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DEVELOPMENT OF THE ALUMINIUM INDUSTRY IN BRAZIL^{1/}

by

R. de Campos Machado*

* Consultant, Companhia Vale Rio Doce, Rio de Janeiro, Brazil.

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The invitation extended to me by the Brazilian Metal Association to come to Ouro Preto and discuss, in open session, the problem of the production of primary aluminium in Brazil, besides doing me great honour, gives me the chance to take a real part in the commemorations of the first centenary of our School of Mines.

As a former student and also one of the teachers at the school for almost 20 years, I wish to pay my tribute to the School of Mines, remembering the contribution made by the engineers who graduated here to the pioneer introduction of the metallurgy of aluminium into Latin America. It was Dr. Américo René Giannetti, a mining engineer graduated in 1923, who was responsible for doing it here, in Ouro Preto, during the difficult days of the Second World War, producing alumina in 1944, in a 10,000 tpy plant, and aluminium in 1945, in a 2,000 tpy potline, only half of which was installed.

It was this initiative that gave rise to the Brazilian aluminium industry, which will have a growing importance in the Brazilian economy if we have the ability and tenacity to take advantage of the natural resources with which Brazil is endowed in Amazônia, the huge bauxite deposits, of first-class quality, and the enormous hydro-electric potential. The challenge to the capacity of our people to set up a large scale industry in this area is a formidable one, but it can be accepted and the difficulties overcome, if Brazil does in this sector what has already been done in other sectors on other occasions.

I must not omit to mention the studies and work of Professor Teodoro Vaz, who, in 1931, published the first news of the occurrence of bauxite in Mor-

ro do Cruzeiro, which probably gave Dr. Giannetti the idea of here producing the aluminium that Brazil was already in need of in the forties.

Another former student of the School - Dr. Simão Woods Lacerda - so early lost to the company of his colleagues, should here be recalled as having been responsible for planning, with the scanty resources of the time (1936), the first pilot installation, which he left at the beginning of the assembly stage and in which, in 1939, we produced the first hundreds of tons of Bayer aluminium hydrate.

After having paid my tribute to the three ex-students of the School of Mines whose names are linked to the setting up of the aluminium industry in Brazil, I wish now to extend it to the dozens of our colleagues scattered today throughout our country who have played their part in the struggle that we must win.

Let us now return to the theme of our open session, the production of primary aluminium in Brazil. The reason for the choice of this subject by the Brazilian Metal Association is most opportune, since, in my view, the time has come for an essential modification in the structure of the Brazilian aluminium industry.

It is common opinion among experts that, after the establishment of cartels by the OPEC petroleum producers and the IBA bauxite producers, the world geography of aluminium is going to change. We are convinced that Brazil will, within a few years, have an outstanding position in the new set-up of the production of this metal in the world.

Up to now, the production of aluminium in Brazil has been oriented towards supplying the internal market, bauxite mining operations having been carried on merely to feed alumina plants of small size - 30/100,000 tpy - which, in turn, have supplied small potlines - 30/40,000 tpy.

To be competitive, companies will in the future have to operate with alumina plants of 600,000/1,000,000 tpy and reduction plants of 70,000 to 100,000 upward. For this reason organizations will have to be brought into the sector that have large investment capacities, so that Brazil's participation in the world alumina and aluminium market can be guaranteed. Brazil will have to compete with the major world producers of alumina, such as Jamaica

and Austrália, and aluminium producers, such as Canada and Norway, to mention only the most important.

Let us see, by means of a rapid analysis, how the aluminium industry is in the world today.

Bauxite mining is practically entirely concentrated in a few tropical countries of the Third World, eleven of which are today members of the association previously mentioned - the IBA, for the purpose of obtaining better prices from the consumer countries. Until very recently, as is universally recognized today, bauxite prices were too low, since their control was entirely in the hands of the multinational companies forming the oligopoly of the sector, who were known as the Six Sisters.

A word now about the discovery of the bauxite reserves of the Amazon in 1963/67. The credit for this goes to the prospecting team of Alumínio Minas Gerais, the company that succeeded that founded by Dr. Giannetti. It was an Englishman of vision, Mr. C. C. Fletcher, who authorized Dr. J. A. Staergaard, a geologist, to extend his activities toward the North, after the promising areas in various states of the Center-West and Northeast of Brazil had been studied. I was witness of the difficulties encountered, since I was able to collaborate in the solving of some of them, in the obtaining of air photographs of the plateaux and of surveying concessions.

The world's bauxite reserves have been growing in the periodic reappraisals which indicate the discovery of new producer areas. The latest reappraisal (1976) mentions 23 billion tons of bauxite, 5 billion of which are in Brazil. As may be seen, bauxite is abundant and entry into the market is not easy.

The world production of bauxite is today around 70 million tpy and growing at the rate of 6 to 9 million tpy. In order not to remain at the mercy of the countries in which the deposits lie, which are now organized to defend themselves, the consumer countries are devoting ever-growing resources to the development of a suitable technology for the replacement of bauxite, which, nevertheless, will continue for a long time to be the best raw material source of aluminium.

Alumina is still produced in the majority of the developed countries, although a growing tendency may be seen to install new plants in bauxite-producing countries, for political and economic reasons. The essential motivation is of an economic nature, for 2 to 2.5 tons of bauxite are required to produce one of alumina, giving rise to the need to dispose of a large quantity of waste. Brazil will be a major producer of alumina because it has two essential favourable conditions: abundant bauxite, all of the trihydrate low-temperature digestion type, and a growing production of caustic soda on a large scale. It may thus enjoy a competitive price, since it uses low cost raw material, obtained by underground dissolution. Another favourable condition is that of the problem of protection of the environment, which is a problem more easily solved in the vast territory of Brazil than elsewhere.

Primary aluminium is, like alumina, largely produced in the major consumer countries. It is still preferable to site potlines close to the metal-consuming areas. The tendency to change this situation is not so marked, for this is the most important stage of production and confers the greatest aggregated value. However, since the OPEC petroleum crisis, some changes are inevitable. Those countries with cheap power and political and financial creditibility will have the chance of a growing participation in the production of primary aluminium. It should be noted that the largest shares in its cost correspond, in decreasing order, to the following items: alumina investment costs (depreciation and interest) and power. Brazil will have a growing opportunity, since it should have two of these three items - alumina and power - on very favourable conditions.

In the world aluminium industry the influence should once more be borne in mind of the six groups already mentioned, who still control a considerable part of the industry, from ore to the finished product. Although their influence is declining, they still control the following percentages of the three stages:

Bauxite mining	:	55%
Production of alumina	:	70%
Metallurgy of aluminium:		60%

As the industries of the raw material producing countries develop, the control of the famous group will continue to decline, but for a long time in the future it will still process preponderant influence, as it has done up till today.

In Brazil two companies of this group today control about 75% of primary production and about 60% of manufacturing. The tendency however, is for their influence to decrease, since the decision-making centers are outside Brazil and their interests do not always coincide with ours.

From 1960 to 1974 the world consumption of aluminium grew at the rate of 9% per year, requiring an annual average increase in production capacity of 680,000 tons. However, the forecast now, following the 1973 crisis, is for an increase of only 5% for the period 1974-1985, requiring annual increases of about 900,000 tons in new production capacity. It is for part of this new installed capacity in Brazil that we have to fight.

Let us look now at the manner in which the Brazilian aluminium industry has been established. It has not accompanied the increase of consumption, thus giving rise to the need to import aluminium in growing amounts. Brazilian consumption per capita has risen, but it is still low in world terms, since it hardly reaches half the average world consumption. The utilization of aluminium in Brazil is limited, due to low per capita average income and also to the high price of the metal within the country, always greater than abroad. The supply is insufficient, since it depends largely on imports, this being another reason why the use of aluminium in Brazil does not increase.

The reasons for the modest production of the Brazilian aluminium producers are, among others: the need for a large amount of initial capital, technology that until recently was restricted and made it difficult for new producers to enter, the need which still exists today, to import certain inputs, scanty availability of ore (in world terms) until recently and unfavourable electricity tariffs.

There were two pioneers in the production of aluminium in Brazil, of whom Dr. Américo René Giannetti has already been mentioned. Educated in Minas Gerais but born in Rio Grande do Sul, he started its production here, in

Ouro Preto, in 1945, but for lack of governmental support was obliged to turn his firm over to a foreign group in 1950. The other pioneer, Dr. José Ermírio de Moraes, educated in São Paulo but born in Pernambuco, began the production of aluminium in Sorocaba in 1954 and had better success, since his company is constantly expanding and accounts for 1/3 of Brazil's production, equivalent to 1/6 of its consumption.

The published or presumed production and expansion figures for the Brazilian aluminium industry as it stands today are given in Table 1. All the expansions announced by the companies as well as some presumable ones have been included. Chart nº 1 shows the ability of the Brazilian market to cater for demand between 1976 and 1985.

Up to now the production of primary aluminium in Brazil has been in private hands, one company being Brazilian and the other two belonging to multinational enterprises. Two are integrated, starting with ore and ending with the finished product (C.B.A. and ALCAN). The third and newest (ALCOMINAS) is, at the moment, only a supplier of primary aluminium.

The policy of expansion of these groups has not been satisfactory, as may be deduced from the constant growth of imports, which were 70/40,000 tpy in the middle of the last decade and reached nearly 126,000 in 1974. Even with all the restrictions placed upon imports, they should be more than 100,000 tpy in 1976. See Table 2, annexed.

The investments required for the installation of the necessary capacity in order to overcome the deficit and accompany the growth of consumption are becoming less and less within the cash-raising capacity of the groups mentioned. It should be noted that the resources necessary for expansion are far beyond their cash generation capacities, and in the case of the two foreign-controlled companies, this situation is aggravated by the need to make remittances to their parent companies. As was mentioned at the beginning of this work, the need for new investors to enter this sector is evident, even if only to satisfy the requirements of Brazil alone.

Brazilian alumina plants have been on the small side until now - 70,000 to 100,000 tpy - and should shortly rise to the level of 120,000/200,000 tpy.

The potlines in operation are on the 8,000 to 40,000 tpy scale and all of the Soederberg electrode type. Only one, that of ALUMINAS, in Poços de Caldas, has equipment for protecting the environment from pollution.

The size of the alumina and aluminium plants is of a scale adequate to cater for internal consumption only because the market is protected. It is clear that the plants cannot compete in the world market. Moreover, of the four producers three are in the interior of Brazil and would be at a great disadvantage if they were to export their products.

The Brazilian aluminium industry will have to undergo radical changes as a result of the discovery of bauxite in Amazônia, which has given Brazil the power to occupy an important position in the world aluminium market, since its reserves are so important in a worldwide context, being smaller only than the reserves of Guinea and Austrália. Moreover, the energy crisis of 1973 gave a new importance to the unexploited and, until recently, almost unknown hydroelectric power potential of Amazônia, exactly in the area where bauxite occurs and which has no alternative use at the present moment. It should be noted that the already defined potential of the Tocantins/Araguaia, 18,000 MW, would alone be enough to produce 5,000,000 tpy of aluminium if its portion of firm power is considered. This amount of aluminium would today represent over 1/3 of the world's output.

Since the recession provoked by the petroleum crisis no fresh decisions have been taken for the setting-up of large reduction units, while various alumina plant projects have also been deferred. Many new reduction projects have been shelved because of their situation in areas where electricity would be thermo or nuclear produced.

The areas of abundant hydroelectric power with little alternative use are going to be the preferred areas for aluminium production and such areas competitive with our Amazônia are: Zaire (River Congo), Canadá, Ghana (River Volta) and the USSR (Siberia). The Northwest of the United States, along the River Columbia, the area of the Bonneville Power Authority (BPA), up till now a preferential zone in the United States for the installation of aluminium producing facilities, will have more expensive electricity in the next decade and will not be competitive in the near future. Other regions that have the chance of installing primary aluminium plants are

petroleum exploitation areas, such as those of the Middle East, where waste gas with no alternative use exists. Some oil-producing countries intend to diversify their sources of income by producing aluminium and they have the great advantage of ample financial resources, which are difficult to compete with. Besides the abundance of bauxite and of hydroelectric power in Amazonia, a third factor which will give a great impulse towards expanding Brazil's aluminium industry on a large scale is the country's imperative need to earn hard currency.

The aluminium industry, the alumina industry and the mining of bauxite on a large scale can form one of the levers that will solve the problem of the Brazilian balance of payments. In aluminium, as it already has in iron ore and will shortly have in semi-finished steel, Brazil can have important aid in the generation of foreign exchange and Table 3 - Ten Year Plan (1976/1985) shows the basic data for a possible position for Brazil in 1985, if the appropriate decisions are taken in time.

The drastic change to be made in the Brazilian aluminium industry has already been started with the installation of the first large hydroelectric power station in Amazônia, Tucuruí (1976/1982) and the beginning of large scale bauxite by Mineração Rio do Norte at Trombetas (1976/1979), for the exportation of 3.35 million tons per year.

The next step should be that of the chemical sector, or of alumina production, in which ALUNORTE, with its first unit of 800,000 tpy, should start up in 1982. The following step, that of metallurgy, will be taken by ALBRÁS, with an output of 320,000 tpy, if the Japanese partners enter. Both will have to be begun in 1977, without waste of time.

The intervention of the State in these four initiatives has been necessary, as, in the same way, its entry into the iron and steel industry was essential in the forties so as to reduce Brazil's dependence on steel imports.

The entry of CVRD into Mineração Rio do Norte was the first step in this direction and it was caused by the abrupt abandonment of the bauxite development at Trombetas by the multinational concessionaire, whose decision was announced "a posteriori" to the Brazilian government, without warning, in mid-1972. At that time the government called its successful iron mining company, CVRD, to take up the interrupted project for the exportation of

bauxite and requested the only national aluminium producer, C.B.A., to collaborate. Today C.B.A. shares the control of Mineração Rio do Norte with the state company.

Another step was next taken by the government, also via CVRD, with a view to the industrialization of the ore, utilizing the abundant power of the region. An attempt was made to attract Japanese partners to take part in the production of alumina and aluminium in Amazônia, in a project of enormous dimensions, since it would be the biggest plant in the world and would also involve participation in the generation of electric power. After the feasibility study had been completed, it was found necessary to modify the conception of the project in order to make it feasible. Today two projects are in the final stage of appreciation by the partners - one for alumina (ALUNORTE, 800,000 tpy) and the other for aluminium (ALBRÁS, 320,000 tpy). The electricity generation project has been separated from the others and will be a State responsibility, without the intervention of the metallurgical company. The output of ALUNORTE will be entirely consumed within Brazil (ALBRÁS and VALESUL) and half that of ALBRÁS will be for Brazilian consumption and half for export.

The ALUNORTE Project requires investments of around US\$ 400 million and the ALBRÁS Project US\$ 950 million. The size of these figures justifies the need for investors on a grand scale.

Besides these three projects, CVRD is engaged in another bauxite mining project - that of Paragominas - in the stage of definition of reserves, quality and quantity, while a feasibility study is being made at the same time. The purpose of this second big mining project - mining, by the way, being a CVRD speciality - is to guarantee large expansion capacity.

A further CVRD initiative, one more in evidence today, since it is closest to realization, is that of VALESUL - Alumínio Valesul S.A. - which will consist of an 80,000 tpy reduction plant in Santa Cruz, State of Rio de Janeiro, with an establishment schedule from 1976 to 1979. The aim of VALESUL is to speed up the production of primary aluminium in Brazil, even at the cost of importing alumina until supplies are available from ALUNORTE and of consumption of power in the Central-South region.

As may be seen in Chart nº 1, already presented, or in Table 1, even with

all the plans of present producers put into practice and assuming an only slightly ambitious increase in consumption, like that put forward now by CONSIDER, calculated in relation to the GNP, there will still be a need for imports, even assuming that ALBRÁS is established.

It should be noted that the implementation of the expansion of present producers has been much slower than actually planned (see Table 4). A project in Amazônia, like that of ALBRÁS, may easily be delayed, since its difficulties will be multifold. VALESUL will have an important function - that of reducing part of the present deficit more rapidly.

Arguments may be raised for and against VALESUL, but we are convinced that its establishment will be an important contribution to facilitating the training of CVRD in the management of the assembly of projects of this size in the metallurgical sector. The Santa Cruz plant may well do much to facilitate the training of personnel to operate the plant in Pará.

The VALESUL Project has been organized by CVRD and in the tripartite control scheme which will probably be adopted control will be in Brazilian but not in State hands. Under this scheme, CVRD will participate with 1/3, private Brazilian enterprises with another 1/3 and foreign companies with the remaining 1/3. Thus neither State control nor foreign capital control will occur. VALESUL will allow to test the association, on an equal share basis, of private enterprise with state enterprise and a multi-national group.

Before ending this exposition, we wish to present Table 5, which shows the large numbers that define CVRD's projects in the aluminium sector now in the installation stage and under study. There are 5 projects which add up to investments of US\$ 2,150 million in their initial phase and of US\$ 420 million in their second phase. When installed, they will generate foreign exchange, through exports or replacement of imports, of US\$ 680 million per year.

Table nº 1

FORECAST SUPPLY AND DEMAND OF PRIMARY ALUMINIUM IN BRAZIL

1976 - 1985

<u>Item</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
1. Supply (NIC-Consider/1976)	182	209	232	289	384	431	481	532	582	638
1.1 Present Producers	155	180	200	234	278	288	308	326	340	356
ALCAN (BA)	28	28	28	28	28	28	28	46	60	76
ALCAN (MG)	32	32	32	45	60	60	60	60	60	60
CBA	50	60	80	90	100	110	120	120	120	120
ALCOMINAS	45	60	60	70	80	90	100	100	100	100
1.2 New Projects	-	-	-	20	67	100	125	152	182	215
ALBRÁS	-	-	-	-	-	20	45	72	102	135
VALESUL	-	-	-	20	67	80	80	80	80	80
1.3 Secondary Aluminium	27	29	32	35	39	43	48	54	60	67
2. Demand	265	287	315	351	391	435	484	539	600	668
3. Deficit (2 - 1)	(83)	(78)	(83)	(62)	(7)	(4)	(3)	(7)	(18)	(30)
4. GNP - Growth	5%	6%	8%	8%	8%	8%	8%	8%	8%	8%

Obs.: Assumption of growth in consumption linked to GNP (rate 1.412).

Table no 2

GROWTH OF BRAZILIAN ALUMINIUM MARKET

1965 - 1975

Item \ Years	1,000 t											Rate Of Growth
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	
Apparent Consumption	55.7	78.8	71.2	82.5	103.6	104.6	127.6	163.9	194.3	261.8	235.4	15.50%
Production	32.0	37.0	41.8	45.8	49.4	64.1	91.1	110.6	130.3	136.0	142.4	15.89%
Net Imports	23.1	41.8	29.4	36.7	54.2	40.5	36.5	53.3	64.1	125.8	93.0	14.94%

June 1st 1976

T A B L E 3 M P 3

10 YEAR PLAN
1976 - 1985

	<u>BRONZE</u>	<u>ALUMINA</u> (million of t)	<u>ALUMINUM</u>
<u>World consumption</u>	1976 77.8	30.0	13.6
	1985 119.0	48.0	23.4
<u>Growth</u>	41.2	18.0	9.8
<u>Brazil</u>	15.0	5.0	1.300
			ALBRAS
			0.320
			VALSUL
			0.080
			Alcan
			Alcominas
			0.120
			0.070
			CBA
			0.080
			Alcoa/Jari
			0.300
			New Products
			<u>0.330</u>
<u>Investment required</u>	US\$/t 60	450	1.300
	Total million (\$) 900	2,250	2,500
<u>Imported Part of Investment</u>	20%	108	3,250
	Total 180	235	308
<u>Net generation of foreign exchange</u>			
	Sales Price		
	US\$ 20	150	900
	Total million		
	US\$ 180	360	1,170
	Total generation of foreign exchange		US\$ 1,710 million

Table nº 4

BRAZILIAN ALUMINIUM PRODUCTION

1965 - 1975

1,000 t

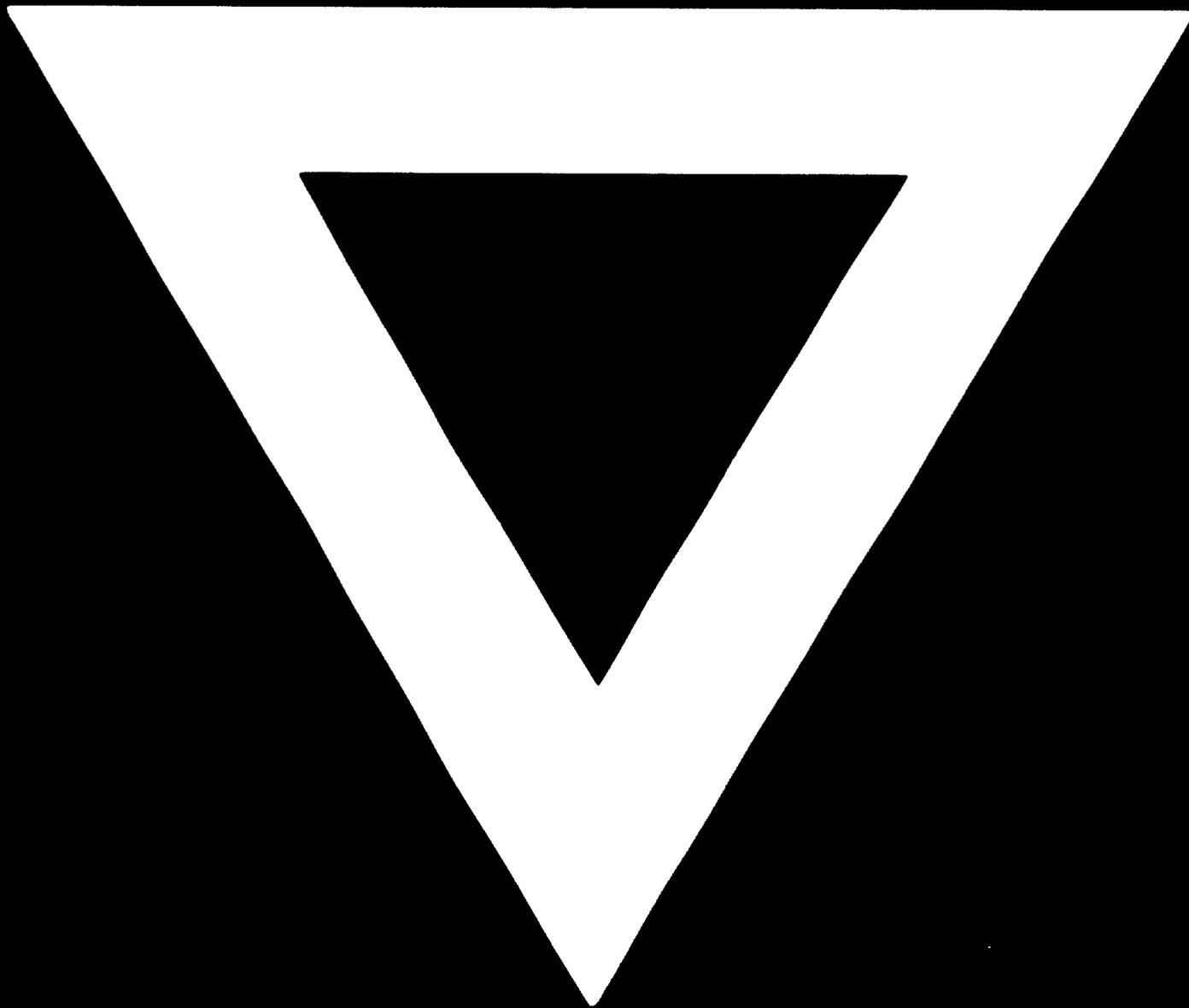
Producers	Years										
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
ALCAN - Saramenha Plant	15.4	17.2	19.3	22.1	22.8	25.1	27.2	28.9	28.9	32.0	32.6
ALCAN - Aratú Plant	-	-	-	-	-	-	-	-	6.9	13.6	18.4
C B A	14.2	15.7	18.8	19.3	20.1	23.1	28.5	30.5	39.6	38.5	40.4
ALCOMINAS	-	-	-	-	-	7.9	24.9	31.3	30.4	29.5	30.0
Total Primary Aluminium	29.6	2.9	38.1	41.4	42.9	56.1	80.6	97.3	111.7	113.6	121.4
Total Secondary Aluminium	3.0	4.1	3.7	4.4	6.5	8.0	10.5	13.0	18.5	22.4	21.0
Total Production	32.6	37.0	41.8	45.8	49.4	64.1	91.1	110.6	130.2	136.0	142.4

Source : ABAL

ALUMINIUM COMPANIES OF ALUMINIUM SECTOR
(Round figures)

FIRM	BASIC DATA		ALUMINA		ALUMINIUM	
	Company Name (Pará)	Location (Pará)	Company Name (Pará)	Location (Pará)	Company Name (Pará)	Location (Pará)
	Mincração Rio Norte S/A	(No name yet)	Alumina do Norte S/A	Alumínio Brasileiro S/A	ALUMINÁS (Barcarena-Pará)	VALSUL (Santa Cruz - RJ)
	Export 3.35 Mtpy (1976/1979)	4 Mtpy Decade of 1980	Phase I - use in Brazil 800,000 tpy Phase II - Export 800,000 tpy (1977/1982)	4 Potlines 80,000 tpy or 320,000 tpy (1977/1985)	1 Potline 30,000 tpy (1976/1979)	
CAPITAL	CVRD - 46% 7 foreign partners CBA - 5% 51% 49%	100% CVRD	CVRD - 25% (minimum) ALUMINÁS - 25% (minimum) Others - 50%	CVRD - 51% LMSA - 49% 100%	CVRD - 34% Remolds - 33% Others - 33% 100%	
INVESTMENT	US\$ 280 million (1978) US\$ Capital = 40%	Probable US\$ 500 million	Phase I - US\$ 400 million Phase II - US\$ 250 million Capital = 40%	US\$ 950 million Capital = 30%	US\$ 220 million Capital = 40%	
EXPORT MARKET	US\$ 56 million 30% Brazilian	Unrelated	Phase I US\$ 10 million 100% Brazilian	US\$ 130 million 50% Brazilian	US\$ 100 million 100% Brazilian	
GENERATION OF FOREIGN EXCHANGE	US\$ 77 million (1978) US\$	Azule US\$ 100 million	Phase I - use in Brazil Phase II - US\$ 120 million	US\$ 300 million per year	US\$ 80 million per year	

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