltd., Bangalore 22.

4. Jindal Aluminium Company Ltd., 1-6B Asaf Ali Road, New Delhi.

5. Patel Extrusions Private Ltd.,

Cable and Conductor Manufacturers

1. Indian Cable Company Ltd., PO Box 514, 9 Hare Street, Calcutta.

2. Indian Cable Company Ltd, Jamshedpur (A K Kahali, BICC Collaboration for XLPE Cables only now; PILC & PVC Cables; paper covered and enamelled wires and a variety of other cables.

3. Apar Private Ltd., (Formerly known as Power Cables Ltd.) PO Box 4, Wittalwadi, Thana, Kalyan. (Maharashtra)

4. Apar Private Ltd., Brelvii Syed Abdulla Road, Bombay 4 (Head Office; the company manufactures PILC & PVC Power Cables, AAC/ACSR Conductors, PVC/VIR Cables etc.

5. Asian Cable Corporation of India Ltd., 241/42 Backbay Reclamation, Nariman Point, Bombay 1. (having Phelps Dodge of USA collaboration; PILC/PVC Power Cables, AAC/ACSR Conductors, PVC/VIR Cables, Paper Covered and enamelled wires.

6. Cable Corporation of India Ltd., Laxmi Building, Ballard Road, Bombay. Collaboration with Siemens of West Germany. PILC/PVC Power Cables, PVC/VIR Cables.

7. Universal Cables Ltd., Satna (MP) PILC/PVC Power Cables, AAC/ACSR Conductors, Solid Aluminium Cables, etc; seem to have been established with BICC Collaboration.

8. Oriental Power Cables Ltd., Kota (Rajasthan); Collaboration with Sumitomo Electric Company of Japan; PILC/PVC Power Cables, AAC/ACSR Conductors etc.,

9. Industrial Cables India Ltd., Rajpura (Punjab) PILC/PVC Power Cables AAC/ACSR Conductors; collaboration with Hackbridge Cable Company of UK.

10. Fort Gloster Industries Ltd., 31 Chowringhee Road, Calcutta. Head Office only.

11. Fort Gloster Cable Company Ltd., Bauria (SE Railway) Near Calcutta, were established with BICC collaboration.

12. Aluminium Industries Ltd., 1, Ceramic Factory Road, Kundara, (Kerala). Producing a variety of cables and conductors as well as cable machinery.

13. Aluminium Industries Ltd., Hirakud (Orissa). PILC/PVC Power Cables. AAC/ACSR Conductors, PVC/VIR Cables.

14. Omega Cables Ltd., Bukharia Building, Moores Road, Madras. PILC/PVC Power Cables, AAC/ACSR Conductors, PVC/VIR Cables; collaboration with Sumitomo Electric of Japan.

15. Premier Cables Company Ltd., Karukutty (Kerala). PILC/PVC Power Cables,AAC/ACSR Conductors, PVC/VIR Cables, Paper Covered and enamelled wires.

16. Traco Cable Company Ltd., Ernakulam, (Kerala).

17. Shamsher Sterling Corporation, Bombay. Collaboration with Showa Electric Wire & Cable Company of Japan.

18. Indian Aluminium Cables Ltd., Ghaziabad (UP).

19. Indian Aluminium Cables Ltd., 21A, Himalaya House, Kasturba Gandhi Marg, New Delhi 1.

20. Asian Cables Ltd., Pokharan Road, PO Box 11, Thana (Maharashtra).

21. Alcond UP Private Ltd., 2A Shakespeare Sarani, Calcutta 16.

22. Electric Manufacturing Company., 136, Jessore Road, PO Box 2840, Calcutta.

23. Jaipur Metals & Electricals Ltd., Railway Road, Jaipur.

24. National Insulated Company Ltd., Nicco House, Hare Street, Calcutta Originally established with BICC Collaboration.

25. Associated Wires & Conductors Pvt Ltd., Jullandhar, (Punjab).

26. Hira Cable Works Ltd., Hirakud (Orissa)

27. Hindustan Conductors Pvt Ltd., Baroda (Gujarat)

28. Mohan Aluminium Pvt Ltd., Gandhi Nagar, Bangalore 9.

29. Assam Conductors & Tubes Pvt Ltd., Gauhati, (Assam).

30. National Screw & Wire Products Ltd., Calcutta.

31. Hindustan Brown Boveri Ltd., Factory Area, Faridabad. (Haryana).

32. Samita Conductors Ltd., Factory Area, Ghaziabad, (UP).

33. Delton Cable Industries Pvt Ltd., Bharat Ram Road, Daryaganj, Delhi.

34. Madras Electricals & Conductors Pvt Ltd., 9 First Lane Road, Madras,

35. Prem Conductors Pvt Ltd., Ahmedabad (Gujarat)

36. Prem Cables Pvt Ltd., Piplia Kalan.

37. Bombay Conductors & Electricals Ltd. Ahmedabad (Gujarat)

38. Anam Electrical Manufacturing Co. Ltd., Kadian (Andhra Pradesh).

39. Gwalior Cables & Conductors Pvt Ltd., Gwalior (MP).

40. Ranga Cable Corporation, Industrial Estate, Cudduppa (AP).

41. Shakti Insulated Wires Pvt Ltd. Bombay.

42 Hindustan Transmission Products Ltd., Bombay.

43. Deepak Insulated Ltd Bangalore.

44. Wandleside National Conductors Bombay.

45. Indo American Electricals Ltd., 21 Old Court House Street, Calcutta Plant at Durgapur

46. Gangappa Cables Ltd., Hyderabad

47. Hindustan Cables Ltd., Ropnarainpur (Bengal)

48. Shakti Insulated Wires Pvt Ltd., Dattapada Road Borivli East, Bomay 92.