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EXPERIENCES IN CREATING AN ALUMINA INDUSTRY IN DEVELOPING COUNTRIES 1/

by

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1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO.

proportion of commercial bauxite reserves. Of course, new discoveries of bauxite are likely to occur both in this group of developing countries and in other developing countries, as well as in some other countries, most notably Australia. Therefore, the opportunities for alumina expansion are not confined exclusively to the present developing countries already entrenched in the industry. They will have to compete with other countries.

Domestic bauxite resources not required for an alumina industry

6. The possession of bauxite resources has been the basis for the alumina industries of Guinea, India, Brazil, Surinam, Guyana, Jamaica and Greece. But there are no domestic resources supporting the alumina plants of Taiwan and the island of St. Croix. Likewise, among the developed countries, no domestic bauxite exists to support the alumina plants of Canada, the United Kingdom, Norway, West Germany, East Germany and even some states of the United States. These countries, however, do have aluminium smelters economically accessible to consume the alumina. The same requirement would have to be met by most developing countries lacking in bauxite. There is again, however, the one exception of the island of St. Croix where a large alumina plant of 350,000 ton capacity has recently been established that receives its bauxite over thousands of miles of ocean transportation from Africa and Australia, and ships the alumina thousands of miles to Norway and the North Pacific coast of the United States.

7. There have been recent developments in Australia, a comparatively developed country now competing with others for the location of alumina capacity. This competition is based on recent recognition that Australia possesses along with the Republic of Guinea the largest known bauxite resources in the world. The most recent experiences of developing countries have been strongly influenced by the competition from Australia. This influence should continue to be felt for many years.

State owned and private enterprises

8. Only one of the developing countries considered here has a state owned alumina industry. This is Taiwan (Republic of China) where the industry was rebuilt out of the damaged facilities taken from the Japanese at the end of the Second World War. All of the other developing countries have private company owned alumina industries, although India for some years has planned at least two state owned alumina plants. This paper is, therefore primarily concerned with experiences involving private enterprises already established in developing countries. We will also refer to efforts not yet successful in some countries.

9. The essential condition for all alumina enterprises - state and privately owned - has been an assured market in smelters that in turn have assured markets for aluminium. The alumina enterprises of the developing countries have been built and financed by those controlling access to the aluminium smelters. Alumina capacity has not been built to serve smelters through competition for the business. The risks of the large investment have prohibited this approach. Hence, there has not developed a large volume of free trade in alumina nor open market prices, as is the case with many industrial products, although there is a growing volume in long term contracts. These facts are reflected in the tables 2 and 3 and supporting Appendix Table A showing control and affiliations of world alumina capacity in the past three years and as projected to 1970-1971. The world alumina capacity now divides 80 per cent into private enterprises and 20 per cent into government enterprises. Of the government enterprises, free market economy countries have only 2 per cent of the alumina capacity and centrally planned economy countries have 18 per cent. Looking ahead to 1971, the plans thus far announced indicate that the share of private enterprises may decline somewhat to 73 per cent and the share of governments, principally centrally planned economy countries, may rise to 27 per cent. This projection, however, must be considered as provisional, allowing for changes that may take place.

Table 2

Percentage control and affiliations of world aluminium capacity: 1964-1966 and by 1970-1971

	1964-1966	1970-1971
Total free market economy countries	100.0	100.0
Six leading companies	86.4	81.3
Alcan Aluminium (Canada)	21.4	18.3
Alcoa (U.S.A.)	24.8	22.7
Kaiser (U.S.A.)	14.0	13.7
Reynolds (U.S.A.)	13.1	12.5
Pechiney-Ugine (France)	9.8	8.9
Swiss Aluminium (Switzerland)	3.2	5.2
Other private companies	11.2	14.0
Free market economy governments	2.4	4.7
Division between private enterprise and governments		
Total world capacity	100.0	100.0
Six leading companies	70.6	61.9
Other private companies	9.2	10.8
Total, private enterprise	79.8	72.7
Free market economy governments	1.9	3.6
Centrally planned economy governments	18.3	23.7
Total, governments	20.2	27.3

Source: Table 3

Table 3

Control and affiliations of world alumina capacity
1964-1966 and by 1970-1971
(thousands of short tons)

	1964-1966	Construction planned 1966-1971	Total by 1970-71
Six leading companies	12,343	3,708	16,051
Alcan Aluminium (Canada)	3,070	545	3,615
Alcoa (U.S.A.)	3,531	939	4,470
Kaiser (U.S.A.)	2,000	707	2,707
Reynolds (U.S.A.)	1,871	590	2,461
Pechiney-Ugine (France)	1,397	367	1,764
Swiss Aluminium (Switzerland)	474	560	1,034
Other private companies	1,597	1,176	2,773
Governments	3,545	3,528	7,073
Free market economy	339	397	736
Centrally planned economy	3,206	2,931	6,137
Total world	17,485	8,412	25,897
Total centrally planned economy countries	14,279	5,481	19,760

Sources: Appendix Table A.

10. Most of the private enterprise capacity is controlled by six world-wide companies. They accounted for 71 per cent of the world alumina capacity in 1966 and 86 per cent of all the private capacity. By 1971 their position may be reduced, subject to changes in plans for alumina capacity. These companies are Alcan Aluminium Limited of Canada; the Aluminium Company of America (Alcoa) of the United States; the Kaiser Aluminum and Chemical Corporation of the United States; the Reynolds Metals Company of the United States; the two French companies that co-operate closely, Pechiney and Ugine; and the Swiss Aluminium Company.

11. The control and affiliations of world alumina capacity have been determined largely by the control of world aluminum smelter capacity. As shown in Tables 4 and 5, and supporting Appendix Table B, this pattern is similar to the alumina pattern. Again, the projected smelter capacity by 1971 is subject to changes in plans.

12. There are scales of projected alumina capacity for some countries not explained by the corresponding projected smelter capacity. These are due in part to the fact that some alumina plans have been announced before all of the corresponding smelter plans. Also, some countries with smelters will be importing larger or smaller proportions of the alumina they consume. Also, some alumina capacity serves non-aluminium markets, namely chemicals, abrasives, ceramics and refractories. About 6 per cent of the alumina produced in the United States is consumed in such markets.

Table 4

Percentage control and affiliations of world primary aluminium capacity, 1966 and by 1970-1971

	Dec. 31, 1966	1970-1971
Total free market economy countries	100.0	100.0
Six leading companies	82.4	78.6
Alcan Aluminium (Canada)	20.7	20.2
Alcoa (U.S.A.)	19.6	16.8
Kaiser (U.S.A.)	12.8	12.8
Reynolds (U.S.A.)	13.6	13.7
Pechiney-Ugine (France)	9.4	9.0
Swiss Aluminium (Switzerland)	6.3	6.2
Other private companies	12.1	15.3
Free market economy governments	5.6	6.0
Division between private enterprise and governments		
Total capacity	100.0	100.0
Six leading companies	63.0	55.4
Other private companies	9.3	10.7
Total, private enterprise	72.3	66.1
Control not determined	-	0.6
Free market economy governments	4.3	4.2
Centrally planned economy governments	23.4	29.0
Total, governments	27.7	33.2

Source: Table 5.

Table 5

Control and affiliations of world primary aluminium capacity, 1966 and by 1970-1971
(thousands of short tons)

	Dec. 31, 1966	Construction probable by 1970-1971	Total by 1970-1971
Six leading companies	5,258	1,423	6,681
Alcan Aluminium (Canada) a/	1,322	396	1,718
Alcoa (U.S.A.)	1,250	177	1,427
Kaiser (U.S.A.) b/	819	266	1,085
Reynolds (U.S.A.)	867	295	1,162
Pechiney-Ugine (France)	602	163	765
Swiss Aluminium (Switzerland)	398	126	524
Other private companies	775	520	1,295
Governments	2,305	1,710	4,015
Free market economy	355	157	512
Centrally planned economy	1,950	1,553	3,503
Control not determined	-	72	72
Total, world	8.338	3,725	12,063
Total, free market economy world	6,388	2,100	8,488

Sources: Appendix Table B

a/ Includes in Norway affiliation with Reynolds, and Ardal og Sunndal Verk. Affiliation with Ardal added 187,000 tons at the end of 1966.

b/ Includes affiliation with Reynolds in Ghana and Pechiney in Spain.

13. Most of the alumina capacity of the developing countries was built and expanded after 1951, and particularly after 1957 when some 2.6 million short tons were built.

Table 6

Time schedule of alumina plants, developing countries
(capacities in thousand short tons)

	Initial commitments	Initial operations	Capacity Dec. 31, 1966
Jamaica	1950	1952	875
Brazil	Second World War	1945	68
Guyana	1957	1961	385
Surinam	1957	1965	880
Greece	1960	1965	220
India	-	1942	151
Taiwan	1935	1936	46
Republic of Guinea	1957	1960	577

High-cost alumina capacity and developing countries

14. The post-war growth of the alumina plants in Brazil, Taiwan and India falls in the group of high-cost, small capacity developments, protected with high import duties on aluminium and by other regulations that have preserved the local aluminium market against lower cost competition. While Brazil and India based their alumina plants on domestic bauxite, Taiwan has always relied upon imported ore. The experiences of these countries in protecting high cost domestic industries would interest only those developing countries that are willing to accept that pattern of development.

Low-cost alumina capacity and developing countries

15. On the other hand, the alumina growth in the other developing countries - Jamaica, Guyana, Surinam, Greece and Guinea - has been under totally different conditions. All of these countries do have large-scale bauxite resources, but also domestic markets too small to support smelter capacity. In these countries, alumina is produced directly for export or for conversion into aluminium to be exported. Domestic trade protectionism was not a factor in creating the alumina industry in these countries but rather the availability of markets elsewhere and the possibility of low production costs. In addition, the alumina capacity was developed by the largest private companies in the world aluminium industry who had limited sources of

bauxite and had to assure themselves of additional supplies. Each of the six leading private aluminium producers became involved in one or more of these developing countries. Although they were joined by some other private aluminium companies or other investors in certain of these cases, it was the technical and financial resources of the large companies that made the developments possible.

16. Likewise, the requirements of low production costs had to be met in the developing countries because there were alternative choices available to the large companies. The developing countries were, in effect, competing with each other and with developed countries for the location of the new alumina capacities. This fact affected the terms of bauxite concessions and special incentives offered to attract the companies. The incentives in some cases included income tax reductions or suspensions, and import duty suspensions on machinery, equipment and supplies required for bauxite mining and alumina production. Such incentives did not, however, benefit exclusively the companies. When normal income taxes became effective, the developing countries began to receive substantial revenues both in relation to cost of production of the alumina and in relation to the over-all revenues of the countries themselves, both from the industry and from general economic effects. In the case of Surinam and Greece, the alumina plants were tied into smelters, producing additional benefits to the countries from large-scale investment, employment and the export of the metal.

Use of previously uneconomic ores

17. One unique benefit to Jamaica and Guinea from the development of the alumina industry is that bauxite ore, previously not used or considered uneconomic for the aluminium industry, was converted into a useable resource by the technology and favourable economics created by the large investment resources of the bigger companies. Whereas the aluminium industry before the Second World War had become accustomed to using bauxite in the range of 55 to 60 per cent available alumina and up to 7 per cent reactive silica, the bauxite deficiencies of the larger companies induced them to make economical the use of Jamaica ore containing less than 50 per cent available alumina and under 2 per cent reactive silica, and Guinea ore with about 42 per cent available alumina and about 2 per cent reactive silica. At the same time, the companies were able to obtain substantial savings in use of soda and in shipping economics. These made more valuable the lower grade ores whether they were shipped as bauxite or as alumina.

18. This situation, however, has not yet established a firm trend to enable developing countries to plan alumina plants upon the great volume of low-grade bauxite that is widely distributed. Many aluminium enterprises have available to them since

the mid-1950's, the largest presently known deposits of better grade bauxite in the world. These are in Guinea and Australia. In Guinea, a few hundred million tons of reserves are awaiting development that will yield about 58 per cent available alumina with less than 2 per cent reactive silica. In addition, Guinea possesses much larger reserves of only slightly lower quality. In Australia, the commercial reserves are on the order of a few thousand million tons covering a wide range of quality, but with abundant deposits rated around 54 per cent available alumina and less than 2 per cent reactive silica. We will also note in considering Guinea in further detail, that the Government of Guinea is in partnership with leading private aluminium companies for the new bauxite development, and that the conditions for this development open the bauxite resource to all others who wish to buy it. Consequently, the newly evaluated large bauxite resources of Guinea and Australia will compete strongly against developing countries who might hope to develop alumina capacity through the use of lesser grades of bauxite.

19. But even though a trend towards the use of lower grade bauxite is not firmly established, it is taking place in some countries and may make itself felt more strongly throughout the world within a few decades. The rapid depletion of the best bauxites of the United States during the Second World War caused a drop in the average grade of ore processed into alumina from about 60 per cent alumina content to less than 50 per cent. The reactive silica content rose from around 7 per cent to a present average of about 15 per cent, thanks to the so-called "combination process" as developed by the Aluminum Company of America in the United States. The scale of production based on such lower grade ore in the United States is restricted by the quantity of bauxite reserves. Over-all United States bauxite production has not increased in recent years despite the rise in demand. Consequently, the United States aluminium industry has become highly dependent upon imported bauxite and will increasingly import alumina. In 1966, the United States imported 87 per cent of its total bauxite supply.

20. Although France has been able to increase bauxite production in recent years, output is expected to level off near current levels because suitable reserves have not been expanding. Lower grades have been called upon, and plans made to increase imports of bauxite and alumina. In Italy, bauxite production has declined since the peak of 1961, reserves are decreasing, and imports of bauxite have been in a rising trend since 1956.

21. In the Union of Soviet Socialist Republics the high grade bauxite resources are very limited in relation to the growing needs of the aluminium industry. Consequently that country is making greater use of lower grade aluminous materials including

nephelite and alunite, and also is increasing imports of alumina from Hungary by exchange for aluminium, and is sustaining imports of bauxite.

22. A number of countries have continued to support investigations into the use of low-grade aluminous materials in the event imported bauxite or alumina will not be sufficient for future needs. Processes for treating clay, anorthosite, alunite and ferruginous bauxite have been given intermittent pilot plant or laboratory study in the United States during and since the Second World War. One United States aluminium company, the Anaconda Company, had announced plans only two years ago to produce alumina from clay until a more favourable arrangement was made in 1966 to share in a bauxite-based alumina project in Jamaica. Investigations of clay processes have been reported recently in Poland and the Union of Soviet Socialist Republics.

Locating alumina plants closer to the bauxite

23. With the growing dependence of the developed countries upon imported bauxite, the incentive also has increased to locate alumina plants where the ore is produced. The savings are in the transportation cost of shipping one ton of alumina instead of two or more tons of bauxite. These savings include both the economies of a smaller tonnage to be moved and the easier handling of alumina through bulk loading and unloading equipment. These benefits supported the alumina plants of Guinea, Jamaica, Guyana and Surinam. In addition, the alumina was used directly in Greece and Surinam for aluminium production because of suitable costs of electric power and access to the European Common Market for aluminium exports free of import duty.

24. Transportation savings on alumina have been offset in part by certain extra costs of alumina plant investment and operation in developing countries. Machinery and equipment have had to be transported from the developed countries, and also supplies including soda, starch, filter cloth, and fuel oil. Unskilled workers have had to be trained by the alumina producers. Some skilled workers and supervisory personnel have had to be transported and given additional compensation to attract them from their home countries. Extra expenditures have been incurred by some alumina producers in providing facilities for employees in recreation, education for children, and health services not customarily available in the developing countries or in the remote areas where the bauxite is processed. All of these extra costs have had to be considered by alumina producers against the savings of transportation. The savings from lower wage rates in the developing countries also had to be considered against the lower productivity of untrained workers and the extra costs of training them.

Political factors and investment security

25. The comparison of all costs with savings, along with tax and other incentives, favoured the locating of alumina capacity in the developing countries we are reviewing. But questions of political stability and security of investment also have become important. The largest expansions of alumina capacity shown in Appendix Table A outside of the centrally planned economy countries are to take place in Jamaica, Surinam, and Australia. These plans partly reflect the belief of private companies that these countries also offer more security of investment and better unInterruptibility of alumina supply than certain other countries. Security of investment includes preservation of physical property against destruction, respect for ownership rights, repatriation of profits, and convertibility of profits into foreign currencies. Uninterruptibility of alumina supply involves questions of domestic political stability, labour strikes, and wars affecting either the alumina producing country or other countries and resulting in an interference with alumina production or shipment or delivery. Methods have been developed to insure the value of investment, the repatriation of profits and currency convertibility. These devices include treaties between some countries; financial insurance provided by an agency of the home country; and the convention for settlement of investment disputes placed in force in 1966 through the International Bank for Reconstruction and Development.

26. But the methods to protect financial investment do not guarantee a steady supply of alumina. Even though an alumina investment, if destroyed or expropriated, may be recovered through insurance to a company, interrupting the flow of alumina will stop the operations of the entire aluminium industry structure. The investment alone in that structure including smelter, power plant, and fabricating capacity may be eight times the investment in the supporting bauxite and alumina supply. A far greater investment is involved in the aluminium consuming industries - construction, machinery and equipment, electric power, transportation, and consumers goods. Thus, important sections of national economies in developed countries are affected if the supply of aluminium is cut-off. Therefore, where security of alumina supply is the prime consideration to an aluminium enterprise, whether private or state owned, the decision will be to place the alumina plant in the home country and to mine the bauxite in the developing country. The bauxite supply has greater flexibility as long as a number of sources are available, but the alumina supply has less flexibility because of higher investment costs and a more limited number of sources for most aluminium enterprises.

Conclusions

27. In examining the brief histories that follow of certain developing countries in establishing alumina plants, it will be helpful to keep in mind the background factors. These include:

(a) The growing deficiency of bauxite resources among developed countries since the Second World War and their need to import increasing amounts of bauxite or alumina for the aluminium smelters;

(b) The discovery of major bauxite reserves in Jamaica, Guinea and Australia;

(c) The possession by developing countries of most of the world's bauxite resources, but in those developing countries having alumina plants, the proportions at the end of 1966 were 19 per cent of the world alumina capacity and 39 per cent of the commercial bauxite reserves;

(d) The existence of alumina capacity in countries that lack any commercial bauxite, demonstrating that it is not always necessary that a new alumina industry be based on a domestic bauxite supply;

(e) The predominance of private enterprise in alumina capacity held by developing countries, reflecting the predominance of private enterprise in the shares of world alumina and world aluminium capacity;

(f) The essential condition that any alumina enterprise must have an assured market in smelters that in turn have an assured market for their aluminium; and the consequent control of nearly all alumina capacity by enterprises controlling access to smelter capacity;

(g) The concentration in six international private companies of most of the privately owned alumina and aluminium smelter capacity;

(h) The limited position of small and high cost alumina capacity in Brazil, Taiwan and India where the aluminium industry is protected against imports, and prices of aluminium are the highest in the world;

(i) The requirement for low delivered cost of alumina that has to be met by developing countries seeking alumina capacity under control of the large private companies;

(j) The contribution of technology and financial resources from large enterprises in enabling previously lower grades of bauxite to be used in some developing countries;

(k) The desirability of locating alumina plants close to the bauxite in order to obtain economies of transportation; but also the importance of political stability, investment security and dependability of supply of alumina in the location of alumina capacity in developing countries by all enterprises, private or state owned; and

(l) The existence of competition between developing countries affects the terms and conditions offered to attract alumina capacity.

II. EXPERIENCES IN SELECTED DEVELOPING COUNTRIES

Jamaica, West Indies

28. Ever since the Jamaica bauxite and alumina production started in 1952, the bauxite production for export has been much greater than the volume of alumina. By 1957 Jamaica had become the largest producer of bauxite in the world with 4.6 million long tons of output, surpassing the previous leader, the Netherlands colony of Surinam. Since that year, Jamaica bauxite production has varied between one-fourth and one-fifth of the world output. In 1966, the Jamaica production had reached 8.9 million long tons, well ahead of an estimated 5.3 million tons of second place Surinam. Alumina production has expanded steadily to 791,000 short tons in 1966. All of the alumina is exported and likewise all of the bauxite that is not converted into alumina.

29. The producers of Jamaica bauxite are the leading aluminium companies, Alcoa, Kaiser, Reynolds, and Alcan Aluminium Limited. Of these, only Alcan also produces alumina. However, commitments were made in 1966 and 1967 for additional alumina production to be undertaken by a consortium of Kaiser, Reynolds and the Anaconda Company (United States); by the Revere Copper and Brass, Inc. (United States) and conditionally, by Alcoa. These commitments and expansion by Alcan promise to raise alumina capacity in Jamaica by 1971 to approximately 2.6 million short tons. At that time, Jamaica and Australia are scheduled to be the largest alumina producers after the United States and the Soviet Union (Appendix Table A).

30. The island of Jamaica in the Caribbean was a colony of the United Kingdom in 1942 when the bauxite resources were first recognised to have commercial possibilities. The island progressed towards greater political self-rule in 1944 and gained independence in 1962, while choosing to remain within the British Commonwealth. Consequently, the bauxite and alumina industries were established under the tradition of British law and by negotiations with authorities responsible to the British Colonial Office. Important changes in policies were adopted by the native Jamaicans through their legislature, and most of the development of the bauxite-alumina industry has occurred under legislation controlled by the Jamaicans. The political setting in Jamaica has been stable since the Second World War in a two-party system. This fact has encouraged investment decisions of the companies, giving them confidence that successive governments would respect contractual agreements with companies, and that the population in general would continue to respect the safety of physical property. Occasional labour disturbances and strikes have not changed this attitude.

31. At the time of the recognition of the bauxite resources in 1942, the population of Jamaica was about 1.2 million. Most of the people were descended from African slaves, freed in 1838. The original population of native Indians had been eliminated during Spanish conquest in the 15th and 16th centuries. The Jamaica population was rural, five sixths living outside of cities and towns. Nearly half were employed in agriculture, and about an eighth in manufacturing, including agricultural products. Nearly all of the exports were in agricultural products, principally sugar, rum and bananas. Most of the farms were very small, under ten acres per farm. The large plantations occupied about two thirds of the farm lands. Thus, Jamaica was predominantly an agricultural economy with very low per capita income and heavily dependent upon exports.

32. By 1966 the population had increased to about 1.3 million. The country was more urbanised but also had substantial unemployment in the cities. The economy had become more diversified, and per capita income was much greater although comparative figures based on constant prices are not available. As of 1966, per capita income was about $US 414, well about the average level of developing economies in South America, Africa and Asia. The largest section of the Jamaica economy continued to be agriculture and the processing of agricultural products, but there had been progress in other manufactures and more particularly in the growth of the tourist industry and the bauxite-alumina industry.

Major economic effects of the bauxite-alumina industry

33. That industry in 1966 contributed substantially to government revenues although only modestly to total employment. Bauxite production for export employed about 3,300 including operations in mining, agriculture, construction, and related activities of the industry. Alumina production including similar activities employed nearly 3,000 persons. The value of exports of bauxite and alumina had become $US 105 million, or 48 per cent of all Jamaica exports. The payments to the Government in taxes and royalties totalled about $US 22 million, or 14 per cent of all current revenues of the Government. Such payments in recent years have averaged close to $US 2.00 per long ton of bauxite exported and approximately $US 11 per long ton of alumina exported. In the case of bauxite exported, the Government was receiving an amount per ton roughly two thirds as great as the average cost of producing the ore. Employment in the industry had become very desirable to the individual Jamaican. The level of wages was the highest obtainable in any industry of the country, and had strongly influenced increases in wages in some other occupations. The average individual earnings of all employed in the industry during 1964 was

about $US 2,250 per year. The bauxite-alumina industry was, therefore, an important element in the Jamaica economy, contributing substantially to export trade, government revenues, and to wage standards.

The beginnings: stimulated by the Second World War

34. The first production of alumina in Jamaica in 1952 was the outgrowth ten years earlier of submarine sinkings of bauxite ships moving from Surinam and British Guiana to North America. The North American aluminium industry, both in Canada and the United States, was expanding sharply for war production, but the bauxite resources were inadequate. The Canadian smelters depended exclusively upon imported bauxite, and the United States smelters lacked sufficient domestic resources of the high grades then in use. Both the British and United States Governments were concerned over the German submarine sinkings of bauxite ships in the Caribbean during 1941 and 1942. The United States defense agencies sponsored explorations for additional bauxite in the United States and the testing of clays and other low grade aluminous materials to substitute for bauxite. Both the British and the United States Governments were then informed of a new type of bauxite that was reported from Jamaica in 1942. This aroused interest because the distance from Jamaica to United States Gulf ports was about 1,250 miles, or half the distance from the Guyanas. Less than half the shipping would be needed to move a given tonnage of ore from Jamaica.2/

35. The existence of alumina in large areas of "red earth" or "red clay" in Jamaica had been reported by British geological investigators as early as 1869, but the significance of the alumina content was not recognised until investigations were completed in 1942 by Jamaica's agricultural officials of the low fertility of those red soils. 3/ These investigations had been requested by a private land owner. It was he who recognised possible value in the bauxite and informed the British Government, the Canadian Government, and also a Dutch mining company, Billiton, then mining bauxite in Surinam and also on Bintan Island (today a part of Indonesia). The British and Canadian authorities notified the Canadian Aluminium Company, and the Company sent a geologist to Jamaica. The Billiton company promptly took options

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2/ Reynolds Metals Company, Reynolds Jamaica Mines Ltd., Its Origin and Development, 1943-1953, August, 1956.

3/ V.A. Zans, Bauxite Resources of Jamaica and Their Development, Geological Survey Department, Jamaica, B.W.I., 1954.

on some of the private land and asked for rights to mine over a larger area. Reynolds Metals Company of the United States learned early in 1943 of the Jamaica bauxite and immediately tried to acquire exploration rights. Reynolds had become a primary aluminium producer in 1941 and did not yet have its own bauxite resources. However, during 1942 and 1943, only Alcan was granted exploration rights under then war conditions, and only as an agent of the Jamaica Government. Billiton withdrew its interest in 1943 but Reynolds continued to seek exploration rights from the Jamaica Government.

36. It was necessary at the very beginning to determine that the Jamaica bauxite could be converted economically into alumina. Alcan shipped 2,500 tons early in 1943 to an alumina plant of Alcoa in the United States where it was found that the ore could not be economically treated in the standard Bayer process in the alumina plants as then designed in the United States. Alcoa had been using the Bayer process for trihydrate bauxite of up to 60 per cent alumina and 7 per cent silica or less. The Jamaica alumina was not only much lower in alumina as well as in silica, but the alumina was in both the tri-hydrate and mono-hydrate forms in the ratio of about 3 to 1. The ore was also quite different physically, being a mud of fine particles. The principal problems thus to be dealt with were to treat the monohydrate content at higher temperatures and pressures in a more concentrated caustic soda solution, and to develop methods for economic sedimentation and filtration of the fine waste mud. These problems meant that Jamaica bauxite could only be used effectively by redesigning alumina plants of North America. Meanwhile, in 1943 the submarine sinkings of bauxite ships became less severe, lower grade United States bauxite was used in the "combination process", and the pressure was reduced to use Jamaica bauxite. Accordingly, the Combined United States - United Kingdom Raw Materials Board decided in 1943 against the use of the Jamaica bauxite as a war measure.

37. The outlook for the ore then awaited commercial use after the war was over. Both Alcan and Reynolds needed additional bauxite resources, and had strong incentives to develop economical ways of treating the Jamaica bauxite.

38. It should be noted at this point that the British Guiana and Jamaica colonial Governments hoped to obtain producers additional to Alcan. The Governor of British Guiana in 1942 refused Alcan some additional bauxite concessions. The Jamaica Governor likewise in 1943 rescinded the exclusive authority of the company to examine private lands for bauxite when it had become clear that Jamaica bauxite would no longer be needed for the war. Jamaica officials wanted to allow other companies also to have the right to acquire bauxite properties for post-war operation.

Legal problems to be met

39. It should also be noted that in 1942 the legal conditions of ownership of land and minerals did not give control over bauxite developments either to the Jamaica Colonial Government or to any company. Most of the land in Jamaica was privately owned by the Crown. In Jamaica, only petroleum and precious metals belonged to the Government. Other minerals belonged to the land owners. The war situation led the Jamaica Governor to issue an emergency measure late in 1942 declaring all bauxite to be property of the Crown, but this action was later repealed. It was not possible until after the war in 1947 to adopt a law through the legislature vesting all bauxite in the ownership of the Government and establishing a system of royalty payments to the Government and land owners for bauxite mined. Difficulties over private property rights led to this delay. Meanwhile, starting in 1943 Alcan began to purchase private lands, and Reynolds followed in 1944. The Jamaica companies since then have preferred to purchase the bauxite lands rather than to make complicated arrangements for mining with land owners.

Early recognition that technical problems would be overcome

40. It should again be noted that the technical problems of using Jamaica bauxite were not regarded by Alcan as too serious after the first tests were completed in the United States. Alcan officials in 1943 expected to solve the problems of slow filtering and settling of the waste mud, and were planning to build an alumina plant in Jamaica after the war. Alcan also offered in 1943 to mine bauxite for Reynolds, indicating to Reynolds that new alumina plants could be built to process Jamaica ore economically.

Conditions affecting time schedules of the private companies

41. The timing of actual construction of alumina capacity in Jamaica then depended upon a number of conditions. One was the proving of sufficient bauxite reserves to justify mining and plant construction. Another was the completion of further tests and the design of plants to use the bauxite. Another condition was the passing of legislation to clarify ownership of the bauxite, vest it in the Government, establish mining law and regulations governing the private companies, and fix the amount of royalty to be paid per ton of bauxite and any customs duties or income tax concessions. A fourth condition required that after the war was over, the demand for aluminium would rise after the previous sharp drop until the war-built alumina capacity of North America would be sufficiently employed to justify additional capacity.

42. The Jamaica Government could not control these conditions except to take care of the needed legislation. The companies were undertaking exploration and process development at their own cost. By 1947 there were three of them exploring as a result of Kaiser's becoming an aluminium producer the previous year. Reserves of a few hundred million tons were indicated to the Government. The Government, therefore, felt no need to consider exploration on its own behalf. And the Government in any event could do nothing about building up the demand for alumina but had to depend on the time schedule of the companies.

Jamaica bauxite and nearby developing countries

43. Bauxite also was found in the 1940's near Jamaica in Haiti and the Dominican Republic, and mining began also in the 1950's but on a much smaller scale than in Jamaica. The Jamaica bauxite had advantages compared with these nearby Caribbean ores:

(a) The reserves were much larger;

(b) Processing Jamaica bauxite into alumina would be lower in cost because the proportion of trihydrate alumina was greater than in the other bauxites;

(c) The infra-structure already existed in Jamaica for housing, schooling, roads, a railroad, and other services that did not exist or were very limited in the other Caribbean areas.

44. Even though Guiana ores were higher grade - about 55 per cent available alumina and 2.5 per cent reactive silica - Jamaica bauxite offered certain offsetting economies. The bauxite lay under light vegetation and a thin overburden, usually less than twelve inches thick and easily scraped. The ore was soft and readily scooped up by power shovels. By contrast, the Guiana deposits were beneath overburdens up to 100 feet thick or more, and required considerable costs of removal. The ore was loosened with explosives. Again, the Jamaica ore was not more than 25 airmiles from the sea where deep water ports were built, but the Guiana ores were up to 80 miles inland and had to be moved on rivers by partly loaded vessels crossing shallow river bars. The vessels proceeded to another station at Trinidad where the ships were loaded with additional bauxite or else the ore was transferred to larger vessels. These transportation costs were at least double those of moving Jamaica ore.

45. Reynolds reported some of these advantages on the use of Jamaica bauxite to stockholders on 10 March 1948, stating in addition that tests of the ore in the company's alumina plant in Alabama

> "demonstrated that the alumina recovery from Caribbean ore is sufficiently high, without the necessity of making any material plant changes, to realise vast savings compared with the use of

Guiana ore or other imported ore. If comparatively minor plant changes are made, these savings will be materially increased and the net result will be great economies in the production of increasing quantities of alumina".

Jamaica legislation and other policies

46. These terms of legislation adopted by the Jamaica Government are significant for this paper only where they were absolutely necessary to assure the bauxite-alumina development by the companies, and where they affected the rate and size of development as compared with what the companies did in other countries. The Government and the companies negotiated over details of legislation intermittently over the years 1943-1950 until the adoption in 1950 of the incentive legislation for bauxite and alumina was added to the basic mining laws of 1947.

47. Essentially, the companies had to obtain (a) additional bauxite resources; (b) some geographical diversification so as to avoid undue dependency on any one country if the supply were cut off for any reason; (c) keep the costs of taking the bauxite or alumina out of Jamaica and delivering it at a total cost of recovery in the form of aluminium metal not much higher than bauxite or alumina from other sources; and (d) secure a long enough term of years for mining leases and other arrangements that would allow recovery of the investment in the island including later expansions of investment. These principles are still valid today to guide private and state owned alumina enterprises wherever located.

48. Four basic laws were adopted by the Jamaica Government in 1947 and 1950 affecting bauxite mining and alumina production. In 1952 an amendment was adopted to protect the agricultural and forest values of mined areas. In the drafting of these laws, the Colonial officials permitted the companies to examine various stages of the drafts and to make comments. This procedure was unavoidable since the laws would only stimulate development if they were acceptable to the companies. But the Government officials rejected some requests of one or more companies, and on the following matters in particular:

(a) That the bauxite deposits not be nationalised; they were nationalised in 1947;

(b) That royalty payments be fixed for 50 years; the Government limited the period to five years;

(c) That royalty to landowners be greater than 5 per cent of royalty paid the Government; the Government refused this change;

(d) That the minimum initial mining lease period should be 42 years; the Government insisted on 25 years;

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(e) That the over-all royalty paid the Government should be only United States 6 cents per ton; the Government obtained United States 20 cents until revaluation of the British pound in 1949 reduced the royalty to United States 14 cents per ton;

(f) That alumina production be granted income tax suspension under the pioneer industries encouragement law of 1949; this request was refused;

(g) One company wanted exemptions from customs duties on imported equipment and operating supplies for 25 years; the Government limited the period to five years.

49. Under the Jamaica laws in force until the revision of royalty and income tax payments in 1957, the main features affecting the bauxite-alumina industry were the followings:

(a) The bauxite on private land was owned by the Government, but private companies could mine by buying the land from other owners and by paying a royalty of one shilling (United States 20 cents) per ton to the Government of which 5 per cent was returned to the owner. The royalty was reduced 10 per cent for each ton of bauxite converted into alumina on the island;

(b) No limitation was placed on the amount of land the companies could purchase, but mining leases were to be limited to lands owned or under purchase contract or option early in 1950. By the time production began in 1952, the companies had purchased about 100,000 acres or three and a half per cent of the land area of the island. Most of the purchased land did not contain mineable bauxite but had to be acquired in order to secure the portion carrying bauxite. This portion was estimated at one-eighth of the total acreage;

(c) Exploration rights and mining leases were granted only under mining regulations. Leases were limited to a 25 year period but were renewable for an equal period;

(d) A five-year period of exemption was granted on custom duties and tonnage taxes on equipment, construction materials and supplies required for bauxite and alumina operations, and a ten-year exemption was allowed for fuel oil;

(e) Although no special income tax concession was given the alumina producer, the company obtained a reduction in taxes through the general income tax law deducting 20 per cent of new investments in plant and equipment;

(f) The bauxite producers were granted a special income tax arrangement in recognition of the fact that the bauxite was not sold in commercial trade but used by the producers. Because the bauxite had no market value for income tax purposes, a profit was assumed of United States 60 cents per ton for 25 years on which the normal income tax was paid of 40 per cent, or United States 24 cents per ton.

(g) Because of the limited amount of agricultural land in Jamaica, bauxite producers were required to maintain the fertility and productivity of their land holdings, and to level off bauxite pits and restore the top soil removed from mined-out areas, or to reclaim an equal amount of idle land elsewhere, or make a payment of £50 per acre to the Government for the expenses of land reclamation elsewhere.

50. The alumina company, Alcan, was granted a 25 year agreement with the Jamaica Government Railroad, fixing rates for materials hauled to the alumina facilities and for the alumina hauled to the port. The rates were subject to changes in costs of labour, fuel and materials. No restrictions were placed on the bauxite-alumina companies against the repatriation of profits or invested capital, nor on the employment of foreign personnel or the purchase of locally produced materials and equipment.

Income tax and royalty revisions of 1957

51. When the initial royalty rate on bauxite expired in 1957, the Government took the opportunity to negotiate a revision. The revision was directed mainly at the United States bauxite companies (Reynolds and Kaiser). The basic payments then were about United States 38 cents per ton, including the income tax of 24 cents and the royalty of 14 cents on the value of the English shilling following devaluation of the British currency in 1949. The revised arrangements raised both the income tax and royalties to yield initially about $US 2.00 per ton. Half of the amount was fixed and half was to vary in accordance with changes in the price of aluminium in the United States. Alcan's income tax payments were not affected but continued under the regular income tax law. However, Alcan's payments of royalties were increased with a proportional credit for the conversion of the bauxite into alumina. Protection was also assured to sustain payment levels if the British currency were again devalued.

52. These revised payments were substantially responsible for the greater contribution that the bauxite-alumina industry made to the Government's revenues after 1957 and for the figures already noted above for the year 1966. But the operations of the alumina company made a much greater contribution per ton of bauxite consumed, as also noted, and this contribution would have occurred without the revisions of 1957.

53. The new arrangements now provided for a 25 year period for both the new royalty and income tax. The companies had acquired more lands since the 1952 agreements, and the Government extended to these lands the assurance that mining leases would be granted, subject to a cut-off date on land acquisitions of 1 April 1957. However,

the companies were to be permitted to acquire certain additional lands to fill in areas where they held scattered properties. The companies were obligated not to hold bauxite reserves indefinitely idle, but to maintain a substantial (although not defined) rate of production.

54. None of the original or amended terms between the Government and the companies appears to have held back the development of the alumina industry by those companies. Only Alcan, however, built an alumina plant as planned originally in 1943, even though construction did not start until 1950. Reynolds and Kaiser were diverted by a United States tariff on imported alumina, and by financial incentives in the United States during the Korean hostilities, to enlarge their alumina capacity in that country rather than in Jamaica. Not until 1966 and 1967 did conditions change sufficiently so that Kaiser and Reynolds, and other companies, decided to install alumina capacity in Jamaica. Certain companies had previously sought bauxite in Jamaica and could have considered construction of alumina facilities. However, they were discouraged by the limited amount of bauxite reserves they found outside of the holdings of the major companies. They overlooked certain reserves that were proven later.

Alcan Jamaica (Alcan Aluminium Limited)

55. The plans of the Jamaica company were initially to build a plant to produce 36,000 short tons of alumina per year with production starting in 1952. However, the growth of the business of the parent company, Alcan Aluminium Limited, led to a steady series of expansions of the first alumina plant. This plant is to reach a final capacity of 600,000 short tons in 1968. The company also began to build a second alumina plant in 1956 with an initial capacity of 260,000 tons. This plant also has been expanded and is to reach its final capacity of 600,000 tons in 1968.

56. The total investment of the company in Jamaica from 1942 through 1966 in land, development and plant has been approximately $US 130 million. The investment has included a port, railroad connexions to the Government's railroad, the two alumina plants, and extensive operations in cattle raising, citrus improvements, reforestation, and other agricultural activities. When the company launched the first alumina plant, it borrowed part of the costs from the United States Government in 1950 and reported that it had already invested $US 2 million in acquiring land and mineral properties, and nearly $US 1 million in the development work.

57. The alumina expansion programme was designed to supply part of the needs of the aluminium smelters of the Government of Norway, other smelters in which the company was an investor in Norway and Sweden, and the company's smelters in Canada, in

particular a new plant built in British Columbia. As the demands grew for alumina for these markets, and as the alumina capacity rose in Jamaica and production costs per ton declined, the point was reached where it was less costly to produce and deliver alumina from Jamaica to the company's smelters in Quebec, Canada, than to deliver alumina from the company's large alumina plant in Quebec. That plant received bauxite during the 1950's from the company's mines in British Guiana and Guinea (West Africa), and also by purchase from Billiton in Surinam. Because of the economies in using Jamaica alumina in Canada, the company has reduced the level of operations in the Canadian alumina plant, using it as a marginal supplier.

Kaiser and Reynolds in Jamaica

58. Neither Kaiser nor Reynolds decided until 1966 to construct an alumina plant in Jamaica. Although Reynolds had stated as early as 1943 to the Jamaica Government that it might build an alumina plant in Jamaica after the war, conditions made this unnecessary. Both Kaiser and Reynolds acquired large alumina plants in the United States from the United States Government's war built facilities, and had no need for additional alumina capacity until after the Korean hostilities broke out in 1950. The United States Government then provided special financial incentives to the companies to build alumina capacity in the United States for the national defense. These incentives along with the existence of a $US 10 per ton tariff on imported alumina were disadvantages that Jamaica could not overcome.

59. By 1966, conditions had changed substantially, and the United States tariff on alumina had been suspended. Both companies joined with a third aluminium producer, the Anaconda Company, to agree to build an alumina plant in Jamaica. This plant is scheduled to start production in 1969 and will have a capacity of around 1 million short tons, expandable to 1.3 million tons.

60. This project is based on bauxite resources contributed from the holdings of Kaiser and Reynolds. The Government of Jamaica announced that the plant would eventually cost about $US 175 million and would contribute direct revenues to the Government of about $US 9 million annually. Additional benefits were expected to be permanent employment for 800 persons, an annual payroll over $US 2.8 million, and indirect benefits to other industries. Special income tax arrangements were made to allow the companies to adapt to the tax laws of the United States, but an effort was made to avoid discrimination between the Canadian alumina operations and the new plant. The previous temporary exemptions from tonnage tax and customs duties were continued for imported materials, equipment and fuel oil. The Government agreed not to impose additional types of taxes on alumina in the future.

61. New policies were introduced in the arrangement requiring the companies to give preference in the use of materials and equipment produced in Jamaica if competitive with other sources. Also, the consortium was required to use Jamaica personnel when possible and to train Jamaicans for special skills to build and operate the plant.

62. In addition to the projected investment of $US 175 million that the companies will make in the alumina project, Kaiser and Reynolds had previously invested in their separate bauxite operations in Jamaica a total on the order of $US 75 million. Kaiser's investment included two railroads, (each 14 miles long), two ports, mining operations, bauxite drying plants, land acquisitions, and costs of resettling farmers from acquired lands. The Reynolds investment included mining operations, drying plant, a six-mile aerial tramway to carry the bauxite to the loading area, and a port. Both companies engage in land rehabilitation, forestation, crop development and improvement. Reynolds also engages in cattle breeding and operates a herd of over 15,000 head.

Revere and Alcoa

63. In 1967 additional alumina projects were arranged with the Government by Revere and Alcoa. Revere and Alcoa had purchased bauxite exploration concessions from other parties who had previously found substantial deposits. Revere was assured mining rights by the Government but only on condition that it would build an alumina plant. The company did not yet own or lease the lands that had been explored.

64. Revere had been planning for some years to build an aluminium smelter in the United States and had first to arrange for its bauxite and alumina supplies. The Jamaica arrangement solved both problems very economically. The company agreed to build a first stage of 220,000 tons capacity within three years, and the balance of 440,000 tons within ten years.

65. In the arrangement with Revere the Government was able to initiate important policies that offered an opportunity to control an alumina supply at low cost in the event it became feasible for an aluminium smelter to be built in Jamaica. Low cost electric power was not yet available or possible in Jamaica from fuel or hydro sources, but nuclear power might yet make a smelter feasible. Accordingly, the Government's arrangement with Revere provided for the company to reserve for the Government's control all bauxite above that needed for a 40 year supply for the Revere alumina capacity. In addition, if within fifteen years an aluminium smelter became feasible, the company agreed to build and operate another alumina plant of 220,000 ton capacity at the request of the Government and to supply alumina at total cost and without profit from this plant to the operator of the smelter. Revere would have the first right to become the smelter operator.

66. Even if an aluminium smelter were not built, the Government for the first time had laid down a policy of limiting the amount of bauxite committed to a private company and reserving the excess for whatever plans the Government should develop. However, the Government agreed to give the company the first opportunity to undertake whatever development the Government planned.

67. Two other innovations were introduced in the agreement with Revere. The company agreed to purchase domestic caustic soda as well as other domestic supplies if produced in Jamaica and if available at delivered prices not more than the costs of alternatives. Likewise, the company agreed to use ships of Jamaica registry to transport alumina if available on competitive terms with any other shipping the company might hire.

68. Alcoa had begun to mine Jamaica bauxite in 1963 for export to the United States. The 1967 agreement between the Government and Alcoa consisted of additional bauxite exploration concessions granted the company in exchange for the obligation to build an alumina plant if sufficient additional bauxite could be found and at suitable locations to make the alumina plant feasible. The company was obligated to start construction of the first 200,000 ton unit of an 800,000 ton plant within 30 months, or the agreement could be terminated.

69. The Alcoa arrangement also was designed to stimulate the use of lower grade Jamaica bauxites previously not economical for use in the hope of expanding the bauxite reserves of the country. The company agreed to make tests of the feasibility of using bauxite containing less than 47 per cent available alumina and more than 4 per cent silica. If such tests were successful, the Government agreed to make special arrangements with Alcoa to justify mining such ore.

Problems of further development

70. The attractiveness of Jamaica as a location for additional alumina expansion was convincingly demonstrated during 1966 and 1967 by the agreements reached for new capacity with the United States companies. Since then, other companies have expressed interest in obtaining bauxite concessions and possibly establishing additional alumina capacity. The problems of the Government now revolve principally on the best use of the bauxite to become available to Government control in the Revere concession; whether the abundant lower grades of bauxite can be used for additional development; and whether aluminium smelter capacity can be achieved, possibly through nuclear power. The Government does not favour any further expansion of bauxite mining for export but only for conversion into alumina and preferably for domestic production of metal.

Guyana (British Guiana)

71. British Guiana, on the north coast of South America, became an alumina producer in 1957 through a subsidiary of Alcan Aluminium. Only one plant has been built, starting with a capacity of 250,000 short tons per year and rising to the present level of 385,000 tons. The country was the fourth largest bauxite producer in 1966 with an output of 2.9 million long tons. Production has not grown much since 1956 when output of 2.5 million tons ranked third, behind Jamaica and Surinam. Only two bauxite companies operate in Guyana today, Reynolds Metals and Alcan. In 1966 the output by Alcan was 2.4 million tons including ore converted into alumina, and by Reynolds a little over 500,000 tons. Output of alumina was about 330,000 short tons. As in Jamaica, all of the alumina and bauxite not converted into alumina is exported.

72. Geography and limitations of river transportation have restricted the bauxite development. The Alcan alumina plant and shipping point are 80 miles from the coast up the Demerara River in an undeveloped region. The Reynolds mines are in a separate region, also undeveloped, inland from the coast and up another river, the Berbice. Both rivers have bars at the mouths that impede navigation. The Demerara River can accommodate lightly loaded ocean vessels up the 80 miles to the Alcan docks. The Berbice River accommodates only barges at present from the mine docks to a drying plant closer to the coast.

73. The Guyana ore has always been desirable because of its high grade, tri-hydrate character (55-60 per cent total alumina, 2.5 to 5 per cent silica), and convertibility into the most profitable forms of calcined bauxite used in the abrasive and refractory industries. Alcan has produced calcined bauxite for many years in Guyana, and is now being joined by calcined capacity of Reynolds.

74. The country was a colony of the United Kingdom and part of the British West Indies long before the Alcan subsidiary was established in 1916 to produce bauxite, and until independence was granted in May 1966. The name was then changed to Guyana. The country is as large as the United Kingdom but has only about 670,000 population. About 90 per cent live in 5 per cent of the land area along the Atlantic Ocean. Most of the land area is owned by the Government. Per capita income was estimated for 1966 at close to EC$ 270, a level below the average for South America.

75. The economy is unbalanced by concentration in sugar, rice and bauxite-alumina. These products accounted for 82 per cent of exports in 1966. Bauxite and alumina were 42 per cent of all exports. Agriculture employs 37 per cent of the population, most of them on small rice farms of less than ten acres. Sugar plantations also cover considerable acreage. In recent years, taxes on bauxite production contributed about one tenth of the Government's revenues.

76. The population is divided into two principal groups, descendants of African slaves, and descendants of workers brought from India. Although the legal background is in English law, the political climate has been unsettled, especially since 1953. That year a new constitution was introduced and then suspended when disturbances led to calling troops into the colony. A revised constitution was restored in 1956, and the election put into power the same party that had been blamed for the 1953 disturbances. This party won in 1956 on a platform of independence for the colony, expulsion of British imperialism, and improved living standards. Economic and political conditions did not improve. There were intermittent labour strikes, riots, violence, and the steady growth of clashes between the African and Indian populations, each supporting the two main political parties.

77. The present government is African dominated. It was a minority party installed after the election of 1964 under new rules, sponsored by the British, for proportional representation of political groups. This party continued in power after independence was granted Guyana in 1966. The party is more inclined to encourage private enterprise than the opposition party. Consequently, the two bauxite companies in 1965 made tax arrangements and plans for expansion of calcined bauxite production. However, stability is not assured because the Indian voting population is increasing faster than the Africans, and may give the opposition party control in the near future. The leader of the opposition has announced that on resuming power he will expropriate the bauxite industry.

78. The best bauxite resources of Guyana are under concessions for exploration and mining to the two private producers. The Alcan company has had 50 years since it was established to investigate bauxite resources in Guyana, and has released from exploratory concessions over 3 million acres of land during this period. The Reynolds company has had fifteen years since it took over a small bauxite company in 1952 to explore over 1.2 million acres. Government geologists announced in 1960 the discovery of possibly 1.4 thousand million tons of low grade bauxite (41 per cent alumina and 4.4 per cent silica), about 150 miles inland and unaccessible by present transportation means to the coast.

79. Reynolds has not announced any plans to establish alumina capacity in Guyana. Although Alcan has not stated any plans to enlarge its present alumina capacity, the company did state in 1966 that it would negotiate with the Government to purchase power for an aluminium smelter if economical power could be developed out of a study of hydroelectric potentialities being made by a United Nations team. This was a conditional promise that could take some years to materialise, if at all, and would not necessarily mean the construction of additional alumina capacity by Alcan. The

company could use its present Guyanese alumina capacity to serve a Guyanese smelter and could supplement the alumina by expension elsewhere, particularly in Jamaica or in Australia.

80. In 1956, the Alcan subsidiary completed negotiations to build an alumina plant with the interim colonial government of British Guiana that had assumed control following the suspension in 1953 of the elected government. The contract was signed in April 1957. The plans were to start construction of a 250,000 short ton plant in 1957 and to complete it in 1959 in order to supply a new smelter to be built in Quebec, Canada. However, the growing surplus of aluminium capacity in the North American aluminium industry after 1956 led to an indefinite postponement of the smelter and to a delay of one year in completing the Guyana alumina plant. The output of that plant was then to replace partly the higher cost output of the company's Quebec alumina plant and also to meet contracts in Norway. The actual lay-out of the alumina plant allowed for the possibility of expanding to 1 million tons capacity.

81. The features of the agreement with the Government were

(a) A five-year exemption of alumina operations from the 45 per cent income tax of Guiana; and an additional deduction from subsequent taxes of an allowance permitted for new investment under the income tax law. These incentives were not uniquely conceded to Alcan but were available to any new industry being established under the industrial encouragement law in force;

(b) Exemption from customs duties on all materials, equipment and supplies needed to build the alumina plant, and an additional exemption for eight years on the import of raw materials and fuel used to produce alumina;

(c) A reduction in the export duty on calcined bauxite and a commitment by the Government not to impose an export duty on alumina;

(d) A grant of new mining leases to the company with rights to mine that would run for 50 years, renewable for an additional 25 years;

(e) An increase in royalties paid by the company, the new rates to be United States 14½ cents per ton of bauxite exported and United States 11.7 cents per ton of bauxite converted into alumina, subject to changes based on variations in alumina prices after the first fifteen years. The previous royalties had been United States 5.6 cents per ton of bauxite produced on Crown land and exported, and United States 1.12 cents per ton of bauxite converted into alumina.

82. The company expected to invest about $US 35 million in the alumina plant (250,000 ton capacity), and to employ 700 permanent workers. The company retained about 2 million acres under exploration rights, aside from 3 million acres that had been surrendered in previous years. The true reserves under control of the company were not known to the Government because only some of the lands under concession had been explored.

83. The Colonial government granted incentives to Alcan for building an alumina plant more generous than those applicable in Jamaica. No income tax suspension was granted in Jamaica but only the investment allowance against income taxes. The royalties after the new Jamaica agreement of 1957 were higher, at the level of United States 21 cents to 35 cents per ton according to quantity mined. In Guiana the company was allowed to retain control over nearly 2 million acres for exploration, free of any obligation to buy the land to be leased. In Jamaica, the company's holdings were less than 50,000 acres, all purchased.

84. There were, however, basic cost differences between Jamaica and Guiana that prevent the making of meaningful point-to-point comparisons. Guiana was a much larger country than Jamaica but with only one third the population. Exploration concessions could be granted over a much larger territory without restraining the opportunity for others to explore. The costs of mining and transporting bauxite and shipping alumina from Guiana were considerably higher than in Jamaica. Much of the Guiana ore lay beneath an overburden more than 60 feet and up to 200 feet deep that had to be removed or washed away. Shipments had to be made 80 miles by river in lightly loaded vessels to enable them to clear the river bar, and then move on for additional loads to be picked up at Trinidad. No government infrastructure existed to support the bauxite and alumina operations in Guiana. Alcan had to build a townsite, water and electricity supply, employee housing, schools, hospital and recreational facilities. Over 80 miles of railway had to be built to move bauxite from mines to the river. Similar investments were not needed in Jamaica.

85. The more important comparison is that where the bauxite companies in Jamaica were paying about $US 2.00 per ton in government taxes and royalties, in Guiana Alcan was paying the Government about the same amount in all taxes and royalties, and incurring costs of another 40 cents per ton for infrastructure. Hence, the over-all benefits received in Guiana were roughly 20 per cent greater per ton of bauxite than were received in Jamaica. These benefits were increased further in 1965 following a new tax arrangement made by the Government with both Alcan and Reynolds.

86. British Guiana did not have a strong bargaining position with Alcan in obtaining an alumina plant through the agreement of 1957 because of two other competing developing countries in which the company was planning alumina capacity. In Jamaica, the company was building a second alumina plant of flexible capacity. In French Guinea (West Africa) where the company had obtained a concession over the largest and richest bauxite deposits then known in the world, plans were also pending to build an alumina plant. The Colonial authorities in Guiana were thus limited in the terms they could get the company to accept.

SUMMARY

This paper reviews the experiences of some of the developing countries that have obtained an alumina industry either with or without an associated aluminium smelter capacity. The experiences of these countries illustrate substantial economic and political problems in addition to the question of access to an adequate and suitable supply of bauxite. The problems apply in the future equally to those developing countries that prefer state enterprise, or those that prefer private enterprise, or those that prefer joint state and private participation. The developing countries, as defined by the United Nations, who possess an alumina industry are Jamaica, Surinam, Guyana, Greece, Republic of Guinea, Brazil, Taiwan (Republic of China), and India. Also mentioned in this paper are St. Croix, a possession of the United States, and Australia, a country competing strongly for alumina capacity with developing countries.

The developing countries thus defined had about 18 per cent of the world alumina capacity at the end of 1966, about 39 per cent of the world commercial reserves of bauxite. They hold most of the bauxite reserves of all developing countries - about 83 per cent. However, domestic bauxite resources are not necessary to support alumina industries in developing countries, as demonstrated by Taiwan, St. Croix, and by a number of leading developed countries. Private enterprises own the alumina industries of all but one of the developing countries considered here. But for all alumina enterprises, private or state owned, an essential condition is assured markets for aluminium. World alumina capacity now is divided 80 per cent into private and 20 per cent into state enterprises. By 1971 the share of state enterprises may be greater. Six companies control most of the world's private capacity. Control of the world aluminium smelting industry follows a similar pattern.

Control over alumina capacity is determined largely by control over smelter capacity. The alumina plants of Brazil, Taiwan and India are small and high cost, serving associated aluminium smelters under common ownership, protected with high import duties. These plants do not supply export markets. The alumina plants of the other developing countries are larger and operate at lower cost to serve export markets. In Jamaica and Guinea the alumina industry is based on the use of lower grades of bauxite previously ignored or considered uneconomic. Although there is a general growing interest in the use of low grade bauxites and other aluminous ores, the trend is not yet established in view of the large resources of higher grade ores being developed in Guinea and Australia.

The growing dependence of the developed countries upon imported bauxite has increased the incentive to locate alumina plants close to the ore in order to save on transportation costs. But political stability and security of investment have also become important locational factors. An uninterrupted flow of alumina is even more important than the amount of the investment risked in an alumina plant. Far greater investment is at stake in the aluminium industry that consumes the alumina, and the other industries that use the aluminium. Sections of industrial economies can be disrupted seriously if the flow of imported alumina is halted or terminated. For such reasons, enterprises have particularly favoured alumina plant locations in certain countries where conditions are favourable both to the security of alumina investment and the sustained flow of output.

Developing countries seeking alumina capacity have to compete both among themselves and with other countries in arranging the terms and conditions acceptable to the alumina enterprises. The experiences in establishing alumina capacity are reviewed in detail for a number of countries. Considerable variations are evident in background conditions and the kinds of arrangements made. In some details, arrangements negotiated between colonial governments and enterprises appear to have been

87. It appears, therefore, that the Colonial government, like the Jamaica government, had no control over the time when alumina development would take place and the scale of development. These were matters decided by the circumstances of the private companies with which the Government had to deal.

88. The prospects for additional alumina development in Guiana will be affected by four main factors:

(a) The proving of larger bauxite reserves;

(b) Low-cost hydroelectric power or nuclear power may become possible, permitting the more economical combination of bauxite with alumina and smelting facilities;

(c) The question of political stability has to be resolved;

(d) Better transportation may be developed, permitting lower cost movement of bauxite or alumina from the present operations, or opening up to settlement and bauxite exploitation some more remote areas of Guyana. If permanent deepening can be achieved of a channel through the silt bar that impedes navigation on the river used to move the Reynolds bauxite, the economics of this operation will be greatly improved. There is no railroad and no all year roads into much of the unused inland areas of Guyana. The capability of the land to support a larger population under different conditions of agronomy is not sufficiently known. Some of these transportation problems are basic problems of over-all land use and population distribution. They are time-consuming and may have unpredictable effects on the bauxite-alumina industry.

Surinam

89. Surinam, formerly known as Dutch Guiana, is a member of the Netherlands Kingdom and adjoins Guyana. In 1965 Surinam became an alumina producer through a subsidiary of Alcoa. The alumina is used both to serve an associated Alcoa smelter and for export. The capacity was originally planned in 1957 to be only 120,000 short tons per year, but it started eight years later at 440,000 tons and has increased to 880,000 tons in 1966. Additional expansion is now under way to bring the total to 1,100,000 short tons. Surinam produced about 5.3 million long tons of bauxite in 1966.

90. Only two bauxite companies operate in Surinam, Billiton and Alcoa. In 1966 Billiton's output was 1.8 million tons and Alcoa's about 3.5 million. Alcoa produced about 350,000 short tons of alumina that year for its customers and own use, and for Billiton's customers. Billiton supplied the bauxite converted into alumina for its account, and Alcoa supplied the bauxite used for its needs. The balance of bauxite production was exported amounting to about 4.6 million long tons. Billiton

sold all of its exported bauxite having no alumina plant of its own. Alcoa sold some of its exported bauxite but used most of it in the United States for conversion to alumina.

91. Geographic conditions in Surinam for the production and shipment of bauxite are similar to those in Guyana, except that the bauxite now mined is much closer to the ocean. Shallow river bars also limit the direct loading of ships that pick up additional ore at a transfer terminal on Trinidad. Surinam ore is comparable in quality to Guyana ore and is also used to produce calcined grades for the abrasive and refractory industries.

92. The population of Surinam is about 360,000, somewhat more than half that of Guyana. There is a much greater racial mixture and diversification although East Indians are the largest single group, 35 per cent. A similar proportion is of mixed blood.

93. The Surinam Government directs its own domestic affairs as a political co-equal with the home country, the Netherlands. The Government is ruled by a Governor appointed by the Crown and by an assembly publicly elected. Political conditions have been stable without agitation for independence. Foreign investment is strongly encouraged. Surinam is an associate member of the European Common Market, and receives preferential treatment for its exports. This condition has stimulated the production of aluminium and alumina for export to the Common Market.

94. The Surinam economy is richer per capita than many South American countries and produced in 1965 a per capita gross national product of about $US 444. Agriculture employs over a third of the labour force on small farms. Rice occupies about three fourths of the cultivated land and is the main agricultural export. Bauxite has for many years been the dominant export, accounting for 80 per cent of the value of all exports and 26 per cent of the gross national product. In the 1950's the bauxite industry contributed between one third and two fifths of the annual revenues of the Government. With the inauguration of the alumina plant and smelter in 1965 the integrated aluminium industry will become even more important in the economy.

95. Alcoa established a mining company in Surinam in 1916 and first shipped bauxite in 1922. At the same time, Alcoa established in British Guiana the company that is now the subsidiary of Alcan. By 1941, the demands of the Second World War had caused the bauxite shipments of Alcoa from Surinam to pass the 1 million ton level. After 1948, shipments of Alcoa and Billiton remained above the annual level of 2 million tons, and achieved a fairly stable level around 3 million tons during the 1950's. In 1947 Alcoa began to produce calcined bauxite for the abrasives industry

and in 1962 for the refractory industry. Calcined output in 1964 was 235,000 tons, and competed with Alcan's calcined bauxite in Guyana.

96. With the decline in Alcoa's bauxite resources in the United States after the Second World War Surinam became the principal source of bauxite for Alcoa's aluminium production in the United States. But following the policy of diversification, Alcoa also began in 1959 to ship bauxite from the Dominican Republic as a result of exploration begun in 1943. Also, Alcoa started to ship bauxite from Jamaica in 1963 after acquiring properties in 1960. In 1967 Alcoa became a partner with Harvey Aluminum, other companies and the Government of Guinea (West Africa) for the development of bauxite in the Boke area. Shipments may begin in 1970. The company has thus built up a very strong and diversified position to serve the bauxite needs of its United States smelters even though Surinam has continued to be the largest source of bauxite to the company for its United States needs. A supplemental source of alumina was created by Alcoa with the start of bauxite and alumina production in Australia in 1963, but most of the alumina output is committed at present to others.

97. The Billiton company had been producing in Surinam since 1942 but only to sell bauxite to others. The company acquired a need for alumina in 1966 for a smelter it had built with others in the Netherlands, and to serve part of the needs of a smelter in the United States owned by Swiss Aluminium. To meet these needs, Billiton preferred not to build its own alumina plant but to contract with Alcoa to enlarge alumina capacity in Surinam and process bauxite supplied by Billiton. During the 1950's Billiton had been producing between 500,000 and 700,000 tons of bauxite per year. By 1966, the total had tripled to over 1.8 million.

98. Thus, the development of the bauxite-alumina-aluminium industry in Surinam depended upon the decisions made by two private companies, largely by Alcoa and to a minor extent by Billiton. But the Surinam Government was able to shape events to some degree on its own initiative. The Government entered in 1957 an arrangement with Alcoa for the construction of a hydroelectric project and aluminium smelter, with the possibility that an alumina plant also might be built although it was not committed at the time. The Government made geological and mineral explorations beginning in 1959 as part of a ten year plan for development. Substantial bauxite deposits were discovered that are now subject to efforts of the Government and a consortium to work out an integrated programme from electric power to metal.

99. The power-aluminium project was considered for a number of years by the Surinam Government as a result of a study made in 1952 by the International Bank for Reconstruction and Development. The project was proposed to Alcoa in 1955, and further discussions led to a preliminary letter of agreement in February 1957. A formal

contract was signed in January 1958 known as the Brokopondo agreement. This included

(a) A hydroelectric project of 150,000 kilowatt capacity (later raised to 180,000 kW.) to be built on the Surinam River, 100 kilometers upstream from the capital, Paramaribo;

(b) A smelter of 60,000 short ton capacity to use about 90 per cent of the electric energy;

(c) Conditional construction of an alumina plant;

(d) New bauxite exploratory concessions for Alcoa;

(e) New tax and royalty arrangements with Alcoa.

100. Originally, the Government had proposed to finance and own the hydroelectric project. The plan was changed for the company to finance, build and operate the project but for the Government to share in a part of the costs and after 75 years to be given full ownership of the project. The Government was to contribute all lands and waters required, the costs of preliminary investigations and the removal of population and property from the reservoir area, the access roads to the project and to the transmission line, and about 10 per cent of the operation and maintenance costs of the hydroelectric works. The company was to pay for designing and constructing the power project, the transmission line, replacements and additions to the works, and 90 per cent of the costs of operation and maintenance. The Government was to receive about 10 per cent of the power supply and the company the balance but only for company uses. When the project reverted to Government ownership, the company would have the option to buy 90 per cent of the energy for its own use. The schedule called for completion of the power project by 1965.

Aluminium smelter

101. The company agreed to build a 60,000 short ton aluminium smelter. It would use foreign technical and supervisory personnel but was to gradually employ and train local workers. A substantial part of the metal was to be offered for use in Surinam, the Netherlands and the Netherlands West Indies.

Alumina plant

102. The company agreed to build an alumina plant sufficient in size to serve the aluminium plant but only if the company determined that construction would be economically feasible.

Bauxite concessions

103. The Government granted the company bauxite exploration rights in a zone of approximately 7,500 square miles. Over overnment lands in this zone, the rights were exclusive; over private lands in this zone, the rights of owners were to be preferred for a 20-year period. The company was to spend at least $US 5.3 million over 20 years on exploration, or pay the Government half the difference between this amount and actual expenditures. A mining concession, over 20,000 hectares, was granted for 75 years in the exploration zone.

Royalties

104. A new royalty schedule was adopted equivalent to between United States 53 cents and 26½ cents per ton according to depth of the overburden, and an amount 1.5 times greater on calcined bauxite. A reduced rate was allowed on bauxite converted into alumina.

Income taxes and selling prices

105. Minimum selling prices were established for income tax purposes on bauxite taken for company use. A minimum income tax would be paid per ton of bauxite produced in Surinam until the smelter had operated profitably for one year. The minimum was to be the equivalent of $US 1.85 per ton, and above a certain tonnage $US 2.38. These minimums were subject to other adjustments.

106. If the Government raised general income tax rates, limits were placed on the amounts the company would pay on different phases of the bauxite-alumina-aluminium operations, and varying over a period of years between 35 and 40 per cent of taxable income. The Government would protect the company against disproportionate treatment if changes were made in other tax laws. The company guaranteed to pay the Government a minimum of $US 5.2 million in income taxes each year after the smelter was in full and profitable operation.

107. The company was permitted to terminate its Surinam corporate subsidiary and operate through a United States subsidiary in order to obtain certain tax benefits available under United States law.

Other provisions

108. The company would be allowed to repatriate profits and depreciation funds. The company was exempt from duties on goods imported for construction of the power works, smelter, alumina plant and related facilities, for expansion of such facilities, and on equipment and raw materials required for maintenance and operation. No export

duties would be levied on the products of the company. The Government was to take legal steps to protect the company from claims affecting the hydroelectric project, and to enact laws and regulations to permit the agreement to be carried out. Disputes were to be subject to arbitration through certain international agencies.

Benefits

109. The company announced in 1959 that its reasons for building the aluminium smelter were the high quality bauxite, the available power, the exploration rights, the concessions in taxes and import duties, the right to withdraw earnings, and confidence in the stability of the Government. The company also expected to sell the metal in Europe and to gain a competitive advantage if Surinam became an associate member of the Common Market.

110. The company stated in 1957 that the entire costs of the programme would be $US 150 million to the company. This was the equivalent of $US 2,500 per short ton of aluminium capacity, far above the level of $US 1,500 per ton then required for an integrated operation in the United States including power plant, smelter, alumina plant, and investment in foreign bauxite facilities. Extra investment costs, however, would be offset in part by savings on income taxes to be paid by Alcoa in the United States through special incentives granted by United States law for corporations operating in the Western Hemisphere. Furthermore, important savings in over-all production costs would be contributed from transportation economies in having the bauxite, power supply, alumina plant and smelter in the same location, the only aluminium project of the Western Hemisphere operating under these conditions.

111. From the viewpoint of the Government, the agreement promised benefits additional to what the company had been paying to governmental revenues and in creating employment. The company had already been paying in the 1950's between 33 per cent and 39 per cent of the annual revenues of the Government from all sources. Furthermore, the total revenues per ton of bauxite had varied between $US 2.00 and $US 3.00, including royalty, income tax, harbour duties and pilotage, and concession fees. These payments per ton were more liberal than were received by nearly all other bauxite producing countries.

112. The benefits the Government expected could be far more than additional revenues from bauxite production, and alumina and smelter operations. The Government was offered an interest free loan of $US 6.4 million by the company for costs of resettling from the reservoir area some 5,000 bush negroes. A 72 kilometer road was constructed to reach the dam site that would open for development another region, agricultural lands, forests, and possibly some mining opportunities. The Government's

share of the electric power would replace more costly fuel generated power in the capital of Paramaribo. The reservoir behind the dam would cover 600 square miles and might open up previously inaccessible areas by water transport for exploration. The lake might be useable for fish culture. Water released from the reservoir was expected to raise the average level of the Surinam River by about four feet and permit year around barge traffic. This flow was also expected to restrain the seasonal movement of salt water from the sea below the city of Paramaribo and permit the use of fresh water from the river for irrigation during the dry season.

113. The programme was carried out by Alcoa on schedule, and the power project and smelter placed in production in 1965, although rainfall conditions initially proved less favourable than had been planned, and power generation and smelter production were restricted. However, much larger markets for alumina had become available to Alcoa, including the needs of Billiton. As a result, the alumina plant was built at the end of 1966 to a capacity seven times the original plan, and is to be increased further.

114. The Government is now looking towards the possibility of an ambitious and difficult project based on the discovery on government lands of possibly 2,000 million tons of bauxite of which possibly 400 million tons might be high grade. The discoveries were the result of the geological and mineral exploration programme the Government began in 1959. The location is in a mountain region about 80 air miles inland from the coast, lacking in transportation access. The Government sought a loan to finance road construction to permit exploitation of the area. The Government also appointed a bauxite commission to recommend a policy to obtain the greatest benefits to the country from the bauxite discovery. The commission recommended in 1964 that development should be conducted by a consortium of companies in order to obtain the necessary funds for the large investment. Alumina production was to be required with at least one fourth of the bauxite to be produced, and a minimum annual production was to be required of 1 million tons of bauxite. Aluminium production was also to be required when it became feasible. The consortium was to include United States, Dutch and Belgian companies.

115. The Government then undertook discussions with various aluminium companies and also began preliminary investigations of hydroelectric power possibilities in the area. Both the Government and private companies continued to make bauxite surveys. As of 1966, a consortium had agreed to explore and possibly develop the bauxite deposits and try to work out an arrangement with the Government.

Greece

116. The bauxite industry has been long established in Greece to serve export markets, and did not become associated with alumina capacity until an alumina-smelter project entered into production in 1965. This project is the only one in Europe to combine in the same proximity the power supply, bauxite, the alumina plant and the smelter.

117. The essential problems that had to be solved before Greece could become an alumina-aluminium producer were (a) assured access to markets; (b) an economical electric power supply; and (c) an adequate bauxite supply. The Greek Government had an influential position in each of these matters. An equally important problem was to obtain some $US 100 million in capital investment for the project. The Government could not directly control this matter.

118. The possibilities of establishing an aluminium smelter in Greece had been studied after the Second World War by three private aluminium companies who took no further action. In 1957 the Greek Government announced its intention of establishing the industry but could not obtain financial participation from certain companies. The aluminium industry was then in a condition of surplus capacity, and some companies could not secure additional financing. The Government then made a study in 1959 to determine whether it would undertake the project directly without the support of private enterprise. The Government had planned to build a hydroelectric project of 180,000 kW. capacity by 1965 that could support a smelter. The Government also had applied for admission as an associate member of the European Common Market, and this would permit the establishment of a smelter of economical capacity, much greater than the small aluminium needs of the Greek market. The large West German market for imported aluminium would be available.

119. By 1960, the decision had been reached to undertake the project. Technical help would be provided by the French aluminium company, Pechiney, and capital would come from Pechiney, private Greek sources, the Government itself, the American aluminium company, Reynolds, and from various European banks. The power project would be financed in part by a loan from the United States Government. The company, Aluminium de Grece, was established. Reynolds later sold its interest, leaving Pechiney with 67 per cent of the ownership, private Greek interests with 21 per cent, and the Government's Industrial Development Bank with 12 per cent.

120. The alumina plant was built with an initial capacity of 220,000 short tons but designed to be doubled. The smelter was initially built with a capacity of 69,000 short tons. It was being increased to 80,000 tons in 1967, and eventually is to reach 116,000 tons. The alumina output, therefore, will be needed to serve the smelter, but some alumina could be exported until fully needed in Greece.

121. The affiliation of the Greek project with Pechiney gave the necessary marketing outlet for the aluminium. The Greek market as of 1966 could use only about 11,000 tons. The power supply had been assured at a very low price under arrangements made in 1960 between Aluminium de Grece and the Government's Public Power Corporation. The price of the power was established at United States 0.32 cents per kilowatt-hour for the first sixteen years and 0.36 cents thereafter. This price became involved in political controversy. Critics charged that it was below the cost of production. A Greek aluminium fabricator offered to buy power at a much higher price if licensed to build a smelter. As a result, the price was renegotiated in 1966 at a minimum of 0.4375 cents per kilowatt-hour, and rising above this level in proportion to any increase in the world price of aluminium.

122. The bauxite supply for the alumina plant had been a problem from the beginning because the six companies producing bauxite were selling in export markets, and no supply was assured for the Greek plant unless new bauxite discoveries were made or the existing producers were required to sell to meet the needs of the plant. The Government, therefore, agreed in 1960 that it would limit bauxite exports for a 30 year period to 1 million tons per year unless the aluminium company discovered 30 million tons of bauxite reserves in Greece, or the Government made that quantity available to the company. The reserves in 1963 were estimated at 84 million tons. Production and exports in recent years have been around 1.3 million tons per year.

123. At the time the power supply agreement was renegotiated in 1966, other revisions were made in the original agreement with the Greek Government. These provided for:

(a) A temporary increase in the bauxite export quota for the period 1966-1970;

(b) The aluminium company was obligated to offer 15 per cent of its annual aluminium output to domestic Greek fabricators at the average f.o.b. export price;

(c) The company gave up its previous exclusive right to establish additional alumina or aluminium plants but was granted the right to obtain any more favourable terms that might be given by the Government to a new company.

124. In view of the political controversy that had been raised by critics of the aluminium company, including charges that the company was falsifying its investment and operating costs, it was also agreed that the Government could audit the accounts of the company and use a foreign auditing firm. This provision was requested by Pechiney.

125. The alumina-aluminium project continued to receive political criticisms, a situation in Greece different from that of the other countries reviewed in this paper. The leading critic, a former minister in the Government, argued that the power supply

of the country was inadequate, and that additional power supplies should be put to other industrial uses than aluminium production in order to obtain more employment and foreign exchange reserved. The Greek Government replied publicly, summarising the benefits of the project including $US35 million per year in foreign exchange, the sale of $US3 million per year of domestic bauxite to the smelter, employment of 1,000 persons supporting a total population of 4,000, and a modern housing development.

Republic of Guinea (West Africa)

126. Since 1960 Guinea has had a major alumina plant of over 500,000 short tons of capacity located at Fria, operated by a consortium of privately owned aluminium companies called Fria. Arrangements for this plant were completed in 1957 during the period of French colonial rule of Guinea, and have been continued by the Republic from the time it achieved independence in 1958.

127. The Government of Guinea also hopes to obtain an additional alumina development, associated with a power project and a smelter, based on the very large and high grade bauxite deposits of the Boké region. In 1962, the Government revoked a concession on these deposits held by a subsidiary of Alcan Aluminium because the company was unable to comply with the time schedule of its agreement to build an alumina plant. This agreement had been made with the previous colonial authorities at the same time the Fria agreement was made. In order to secure development of the Boké area, the Government joined in 1963 in a partnership with a private aluminium company of the United States and in 1966 and 1967 admitted into the partnership other private aluminium companies. A programme to produce the Boké bauxite is now planned that will make Guinea one of the leading world bauxite producers. Whether or not additional alumina capacity will be built out of this program is not yet definite.

128. The country of Guinea is one of the poorest among the developing countries. Nearly 90 per cent of its population of 3.2 million are engaged in subsistance agriculture, and imports of foodstuffs are also necessary. Manufactures are very limited. About two-thirds of the value of exports has been in alumina, most of the rest in food and fiber products, and a small amount in iron ore and diamonds. Exports were valued only at $US44 million in 1963, of which alumina accounted for about $US29 million. Assistance from foreign countries has been very important to Guinea. But the problems of converting Guinea from a primitive economy to one more advanced will require much time. When Guinea chose independence rather than to remain in the French community of former African colonies, most of the French public servants were withdrawn, leaving the country with few trained personnel to provide the essential services of government. This situation has been a grave handicap to the Government.

more favourable to the countries than arrangements later negotiated by independent developing countries, probably because of the greater sophistication of the colonial representatives.

Where the size of market for an individual enterprise would support less than the most economic arrangement, the consortium device has been used to pool the markets of a number of aluminium enterprises. This method like the joint venture also spreads risks and allows enterprises to support alumina capacity in other countries as well. The consortium or joint venture technique is being used not only to combine a number of private enterprises but also to accommodate mixtures of private and state enterprises. Some developing countries are using alumina developments to support other parts of the domestic economy by provisions such as to require the restoration of agricultural and forest productivity of mined-out bauxite lands; to spread control of large bauxite resources among a number of separate enterprises in order to obtain greater over-all development; to require the employment and training of native personnel; and to use domestic materials, supplies and ocean shipping provided the costs are competitive with alternatives.

129. In this background, the alumina industry has been vital in producing most of the foreign exchange, other than aid and foreign loans, needed by the Government to finance purchases of foreign goods and services. Many former French firms have been nationalised, and a few state owned factories have been built with foreign aid. Guinea has been committed towards a strong participation of government in business, but it has also tried to encourage foreign investment, and has returned some trade activities to private ownership. The economy, therefore, is a mixture of private and state enterprise.

130. The best potentials for future development are in improved agriculture, and development of minerals, particularly bauxite, iron ore and diamonds. Much of the country has not yet been explored for other minerals. Soviet geologists have helped and have reported finds of various minerals including bauxite, manganese, and nickel. The commercial significance of the discoveries is not yet publicly reported. The hydroelectric potential is substantial and was the basis of studies made by private companies under French leadership during the colonial regime. The studies looked towards construction of a dam on the Konkoure River with a capacity of about 450,000 kilowatts to support an aluminium smelter of up to 265,000 short tons capacity. The metal would have been sold in the European Common Market. The political uncertainties following the independence of Guinea and withdrawal from the French economic sphere suspended the interest of private enterprises in this major project, but it has remained an ambition of the Guinea Government. The Fria alumina plant was designed to serve part of the needs of the proposed smelter and also export markets for alumina. In the summer of 1965, the President of Guinea announced that the Union of Soviet Socialist Republics would assist in the construction of hydroelectric capacity and an associated aluminium smelter, but no announcements have been made of progress in planning this program.

131. The alumina plant is operating in Guinea through a consortium known as Fria and managed by the French company, Pechiney. The ownership of the company as shown in Appendix Table A is held by an American company, Olin Mathieson Chemical Corporation; the two French companies, Pechiney and Ugine; Swiss Aluminium; British Aluminium; and the West German Vereinigte Aluminium Werke. The alumina is taken by these companies for their own use and some resale. The capacity was originally built at 528,000 short tons, and has been enlarged to 577,000 tons. Further expansion is planned. The alumina plant is located at the bauxite deposits of the Konkoure River region on a railroad built and used only by the company, 140 kilometers from the port of Conakry. In order to bring construction materials and equipment into the area the company had to build a 60 kilometer road to connect with the existing system

of roads. The company also built the townsite of Fria, initially to house 7,000 population. The original estimate of the investment required was about $US125 million.

132. The bauxite reserved in the Fria area were first estimated at about 140 million tons and later around 200 million tons. The quality being processed into alumina is reportedly low, about 42 per cent available alumina but less than 2 per cent reactive silica. Exploration in the Fria area and in other parts of Guinea originated with the predecessor company of Pechiney in 1942. To undertake the large investments for the Fria project, Pechiney formed the consortium.

133. The agreement with the French Colonial Government was approved by the French West African Grand Council in May 1958. The main features were:

(a) A term of 75 years after production of alumina began, with a renewal term of 25 years.

(b) A six year obligation of the company to complete the initial program regardless of changes in business conditions or labor strikes.

(c) The alumina capacity to be reached in six years was 480,000 metric tons, and within 20 years a total of 720,000 metric tons. Any lesser capacity at the end of 20 years would lead to a proportional reduction in the area of mining concessions granted to the company.

(d) The colonial government guaranteed stable legal, economic and financial conditions to the company, non-discriminatory policies, and equality of treatment with any other alumina company.

(e) Investment and profits could be withdrawn in other than French currency.

(f) No exemption was stated for customs duties or income taxes. The amount of royalty on bauxite was not stated but a formula was defined for the value of the bauxite on which royalty would be paid.

(g) A limited proportion of foreign technical personnel could be used, but the number and the proportion would have to be reduced over a ten year period. Preference was to be given to employment of local Frenchmen in management and staff levels, and local manual labor. The company was required to respect trade unions; to provide sanitary housing for workers; to contribute to medical and educational facilities for workers; to help organise recreational activities; and to provide the same workmen's compensation as imposed by laws in France.

(h) The alumina supply was subject to a priority to meet 80 per cent of the needs of a smelter that would be built by Fria.

(i) The company was obligated to restore mined-out bauxite lands to their previous condition within ten years after mining was completed.

(j) The company was to contribute $US1.8 million during the first five years of production to the costs of general government administration.

(k) Disputes between the Government and the company were subject to an arbitration procedure.

134. At the same time that the Fria agreement was reached, a somewhat similar agreement was entered with a subsidiary of Alcan Aluminium Limited for an alumina plant and also a large program for export of bauxite. Alcan's subsidiary had begun bauxite explorations in Guinea in 1946, and had started to produce bauxite in 1953 on the Islands of Los near Conakry. Production there had reached a level of 500,000 tons by 1957 for use in the company's Canadian alumina plant and in Europe. But the deposits were very limited and would be exhausted in a few years. On the other hand, the company had explored the Boké area of Guinea and determined the existence of hundreds of millions of tons of very high grade bauxite, later to be estimated around 2 thousand million tons. This ore was then and still is about the highest grade known in the industry, for substantial tonnages, averaging a quality of 58 per cent available alumina and less than 2 per cent reactive silica.

135. Under the competitive influences of that period, Alcan undertook a commitment to build within six years - by 1964 - an alumina plant with 220,000 metric tons of capacity, and a mining operation to produce a minimum of 1.5 million tons of bauxite per year.

136. Other conditions of the agreement were similar to those made with Fria. Alcan was obligated to supply 20 per cent of the needs of the aluminium plant that Fria was to build. As in the case of the Fria agreement, the company would not be allowed to modify its programme because of changes in business conditions.

137. However, as we have noted, Alcan was also committed at that time to build a second alumina plant in Jamaica and one in British Guiana. Within two years it became evident that the company's volume of business and financial resources could not support all of the contemplated expansions of alumina and smelter capacity. The company sought the partnership of other companies for the Guinea project. In August, 1961, Alcan announced that all construction work had been halted on the project. In October, 1961 the company notified the President of Guinea that it could not complete the project by 1964. The President ordered the company to halt all operations including those on the Los Islands, and expropriated all of the

company's property as compensation for default on the agreement of 1958. A few months were granted for the company to resume its original commitment and recover the properties, but the company was unable to comply. The expropriation was made final in 1962 and the Government announced it would consider association with other foreign partners to complete the project. Some $US25 millions of investment were lost by the company including the operating properties on the Los Islands, and the incomplete road bed of the railroad that was to have been built from Boké 135 kilometers to a new port on the sea coast.

138. In October 1963, the Government entered a new agreement with Harvey Aluminium, Inc. of the United States for a partnership in the development of the Boké bauxite but without any commitment to build an alumina plant. A United States corporation (Compagnie des Bauxites de Guinée (CBG)) was established, owned 49 per cent by the Government and 51 per cent by Harvey. The Government agreed to finance and build the railroad and seaport, and Harvey would finance and operate the mines and transport facilities. The Government applied to the International Bank for Reconstruction and Development for loans to help finance the construction projects to which it is committed. An initial loan of $US1.7 million was made by the Bank in 1966 for engineering work.

139. In order to develop the largest possible initial scale of bauxite production, Harvey Aluminium late in 1966 and in 1967 arranged with approval of the Guinea Government to share with other companies in the mining investment and to sell bauxite on 20 year contracts. These companies then became stockholders in the United States company that is the legal partner with the government of Guinea in CBG. The amount of bauxite to be produced under this arrangement will be initially a minimum of 4.7 million tons per year.

140. The estimated cost of the Government's investment to be made in railroad, townsite and port is $US61 million. The estimated cost of the investment for the mining and transport facilities is $US47.5 million. The United States Agency for International Development originally guaranteed the major portion of the investment planned by Harvey against currency inconvertibility, expropriation and war risk, and has been asked to guarantee additional investments to be made for the enlarged [illegible]. The Guinea government also guaranteed against nationalisation of the enterprise.

141. The companies that have joined with Harvey in the Boké project are Alcan, Alcoa, Pechiney-Ugine, Vereinigte Aluminium Werke, and Montecatini Edison (Italy).

The effect of the arrangement is to supply Guinea bauxite for alumina plants of those companies in Canada, the United States, St. Croix, France, West Germany and Italy.

142. Under the original agreement between the government of Guinea and Harvey, the United States company within three years after mining begins is to submit to the Government a complete project for an alumina plant and smelter. The working out of actual commitments and plans for this additional programme is left for future negotiations.

143. The Guinea-Harvey arrangement is distinguished by certain features:

(a) It is a partnership in a joint company between a government that favors state enterprise and a private company.

(b) The joint company, CBG, must sell bauxite to any others who are willing to pay a price that yields a satisfactory profit and pays in a currency convertible into United States dollars. The effect is to open the abundant bauxite reserve of the Boké area to the aluminium industries of all countries and to all competitors. The desirability of the Guinea ore was shown by the arrangements made with leading world producers of aluminium, all competitors, to join in the project. These producers included Alcan, the company that had originally planned the project in 1958.

(c) The Government will obtain a 65 per cent income tax on profits.

(d) Exemption is granted on import duties affecting materials, equipment and supplies needed to establish bauxite production, and the Government agreed not to impose export duties on the bauxite. Import duties at a rate of 5.6 per cent of f.o.b. value would apply after production began.

(e) The Government will own the railroad and port in order to use these facilities for the general economic development of Guinea. This arrangement differs from the Fria railroad which is private and not available for public use.

(f) The bauxite company will give preference to hiring Africans and will establish training schools for workers.

(g) Harvey agreed to build and operate a separate plant to make aluminium household and building products, and to give half the ownership to the Government after the investment is paid back to Harvey. This plant was placed in operation in May 1966, the first to produce aluminium products in Guinea.

(h) The obligations of either the Government or Harvey can be suspended if affected by major conditions beyond the control of either party. This provision is much more flexible than the previous arrangement between the French colonial authorities and Alcan.

(i) Disputes are to be settled by procedures for conciliation, and, if necessary, for arbitration.

St. Croix, Virgin Islands

144. An alumina plant was placed in operation in 1967 in this island possession of the United States located in the Caribbean Sea. Although St. Croix would be considered a developing country only if it were not a part of the United States, the conditions affecting the establishment of this plant were competitive with other developing countries. The plant was built by Harvey Aluminium to process bauxite from various sources and to supply alumina to both the company's smelter in the Northwest United States and a jointly owned smelter in Norway. The location on St. Croix was chosen because

(a) It offered security within United States territory.

(b) Concessions were granted of a free plant site, exemption for 16 years from most taxes and import duties and for 75 per cent of income tax, and contribution by the government of St. Croix of up to $US3 million of the costs of building a ship channel. Profits made in St. Croix were exempt also from United States income tax.

Australia, competitor to developing countries

145. Expansions of alumina capacity recently accomplished in Australia and those now pending (Appendix Table A) reflect the strong competition from this continent facing developing countries. It is an outstanding accomplishment for Australia to have had its large bauxite resources recognised only since 1955. Within twelve years, Australia has established an alumina industry to a level of 1.2 million short tons of capacity that may be doubled by 1971. Most of the output is destined for export markets, including Japan, Western Europe and the United States.

146. The aluminium companies participating in the Australian bauxite and alumina development are Alcan, Alcoa, Kaiser, Pechiney, and Swiss Aluminium. Australian companies have also invested in some of these developments. Other companies are exploring for bauxite and considering additional alumina projects. The attractions of Australia rest in

(a) A stable government with a tradition of English law.

(b) Bauxite deposits that have been only partly explored and already are believed to be the largest in the world, although not as high quality as those of Guinea.

(c) The location of bauxite close to the sea coasts and the availability of low-cost ocean transportation for bauxite or alumina in very large ships to reach smelters located on deep water anywhere in the world.

(d) A moderate tax and royalty system, favouring mining operations, and a current corporate income tax level of 40 per cent of profits, before deducting allowances for new investment.

(e) A willingness of Australian state governments to assist with investment in infrastructure. The alumina plant and associated bauxite operations in Queensland represent a private investment of approximately $140 million, but the State of Queensland has also contributed about $US21 million in public facilities.

Other developing countries - India, Taiwan, Brazil, Ghana

147. No discussion is offered in this paper of the experiences in establishing alumina plants in Taiwan, India and Brazil. The facilities in Taiwan were built by the Japanese before the Second World War, damaged during the war, and then reconstructed after being taken over by the new Chinese Government. Alumina production in India originated in the Second World War and in Brazil right after the war. In these three countries, small plant capacities were started and high production costs were incurred. This was possible only because of high import duties on aluminium and other measures taken to protect the domestic aluminium industries that use the alumina. The example of these countries for other developing countries shows that under conditions of trade protectionism, high cost alumina capacity can be established to serve a domestic aluminium industry but cannot compete with large scale alumina capacity serving foreign markets.

148. The situation in Ghana deserves comment. Ghana does not yet have an alumina plant although one company exports bauxite and another recently opened an aluminium smelter that uses imported alumina. Bauxite exports have varied in the past ten years between 150,000 and 300,000 tons per year. The producer is British Aluminium, the company that originally gained the bauxite concession during the British colonial period when Ghana was called the Gold Coast. Nearly all of the bauxite is shipped to the company's alumina plants in the United Kingdom.

149. The aluminium smelter was built as part of the Volta River hydroelectric program that had been investigated in colonial days. Following the independence

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Appendix

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I. THE DEVELOPING COUNTRIES AND THE ALUMINA INDUSTRY SINCE THE SECOND WORLD WAR

1. The countries considered in this paper fall within the developing group as recognised by the United Nations. In recent world economic surveys, the United Nations includes as developing countries those outside of the centrally planned economies and the developed market economies. Countries thus excluded that have bauxite or alumina industries are Australia, Canada, the United States, the United Kingdom, France, Italy, the Federal Republic of Germany, Norway, East Germany, Czechoslovakia, Yugoslavia, Rumania, Hungary, the Union of Soviet Socialist Republics, Japan, and China (mainland).

2. The developing countries that have acquired alumina industries are: in Africa, only the Republic of Guinea; in Asia, only India and the Republic of China (Taiwan); in South America, only Brazil, Surinam (a colony of the Netherlands), and Guyana (formerly British Guyana and now an independent member of the British Commonwealth); in the Caribbean, only Jamaica (also an independent member of the British Commonwealth); and in Europe, only Greece. One island in the Caribbean that has recently acquired an alumina industry is a possession of the United States that would otherwise be indistinguishable economically from some small developing countries. This is the island of St. Croix in the Virgin Islands, population about 15,000, dependent primarily on agriculture and tourism, and with a low income for the predominantly Negro population. This island does not have bauxite resources.

3. These developing countries, excluding St. Croix, as of the end of 1966 had a total alumina capacity of 3.2 million short tons, or about 18 per cent of the world capacity. All of this capacity was built up after the Second World War with the exception of Taiwan (Republic of China) where Japanese controlled alumina capacity had existed before the war. By 1970-1971, the position of this group of developing countries may improve significantly according to announced plans for expansion of alumina capacity. At that time, these countries may have 6.1 million or 24 per cent of a world total of possibly 26 million short tons. The largest producers will be Jamaica, Surinam and India, and the greatest expansion is planned in Jamaica and India. This projection, of course, reflects only plans that have been announced. Some of them may be changed and new projects may appear.

Table 1

Developing countries having alumina capacity, 1966, and projected capacity, 1970-1971
(thousands of short tons)

	Approximate capacity, end of 1966	Projected capacity, 1970-1971
Caribbean area - Jamaica	875	2,620
South America - Brazil	68	133
Guyana	385	385
Surinam	880	1,110
Europe - Greece	220	220
Asia - India	151	963
Taiwan - Republic of China	46	82
Africa - Republic of Guinea	577	577 a/
Total, developing countries	3,202	6,090
World total	17,584	25,896
Per cent of world capacity in developing countries	18.2	23.3

Source: Appendix Table A

a/ Expansion expected but information not available

Bauxite reserves of the developing countries

4. These same developing countries as of 1963 had about 39 per cent of the world commercial reserves of bauxite (proven and indicated), or 2.3 thousand million out of a total of 5.8 thousand million tons. They also accounted for nearly all of the estimated reserves of all developing countries in the Caribbean, South America, Africa and Asia (2.3 thousand million out of 2.8 thousand million, or about 83 per cent).1/ The proportions are higher when potential resources are included.

5. Thus, the developing countries with established alumina industries currently contribute 18 per cent of world alumina capacity while possessing about twice that

1/ Estimates based on Sam. H. Patterson, U.S. Geological Survey, Professional Paper 475-B, 1963.

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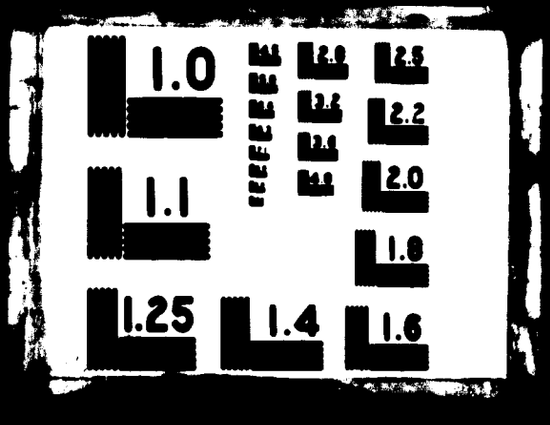

of Ghana in 1957, the Ghana Government sponsored new investigations, and was able to finance the power program in 1961 with loans from Governments of the United Kingdom and United States, and from the International Bank for Reconstruction and Development. This program was to cost about $US196 million. An essential part of the program was an aluminium smelter, built by Kaiser Aluminum in a joint venture with Reynolds Metals of the United States and partly financed by a loan from the United States Government. The smelter went into production late in 1966. Output may reach an annual rate of 115,000 short tons by the end of 1967. A capacity of 165,000 tons is planned for 1972. Ultimate capacity may be considerably greater. The present capacity, therefore, would support an alumina plant of economic size. The investment in the smelter alone was expected to be about $US164 million.

150. The Kaiser company has been investigating bauxite resources of Ghana other than those held by British Aluminium to determine the feasibility of mining and producing alumina for the smelter. As part of the agreement with the Ghana Government, the company must use alumina produced in Ghana within ten years from the date aluminium production began, or pay an extra charge to the Government for the alumina imported.

III. CONCLUSIONS

151. The controlling questions in the experiences reviewed here of the developing countries in obtaining alumina plants have been:

(a) Will an adequate long term supply of bauxite be available, domestic or imported.

(b) What markets would be assured for the alumina.

(c) Who would supply the investment capital.

(d) Would the costs of the alumina delivered to the consuming smelters have to compete with alternatives available to enterprises making the decisions.

(e) What terms and conditions have to be met in arrangements with the alumina enterprises in order to attract the industry.

(f) Will the alumina investment made by foreign enterprises be politically secure and the supply of alumina dependable.

152. The decisions have not rested on availability of trained personnel or such infrastructure as ports, housing and public services. These can be provided by the enterprises when not otherwise available. The decisions have not always required the existence of domestic bauxite resources because the ore can be imported to alumina plants that are well located, as illustrated in the cases of Taiwan,

Appendix Table B (Continued)

Control and Corporate Affiliations of World Primary Aluminium Capacity, 1966
(Thousands of short tons)

Control or affiliation	31 Dec. 1966	In construction or probable by 1971	Planned or possible	Total
Pechiney-Ugine b/ (France)				
Cameroon	57	-	50	107
France	400	-	63	463
Greece	69	11	36	116
Spain (see Kaiser)	(35)	(15)	(-)	(50)
United States (with others)	76	152	-	228
Total	602	163	149	914
Swiss Aluminium (Switzerland)				
Austria	13	9	-	22
Iceland	-	33	33	66
Italy	53	-	117	170
Netherlands (with others)	35	44	-	79
Norway	66	-	132	198
Switzerland	70	6	-	76
United States	106	34	160	300
Germany (Fed. Rep.)	55	-	66	121
Total	398	126	508	1,032
Total, six leading companies	5,258	1,423	1,446	8,127
Other private companies (11 in 1966 to 17 in 1971) g/				
Brasil (1)	11	-	44	55
India (2)	19	17	6	42
Italy (1) and (2)	93	-	110	203
Japan (3) and (4)	254	188	33	475
Norway (1)	-	85	-	85
Switzerland (1)	6	-	-	6
United States (3) and (6)	392	230	350	972
Total, other private companies	775	520	543	1,838
Governments other than centrally planned economy countries				
Austria	77	25	-	102
Egypt	-	44	-	44
India	-	28	137	165
Indonesia	-	-	28	28
Iran (see Reynolds)	-	(22)	(28)	(50)
Norway d/	-	-	-	-
Spain	43	36	-	79
Taiwan	22	24	-	46
Turkey	-	-	66	66
Venezuela (see Reynolds)	-	(11)	(11)	(22)
Germany (Fed. Rep.)	213	-	-	213
Total	355	157	231	743

Appendix Table B (Continued)

Control and Corporate Affiliations of World Primary Aluminium Capacity, 1966
(Thousands of short tons)

Control or affiliation	31 Dec. 1966	In construction or probable by 1971	Planned or possible	Total
Centrally planned economy countries				
China, mainland	110?	-	-	110?
Czechoslovakia	66	-	-	66
East Germany	74	-	-	74
Hungary	72	-	-	72
Poland	106	70	-	176
Rumania	55	28	82	165
Yugoslavia	57	55	55	167
U.S.S.R.	1,410	1,400	?	2,810
Total	1,950	1,553	137	3,640
Control not yet determined				
Belgium	-	-	110	110
South Korea	-	17	-	17
Portugese Angola	-	-	55	55
Republic of Guinea	-	-	265	265
Republic of South Africa	-	55	-	55
Total/	-	72	430	502
Grand total	8,338	3,725	2,787	14,850

Sources: Various publications.

a/ Includes for 1966 a 50% interest in Ardal og Sunndal Verk, acquired early in 1967.
b/ The French company Ugine co-operates closely with Pechiney
c/ Eleven companies in 1966, rising to 17 companies when expansions are completed.
d/ The Government of Norway's Ardal og Sunndal Verk is included for 31 December 1966, with Alcan Aluminium as a result of affiliation completed early in 1967.

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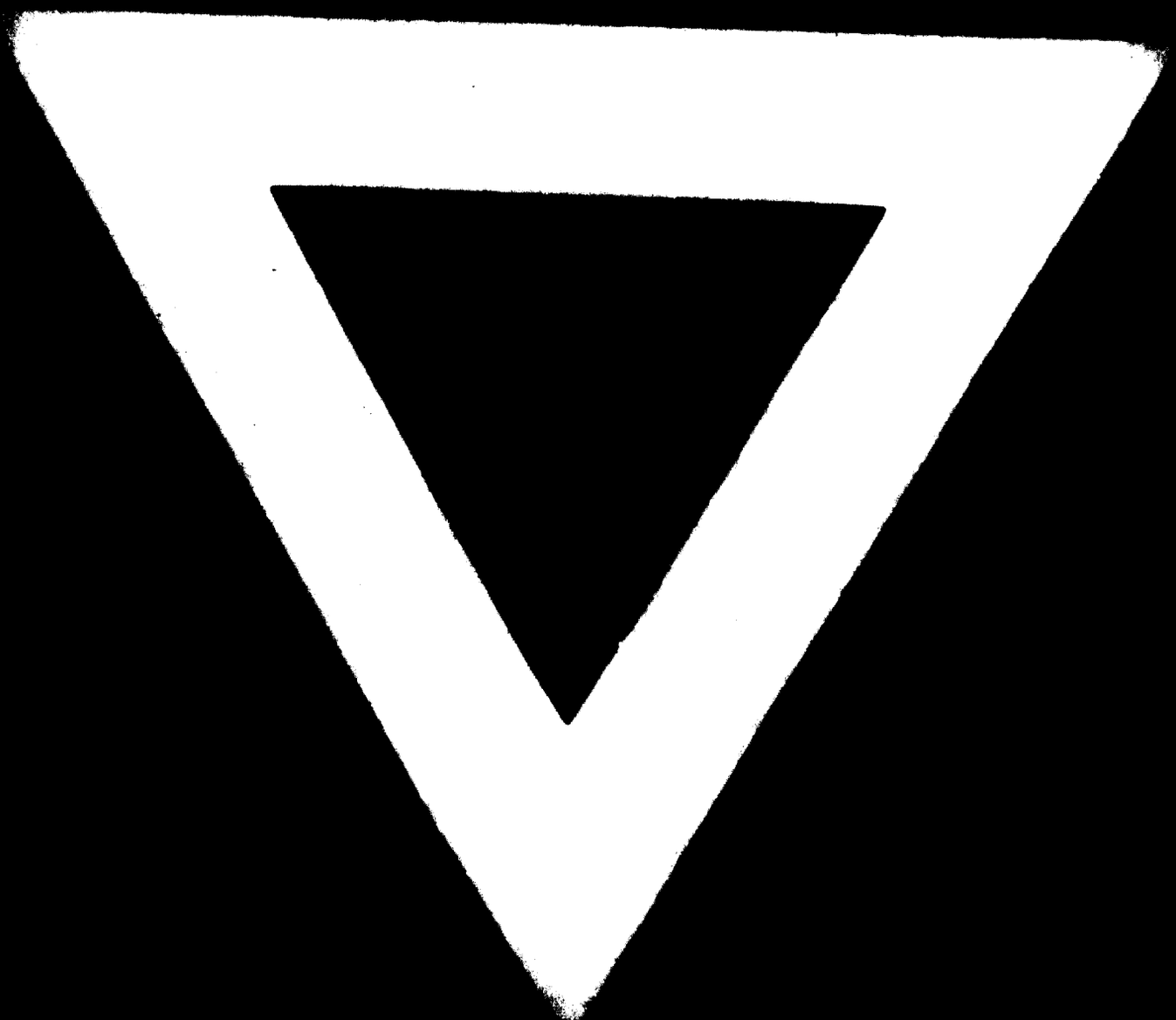

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St. Croix and the location of much alumina capacity in developed countries lacking bauxite resources.

153. Where the market has been initially small, the alumina development has survived only through trade protectionism for the associated domestic aluminium industry, as in Taiwan, Brazil and India. Where the export market has been large, low-cost efficient plants have been built.

154. Where the market for some individual enterprises could not support the most economical alumina development, the consortium or joint venture has been used to increase the total market and build a larger alumina plant. At the same time, this device spreads the risks of the enterprises both in the investment made and in the dependability of supply of alumina. The enterprises in a consortium are better able to participate also in alumina capacity elsewhere and to obtain geographical diversification.

155. The principle of the consortium or joint venture is equally available to private and state owned enterprises. The West German aluminium enterprise, Vereinigte Aluminium Werke, is state controlled, but is a partner in the Fria consortium. Late in 1966 the Government of Norway sold half of its interest in the state owned aluminium enterprise (187,000 short tons of capacity) to Alcan Aluminium, and acquired representation in Alcan's alumina enterprise operating in Jamaica. The Greek Government is a partner with Pechiney and private Greek interests in the alumina-smelter project of Aluminium de Gréce. Reynolds is a partner with the Venezuelan Government in a new smelter, and is negotiating for a partnership in a smelter that may be built for the Iranian Government. Such joint ventures pool capital and markets.

156. The security of investment made in a developing country and the dependability of the flow of the alumina to the market are the final controlling factors. The economies of the market countries would be upset by the interruption of the alumina flow. This condition would affect equally predominantly private enterprise economies and state controlled economies. Each type of economy needs security for its investment and the uninterrupted flow of essential materials.

157. The cases reviewed in this paper have demonstrated that competition between developing countries has been important in guiding the decisions of enterprises to invest alumina capacity. The competition includes the kinds of terms and concessions granted regarding bauxite exploration and mining, and tax and other incentives. The most important element of competition, however, is the kind of

stability a country can offer, politically, legally and financially, as the environment in which the alumina enterprise must exist.

158. Some developing countries are increasingly concerned with using alumina development and the associated bauxite or smelter development as a means to support or strengthen other parts of the domestic economy. Some countries require the restoration of the mined-out areas to previous agricultural or forest productivity. Some limit the size of bauxite holdings of individual enterprises so as to allow room for others to develop the industry and thus create a greater scale of development. Some require the alumina enterprises to give preference to training and employing native personnel, and to using domestic materials, supplies and ocean shipping provided the costs of these adjustments are competitive with alternatives. Such policies are part of a general attitude that foreign enterprises should operate for the maximum benefit of the developing economy.

Appendix Table A

Approximate Capacities of Producers of Alumina, 1964-1966, and Reported Expansions Under Way or Planned, 1966-1971
(Short tons)

Country, company and plant locations	Approximate capacity, 1964-1966	Reported expansions under way or planned, 1966-1971	Participants or parent company
NORTH AMERICA			
Canada—Aluminium Co. of Canada, Arvida, Quebec	1,250,000		Alcan Aluminium Ltd.
United States and Virgin Islands	5,908,000	603,000	U.S. companies
Jamaica—Alcan Jamaica Ltd.			
Kirkvine	565,000	35,000	
Ewarton	310,000	290,000	
Alumina Partners of Jamaica	-	1,000,000	Anaconda 37%; Kaiser 26%; Reynolds 37%.
Revere Copper and Brass, Inc.	-	220,000	
Aluminium Co. of America	-	200,000	
Total North America	8,033,000	2,348,000	
SOUTH AMERICA			
Brazil—Alcominas	-	50,000	Alcoa, Hanna Mining, Brazilian interests
Aluminio Minas Gerais, Ouro Preto	35,000	15,000	Alcan Aluminium Ltd.
Cie. Brasileira do Aluminio, Sorocaba	33,900		Industries Votorantim S.A., 80% other Brazilian interests, 20%.
Guyana—Demerara Bauxite Co. Ltd., MacKenzie	385,000		Alcan Aluminium Ltd.
Surinam—Surinam Aluminium Company	880,000	230,000	Alcoa
Total South America	1,333,900	295,000	
EUROPE			
France—			
Pechiney-Compagnie de Produits Chimiques et Electrometallurgiques,			
Gardanne	560,000	57,000	
Salindres	220,000	133,000	
Soc. d'Electro-Chimie, d'Electrometallurgie et des Acieries Electriques d'Ugine,			
La Barasse	110,000	110,000	
Société Francaise Pour L'Industrie de L'Aluminium,			
St. Louis les Aygolades	66,000		Swiss Aluminium
Sub-total, France	956,000	300,000	

Appendix Table A (Continued)

Approximate Capacities of Producers of Alumina, 1964-1966, and Reported Expansions Under Way or Planned, 1966-1971
(Short tons)

Country, company and plant locations	Approximate capacity, 1964-1966	Reported expansions under way or planned, 1966-1971	Participants or parent company
Germany (Fed. Rep.)—			
Aluminium G.m.b.H,			
Martinswerke.....	240,000		Swiss Aluminium
Vereinigte Aluminium Werke A.G.,			Government owned
Lippewerk.....	143,000	121,000	
Innwerk.....	121,000		
Gebrueder Giulini, G.m.b.H.			
Ludwigshafen.....	132,000		
Sub-total, Germany (Fed. Rep.)	636,000	121,000	
Greece—Aluminium de Grèce, Distomon	220,000		Pechiney, 75%; Greek interests, 25%.
Italy—			
Montecatini-Edison			
Porto Marghera.....	165,000		
Soc. Alluminio Veneto per Azioni (SAVA),			Swiss Aluminium
Porto Marghera.....	110,000		
Sub-total, Italy.....	275,000		
Norway—Norsk Aluminium A/S,			Privately owned
Hoyanger.....	18,700		(Norwegian), 50%; Alcan Aluminium Ltd., 50%.
United Kingdom—			
British Aluminium Co., Ltd.			Tube Investments,
Burntisland.....	84,000		Ltd. (British) 46%;
Newport.....	50,400		Reynolds Metals Co.,
Sub-total, U.K.....	134,000		45%; Reynolds Tube Investments, Ltd., 5%; and miscellaneous shareholders, 4%.
Total Europe.....	2,239,700	421,000	

Appendix Table A (Continued)

Approximate Capacities of Producers of Alumina, 1964-1966, and Reported Expansions Under Way or Planned, 1966-1971
(Short tons)

Country, company and plant locations	Approximate capacity, 1964-1966	Reported expansions under way or planned, 1966-1971	Participants or parent company
ASIA			
India—			
Indian Aluminium Co.,Ltd., Muri	74,000		Indian owned, 35%; Alcan Aluminium Ltd., 65%.
Mysore State		66,000	
Aluminium Corp. of India, Ltd., Jaykaynagar	11,000		Privately owned (Indian).
Hindustan Aluminium Corp. Ltd., Renukoot	44,000	272,000	Birla interests (Indian), 73%; and Kaiser, 27%.
Madras Aluminium Co., Ltd., Coimbatore	22,000	34,000	Montecatini and private Indian interests.
Government of India, Koyna		220,000	
Korba		220,000	
Sub-total, India	151,000	812,000	
Japan—			
Nihon Keikinzoku (Nippon Light Metal Co.), Shimizu	298,000	72,000	Alcan Aluminium Ltd., 50%; privately owned (Japanese), 50%.
Showa Denko K.K., Yokohama	210,000	56,000	Privately owned (Japanese).
Sumitomo Kagaku K.K., Kikumoto	210,000	86,000	Privately owned (Japanese).
Sub-total, Japan	718,000	214,000	
Taiwan—Taiwan Aluminium Corp., Takao	46,000	36,000	Government owned
Total, Asia	915,000	1,062,000	
AFRICA			
Guinea—FRIA, Compagnie Internationale pour la Production d'Alumine	577,000	Amount Unreported	Olin Mathieson Chemical Corp., 48.5%; Pechiney-Ugine, 26.5%; British Aluminium Co.,Ltd. and Swiss Aluminium, each 10%; and VAW (German), 5%.
Total, Africa	577,000		

Appendix Table A (Continued)

Approximate Capacities of Producers of Alumina, 1964-1966, and Reported Expansions Under Way or Planned, 1966-1971

(Short tons)

Country, company and plant locations	Capacity, 1964-1966	Reported expansions under way or planned, 1966-1971	Participants or parent company
OCEANIA			
Australia—			
Comalco Industries Pty.Ltd., Bell Bay	56,000		Kaiser aluminium, 50%; Consino Rio Tinto of Australia Ltd, 50%.
Alcoa of Australia Pty.Ltd., Kwinana	451,000	459,000	Aluminium Company of America, 51%; Western Aluminium N.L.(Australian), 49%.
Queensland Alumina Ltd.	672,000	336,000	Kaiser, 52%; Consino Rio Tinto, 8%; Alcan Aluminium Ltd., 20%; Pechiney, 20%.
Nabalco Pty.Ltd.		560,000	Swiss Aluminium, 50%; Australian interests, 50%.
Total Oceania	1,179,000	1,355,000	
Total	14,278,100	5,481,000	

Centrally planned economy countries

EUROPE			
Czechoslovakia, Zavod	120,000		
Germany, East—			
Vereinigte Aluminium Werke, A.G., Lauta	100,000		
Hungary—			
Bonautalor Alaunnerde, Alamasfuzito	172,000	146,000	
Ungarrische Bauxit Grubon A.G. Ajaka	104,000	567,000	
Bauxit Industie A.G., Magyarovar	38,500		
Sub-total, Hungary	314,500	713,000	
Rumania—Oradea	132,000	66,000	
Yugoslavia—			
Loscrnc	8,800	582,000	
Kidricovo (Strnisce)	100,000		
Mosto	8,800		
Sub-total, Yugoslavia	117,600	582,000	
Total, Europe, Centrally planned economy countries	784,100	1,361,000	

Appendix Table A (Continued)

Approximate Capacities of Producers of Alumina, 1964-1966, and Reported Expansions Under Way or Planned, 1966-1971
(Short tons)

Country, company and plant locations	Capacity, 1964-1966	Reported expansions under way or planned, 1966-1971	Participants or parent company
Centrally planned economy countries (Continued)			
U.S.S.R.—			
Achinsk, Siberia	88,000	800,000	
Boksitogorsk, N.W. Russia	165,000		
Kamensk, Urals	385,000		
Kirovbad, Azerbaijan		220,000	
Kandalaksha, Kola Peninsula	55,000		
Krasnotourinsk, Urals	385,000		
Novokuznetsk	110,000		
Pikalevo, N.W. Russia	800,000		
Pavlodar, Kasakhstan		550,000	
Volkhov, N.W. Russia	88,000		
Zaporoshye, Ukraine	275,000		
Sub-total, U.S.S.R.	2,354,000	1,570,000	
ASIA			
China—			
Fushun	24,200		
Nanting	44,000		
Sub-total, China	68,200		
Korea, North	a/		
Total	3,206,300	2,933,000	
Total, world	17,484,400	8,412,000	

Sources: U.S. Bureau of Mines, Minerals Yearbook 1964, 1965; company reports, various periodicals and press.

a/ Data not available; capacity in 1943 was given as 75,500 tons.

Appendix Table B

Control and Corporate Affiliations of World Primary Aluminium Capacity, 1966
(Thousands of short tons)

Control or affiliation	31 Dec. 1966	In construction or probable by 1971	Planned or possible	Total
Six leading private companies				
Alcan Aluminium (Canada)				
Australia	-	40	-	40
Brazil	19	6	-	25
Canada	832	138	172	1,142
India	41	33	77	151
Italy	6	-	-	6
Japan	139	75	-	214
Norway (partly the Government of Norway; also with British Aluminium - Reynolds) a/	252	71	35	358
Swedon	33	33	-	66
Total	1,322	396	384	2,002
Aluminium Company of America (U.S.A.)				
Australia	44	-	-	44
Brazil	-	25	-	25
Mexico	22	-	22	44
Norway	68	52	85	205
Surinam	66	-	-	66
United States	1,050	100	-	1,150
Total	1,250	177	107	1,534
Kaiser Aluminum & Chemical Corp. (U.S.A.)				
Australia-New Zealand	61	19	135	215
Ghana (with Reynolds)	-	165	85	250
India	53	26	79	158
Spain (with Pechiney)	35	15	-	50
United States	670	41	-	711
Total	819	266	299	1,384
Reynolds Metals Company (U.S.A.)				
Canada (through British Aluminium)	103	12	60	175
Ghana (see Kaiser)	(-)	(165)	(85)	(250)
Iran	-	22	28	50
Norway (see Alcan Aluminium)	(32)	(-)	(-)	(32)
United Kingdom	39	-	-	39
United States	725	250	-	975
Venezuela (with government)	-	11	11	22
Total	867	295	99	1,261