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TRANSPORT OF BAUXITE AND ALUMINA
- VOLUME, COSTS, TECHNICAL BACKGROUND, FUTURE TRENDS

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TRANSPORT OF BAUXITE AND ALUMINA

- Volume, Costs, Technical Background, Future Trends

1. Ocean Transport

The pattern of international trade in aluminium raw materials has changed considerably since the early 1960's. Not only have major new sources of bauxite supply been developed in Australia, West Africa and other areas, but conversion to alumina has also been increasingly carried out by bauxite exporting countries resulting in a rapid growth in shipments of this material.

In the period 1966-76 total world combined shipments of bauxite and alumina increased by 80% from 23.4 million tonnes to 42.3 million tonnes. Expressed as bauxite equivalent this represented a growth rate of some 7.7% per annum. During the period the alumina component of the trade grew significantly but experienced a severe decline during the 1975 recession unlike bauxite trade which continued to show some modest growth as set out below:

TABLE 1

World Seaborne Trade in Bauxite and Alumina

	Bauxite (million tonnes)	Alumina (million tonnes)
1966	21.1	2.3
67	22.0	2.9
68	22.2	4.1
69	25.6	4.4
70	27.9	5.8
71	28.6	6.8
72	27.5	7.3
73	28.8	9.1
74	32.5	10.0
75	32.8	8.8
76	33.2	9.1

The ten years to 1976 was characterised by five main developments. These were:-

(i) A sustained upward trend in primary aluminium consumption (apart from the setback in 1975) with growth rates averaging 7.0% p.a. in western countries and 6.9% in eastern countries.

(ii) The rapid rise in Australia's bauxite and alumina shipments which accounted for 4.3% and Nil% respectively of world seaborne trade in 1966 and some 22.0% and 49% respectively by 1976.

(iii) The growth and subsequent decline in Caribbean alumina production which rose from 0.8 million metric tonnes in 1966 to a peak of 3.5 million tonnes in 1973, falling to 1.7 million tonnes in 1976.

(iv) The very rapid increase, from 1973 onwards, in West African bauxite shipments which rose from 1.1 million tonnes in 1972 to 9.6 million tonnes in 1976 almost entirely due to the development of the Guinea deposits.

(v) The increasing importance of Western European imports of bauxite and alumina, which accounted for some 17.0% of total trade in the two commodities in 1966 and 38% by 1976.

Changes in the volume and direction of ocean trade over the past decade have been accompanied by far-reaching changes in bulk transportation and handling. At a comparatively early date, the aluminium industry initiated the transport of materials in bulk, usually as full shiploads, in order to reduce, or control, transport costs, but the changing structure of international trade from the early 1960's onwards:-

(i) encouraged the use of larger and, in some instances, specialised vessels of the bulk carrier type to effect even larger savings in freight on the longer routes.

(ii) stimulated investment in modern bulk handling equipment at many ports shipping or receiving aluminium raw materials to permit the employment of larger ships.

(iii) and led to an even greater dependence on long-term bulk shipping arrangements, freight contracts or period time-charter agreements being increasingly preferred to proprietary control of ocean transport operations.

The aluminium industry is unique in its high degree of vertical integration. The greater part of all ocean trade arises at mines or plants which are captive, or which are tied in other ways to individual companies or multi-national consortia. Against this background, it is hardly surprising that a large and growing proportion of all shipments of aluminium raw materials are carried under long-term arrangements. Open-market, short-term chartering operations, as will be shown, only cater for marginal transport requirements, with the result that fluctuations in the "open" freight market do not have an important impact on transport costs.

Although shipping distance - which, on some routes, can exceed 11,000 miles - is a major determinant of transport cost, it is not the only one. The efficiency of the ocean transport system - port capacities, cargo handling, size of ship, type of ship, organisation of shipping, etc. - is also important.

2. <u>Alternative Shipping Arrangements</u>

While some aluminium companies have chosen to integrate the ocean transport of raw materials into their overall operations, by owning bulk vessels, there are various alternatives to be considered which meet the generally-expressed preference for long-term shipping arrangements. Obviously, there is greater security in owning vessels, as certain of the aluminium companies in North America do, while there is the advantage of being able to stabilize costs.

With the high degree of vertical integration within the aluminium industry, it is not surprising that the responsibility for arranging ocean transportation lies with aluminium companies rather than with their suppliers. This position is, however, being challenged by the countries mining bauxite, the majority of which are in the Third World and recently independent, partly through participation in, or control off, the off-shore operations of the major companies but also through their attempts to legislate their way into the shipping business.

Proprietary control of shipping is, in fact, less in evidence in the bauxite/alumina trade, increasing reliance being placed on other types of transport arrangement. When raw material volume is known, or can be estimated reasonably accurately, as is often the case with individual plants, the shipper - generally an aluminium company - may prefer to enter into a contract of affreightment (or COA) to satisfy the shipping requirement. This option removes all financial risk, other than the obvious consequences of the operator not carrying out his contractual obligation, and is, in fact, a relatively straightforward way in which transportation can be secured in advance and perhaps more important - freight costs stabilized.

The amount of cargo - as well as the frequency of shipments - normally specified under a COA, although the owner may carry other cargo, substitute vessels (or sub-let shipments) and change schedules in order to optimize the employment of his fleet. To obtain this operational flexibility, the operator is frequently willing to quote a highly competitive rate and there is little doubt that under present market conditions, the COA is a less costly method of transportation than either vessel ownership or the other main option, the period charter.

Even those aluminium companies with proprietary fleets will frequently supplement their transport capacity by timechartering tonnage for short or long periods. The charterer (in this case, the aluminium company) is able to control the scheduling of the vessel, ensuring a high level of operating efficiency in the transport and handling of materials. Depending on the length of the charter, the vessel may even possess special features (e.g. shallow draft) to increase its efficiency, or reduce costs. Another advantage of timechartering is that transport costs can be estimated fairly closely, being based on a hire rate per DWT/month agreed with the vessel's owner (which may escalate modestly) plus the cost of fuel and port charges.

Another option, used on certain routes, is to charter vessels for single trips. The risks associated with this type of arrangement which is essentially to cover marginal transport requirements is that (i) vessels may be unavailable at short notice, or delayed and (ii) the shipper is exposed to short-term market fluctuations, which may not necessarily be to his advantage. Such spot chartering is - as will be shown later - responsible for only a small part of the total trade in aluminium raw materials, reflecting the dependence of the industry of longer, more stable, shipping arrangements based on freight contracts, or owned and timechartered tonnage.

Only rarely, for example, are vessels required on a one-trip basis to transport aluminium raw materials to Japan. The Japanese have a unique system under which the aluminium companies enter into "cargo guarantees" with Japanese shipping lines either directly, or, more usually, through one or other of the Japanese trading houses. It is sometimes feasible for the shipping company to allocate one of its own ships to the trade and there are, in fact, several specially-built bauxite carriers in the Japanese fleet which regularly proceed to the same plant, though not necessarily from the same source. Alternatively, the Japanese shipping company can deploy chartered vessels, usually those taken for longish periods under "tie-in" arrangements with foreign interests.

The bauxite carriers under Japanese flag - listed below - are employed mainly in Australian trades, although the smaller ones are often required to load at Bintan Island or Malaysian ports:-

TABLE 2

Name	DWT	Built	Owner
NIKKEI MARU No. 2	18,506	1963	Nippon Yusen Kaisha
SEIRYU MARU	21,021	1968	Taiheiyo Kisen KK
EIRYU MARU	22,103	1972	Taiheiyo Kisen KK
WEIPA MARU	23,594	1969	Daiichi Chuo Kisen
NIKKEI MARU No. 3	29,700	1969	Nippon Yusen Kaisha
SHORYU MARU	32,400	1971	Taiheiyo Kisen KK
KAIRYO MARU	32,941	1971	Taiheiyo Kisen KK
NIKKEI MARU No. 5	33,876	1974	Yamashita-Shinnihon KK
NIIHAMA MARU	76,324	1971	Daiichi Chuo Kisen

A problem in arranging transport has been the trend towards consortia in establishing bauxite mines or alumina plants. Not only is scheduling of vessels made more difficult, "take or pay" contracts prevent raw material output from being adjusted in line with reduced consumption downstream at company plants, but Government action may place responsibility for shipping in other hands (as, for example, in the case of bauxite shipped from Guinea).

3. <u>Bulk Shipping Market and Freight Rates in Bauxite/Alumina Trades</u>

A large part of the trade in aluminium raw materials is - as has been shown - conducted under long-term arrangements, the freight rate per tonne either being fixed, or established independently of the charter market by negotiation. Open market chartering does, however, cater for part of the industry's raw material needs, supplementing shipping capacity either owned, or operating under long-term freighting arrangements.

Open-market freight rates are rarely stable for any length of time, fluctuating in response to world wide changes in the demand for shipping services in the bulk trades. Frequently, the rate charged (which may be either on the cargo, or, through time chartering, on the ship) is for a single shipment, and is not respresentative of average transport costs because of the widespread dependence on stable, long-term freighting, or integrated transport.

Not only are single-voyage charters only a small part of the bulk shipping requirement generated by trade in bauxite and alumina materials, but, in many instances, the practice of sub-letting cargoes disguises the dependence on proprietary carriage, or other forms of long-term freighting. Moreover, in only a few trades is there sufficient open-market chartering of ships to enable freight rate trends to be observed with any accuracy.

We have chosen to illustrate trends by presenting freight rate data for three routes: (i) Jamaica-US Gulf, (ii) Guinea-US Gulf and (iii) Australia-NW Europe. These freights - shown in Table 3 - have been extrapolated from reported charters ("Fixtures"), the ranged values, in U.S. Dollars per cargo tonne, being considered representative of average freights on the routes selected.

The trend - illustrated by Graph 1 - broadly mirrors the depressed market conditions which set in early 1971 and which persisted, to a greater or lesser degree, through to the middle of 1972. At that time, certain developments (e.g. large scale purchases

TABLE 3

EVOLUTION OF SINGLE VOYAGE FREIGHT RATES FOR

FULL CARGOES OF BAUXITE: 1972/77

(U.S. Dollars per Cargo Ton)

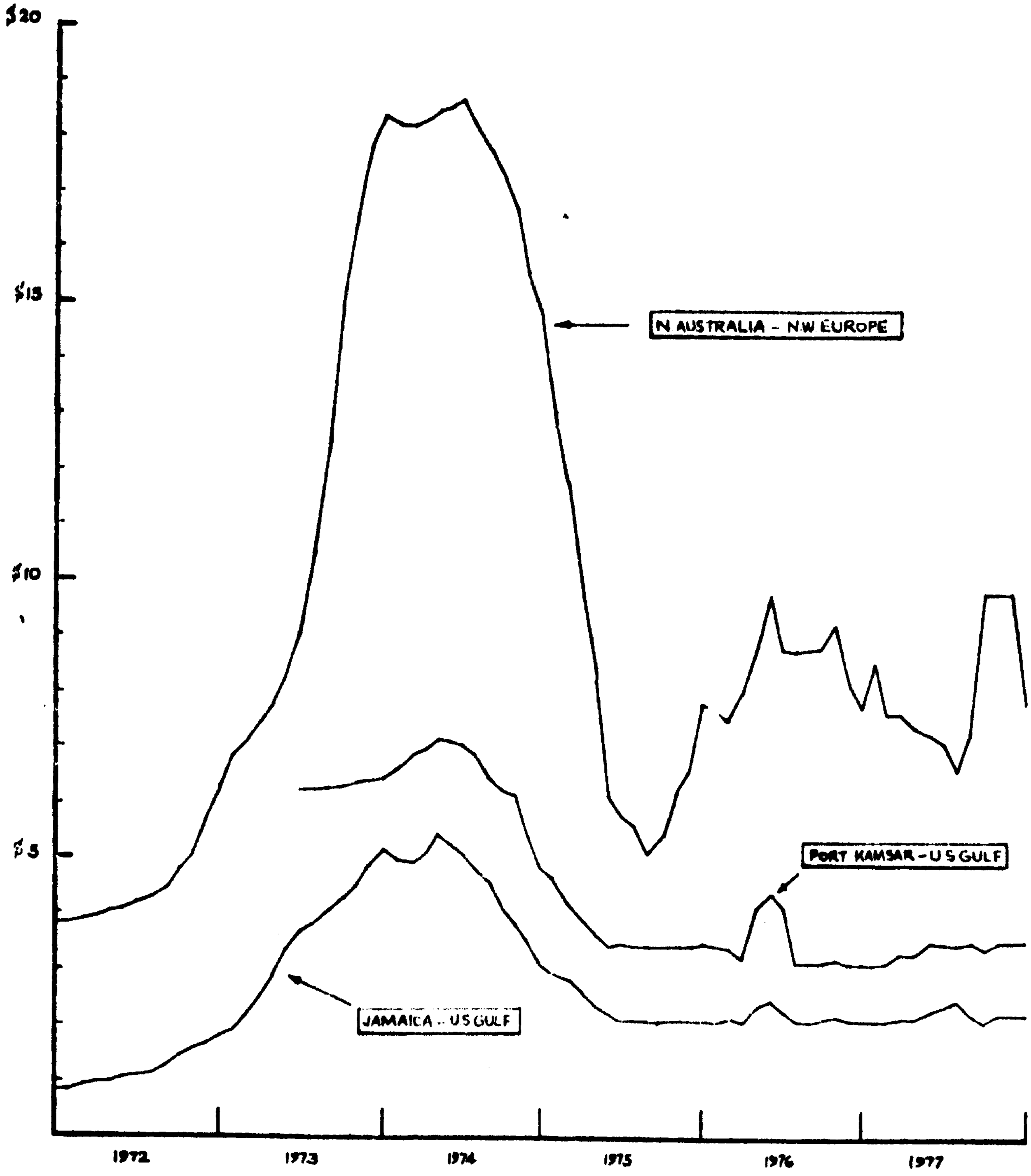
TRADE		JAMAICA-US GULF	N. AUSTRALIA-N.W. EUROPE	PORT KAMSAR-US GULF
DISTANCE		1,050	10,080	4,800
SIZE		25/35,000 DWT	45/65,000 DWT	25/30,000 DWT
TERMS		55 [illegible]S SHINC FIO	25,000/15,000 [illegible]OT	24,000 SHINC/15,000 SHINC FIO
1972	J	0.80 - 0.90	3.40 - 3.61	-
	F	0.85 - 0.95	3.80 - 3.90	-
	M	0.90 - 0.95	3.90 - 4.00	-
	A	0.90 - 0.95	4.00 - 4.10	-
	M	1.00 - 1.05	4.10 - 4.30	-
	J	1.05 - 1.10	4.25 - 4.36	-
	J	1.15 - 1.20	4.30 - 4.40	-
	A	1.25 - 1.35	4.45 - 4.56	-
	S	1.40 - 1.50	4.75 - 4.90	-
	O	1.50 - 1.60	5.00 - 5.30	-
	N	1.65 - 1.75	5.20 - 5.83	-
	D	1.75 - 1.85	6.10 - 6.50	-
1973	J	1.90 - 2.00	6.70 - 7.00	-
	F	2.20 - 2.30	6.95 - 7.30	-
	M	2.40 - 2.60	7.25 - 7.70	-
	A	2.80 - 3.00	7.60 - 8.00	-
	M	3.25 - 3.50	8.10 - 8.60	-
	J	3.60 - 3.75	8.70 - 9.50	6.25 - 6.30
	J	3.75 - 3.90	9.50 - 11.50	6.25 - 6.30
	A	4.00 - 4.15	12.00 - 13.14	6.30 - 6.35
	S	4.25 - 4.35	14.25 - 15.50	6.30 - 6.40
	O	4.40 - 4.60	16.00 - 17.16	6.35 - 6.45
	N	4.75 - 4.90	17.50 - 18.00	6.35 - 6.50
	D	5.00 - 5.25	16.00 - 16.75	6.40 - 6.80
1974	J	4.50 - 5.00	16.00 - 16.56	6.60 - 6.75
	F	4.80 - 5.00	16.00 - 16.50	6.80 - 6.90
	M	5.00 - 5.20	16.10 - 18.56	6.90 - 7.00
	A	5.30 - 5.50	18.15 - 18.75	7.10 - 7.25
	M	5.20 - 5.35	18.25 - 18.75	7.00 - 7.15
	J	5.00 - 5.20	18.50 - 18.75	6.90 - 7.00
	J	4.75 - 4.90	18.00 - 18.21	6.75 - 6.90
	A	4.50 - 4.60	17.80 - 18.00	6.35 - 6.60
	S	4.00 - 4.10	17.00 - 17.50	6.10 - 6.35
	O	3.75 - 3.90	16.40 - 16.85	6.00 - 6.25
	N	3.40 - 3.60	15.25 - 15.75	5.25 - 5.60
	D	3.10 - 3.25	14.80 - 15.00	4.75 - 4.90
1975	J	2.90 - 3.00	12.10 - 13.95	4.50 - 4.75
	F	2.70 - 2.80	10.80 - 11.50	4.00 - 4.30
	M	2.50 - 2.65	9.25 - 10.00	3.75 - 4.00
	A	2.[illegible] - 2.50	7.70 - 8.80	3.50 - 3.75
	M	2.30 - 2.35	6.00 - 6.10	3.40 - 3.50
	J	2.15 - 2.30	5.65 - 6.00	3.40 - 3.45
	J	2.15 - 2.30	5.30 - 5.70	3.40 - 3.50
	A	2.15 - 2.20	4.85 - 5.30	3.40 - 3.45
	S	2.15 - 2.20	5.30 - 5.61	3.40 - 3.45
	O	2.15 - 2.20	6.00 - 6.50	3.40 - 3.45
	N	2.15 - 2.20	6.00 - 7.10	3.40 - 3.45
	D	2.15 - 2.20	7.70 - 7.56	3.45 - 3.50
1976	J	2.10 - 2.20	7.80 - 7.86	3.30 - 3.50
	F	2.15 - 2.30	7.25 - 7.70	3.35 - 3.50
	M	2.00 - 2.10	7.50 - 8.56	3.00 - 3.40
	A	2.25 - 2.50	8.50 - 9.08	4.00 - 4.30
	M	2.30 - 2.60	9.80 - 10.00	4.25 - 4.50
	J	2.20 - 2.40	8.80 - 9.10	4.00 - 4.25
	J	2.00 - 2.25	8.50 - 9.00	3.00 - 3.25
	A	2.00 - 2.25	8.25 - 9.21	3.00 - 3.25
	S	2.00 - 2.30	8.50 - 9.21	3.00 - 3.25
	O	2.10 - 2.25	8.90 - 9.50	3.20 - 3.40
	N	2.00 - 2.20	7.75 - 8.50	3.00 - 3.20
	D	2.00 - 2.20	7.80 - 8.00	3.00 - 3.20
1977	J	2.00 - 2.20	8.00 - 9.00	3.00 - 3.20
	F	2.05 - 2.25	7.80 - 7.78	3.10 - 3.30
	M	2.10 - 2.30	7.45 - 7.76	3.20 - 3.45
	A	2.10 - 2.30	7.25 - 7.41	3.20 - 3.45
	M	2.20 - 2.45	7.10 - 7.36	3.40 - 3.60
	J	2.33 - 2.45	7.00 - 7.10	3.45 - 3.50
	J	2.35 - 2.55	6.50 - 6.75	3.45 - 3.50
	A	2.15 - 2.35	7.00 - 7.50	3.40 - 3.60
	S	2.00 - 2.20	9.70 - 9.90	3.35 - 3.50
	O	2.15 - 2.35	9.70 - 9.94	3.40 - 3.60
	N	2.15 - 2.35	9.70 - 9.80	3.40 - 3.60
	D	2.15 - 2.35	7.80 - 8.06	3.40 - 3.60

EVOLUTION OF SINGLE VOYAGE FREIGHT RATES FOR

FULL CARGOES OF BAUXITE: 1972/77

(U.S. Dollars per Cargo Ton)

GRAPH 1



of grain by the USSR) combined with a buoyant world economy, brought about a sustained upward movement in freight rates, which was not halted until the middle of 1974. The "break" in the market was initiated by the "Oil Crisis", which caused combined tonnage to spill over into the dry cargo market, but it was some time before rates for the smaller vessels weakened. Since then, freight rates have subsided to extremely low levels due to a world recession, the stagnation of world trade and the resulting tonnage surplus.

Generally, single voyage freight rates for bauxite - as Table 3 reveals - were, in terms of U.S. Dollars, at their lowest in the early part of 1972 and 1975, reaching a peak in late 1973 and early 1974. The most responsive to market pressures of the three trades was that between Australia and NW Europe, rates rising from a "low" of $3.65 to a "high" of $18.50 - a fivefold increase - for shipments between 45-65,000 tonnes of bauxite. In contrast, freight rates on the shorter, 1,050 mile, voyage between Jamaica and the U.S. Gulf remained at more reasonable levels, and did not, in fact, rise much about $5.00 before declining. However, the peak of $5.50 per tonne FIO recorded in this trade was six-and-a-half times the low of $0.85 seen in early 1972 for the -35,000 DWT size. Latterly, freights have remained above $2.00 per tonne.

It will be observed that spot freight rates for bauxite do not fully reflect differences in the length of haul. In 1972, despite the exceptionally long voyage to ports in NW Europe round the Cape, freight rates from Australia fell to only $4.00 a tonne on free-in-and-out terms and even during the recent depression were reduced to $7.00 despite the much higher fuel prices, escalation of operating expenses and changes in exchange rates. At the peak of the market, shippers were penalized by the high freight, although a high proportion of all shipments on this route are covered by freight contracts, the operators sub-letting shipments in the open market when they are not able, or unwilling, to employ their own vessels. There is, in fact, a good supply of vessels for this trade because of the proximity of Japanese ports, "Panamax" types ballasting away to load bauxite at Weipa after discharging coal or iron ore. This explains why freight rates between Australia and Europe are so low, owners accepting a loss simply to avoid long-ballast voyages.

The other principal trade identified in the freight rate data is that between Guinea and the U.S. Gulf, which commenced in 1973 following the opening of Port Kamsar. Bulk carriers of up to 50,000 tonnes capacity are required for this trade, which is directed to Alcoa's Point Comfort and Mobile plants. Initially, spot freight rates were in the range U.S. $6.25-$7.25 per tonne for shipments in this size of ship, but since 1975, have averaged about $3.50. At this level of freight, Guinea bauxite (from Boké) may be delivered more cheaply to plants along the U.S. Gulf coast than can material from traditional origins, such as Surinam (maximum 20,000 tonne shipments) or the Dominican Republic. This is why more bauxite is imported into the U.S. Gulf from Guinea than from any other source other than Jamaica;

in 1976 2.36 million tonnes were received by Gulf plants, or 18% of the total.

Guinea bauxite is taken by Halco's partners in proportion to their equity, being transported to St. Croix (Virgin Islands), Port Alfred (Canada), Rotterdam, Porto Marghera (Italy) and Fos (France) as well as to the U.S. Gulf. However, the Guinea Government is nominally responsible for arranging the shipment of 50% of the bauxite exported from Port Kamsar and, until recently, chartering operations were conducted through "Afrobulk". The problem, with shipping operations in the hands of the aluminium companies (or their brokers), as well as those nominated by the Guinean authorities, has been to maintain efficient scheduling of shipments as, at the present shipping rate of 8 million tonnes per annum, vessels call almost daily. Inevitably, more and more reliance has been placed on long-term arrangements, and less on spot chartering, one of the reasons being the scarcity of suitable tonnage in the 40-60,000 DWT range on that side of the Atlantic.

Only rarely are vessles chartered to load bauxite on routes other than those covered by Table 3. However, alumina cargoes feature regularly in the charter market on a variety of routes. The principal origin is, of course, Australia, shipments of up to 50,000 tonnes being fixed from either Gladstone or Western Australia ports to the U.S. North Pacific area fairly regularly. For the 8,500 mile haul from Kwinana, in Western Australia, to ports like Ferndale, freights peaked at almost $20.00 per tonne in early 1974, but have recently been in the range of $8.00-$8.50 per tonne for shipments of around 35,000 tonnes. Larger vessels are required to the shorter voyage from Gladstone, to Tacoma, reducing the freight by approximately $1.50.

Alumina cargoes do, of course, arise at other plants, although chartered vessels are normally only required for occasional shipments. Often the destination will be unusual; for example, the requirements of the smelter at Baie Comeau in Canada may necessitate shipping alumina from Stade, West Germany rather than from the usual supply source, Corpus Christi.

4. Ocean Transports Costs

While the high degree of integration exerts a major influence, the existing pattern of international trade in materials employed in aluminium production also reflects competitive relationships arising from (i) the quality, quantity and pricing of these materials and (ii) cost of ocean shipping. Ocean freight and other shipping and cargo handling costs do, of course, constitute a large - if variable - element in total raw material costs, and for some producers are of critical importance, particularly those dependent on "armslength" sales of a low-value material like bauxite.

The level of these transport costs is related, in a general way to such factors as shipping distance, the size of shiploed (and, therefore, the type of vessel employed), and the way in which ocean transportation is organized. The economies of scale, as they apply to ocean shipping are well known but, simply stated, freight costs increase with the length of haul and decrease with vessel size, the employment of the larger bulk ships offering substantial savings in freight on all but the shortest routes.

A comparison of actual freight rates charged on cargoes of bauxite or alumina illustrates these relationships quite well. However, the picture becomes confused and somewhat distorted when shipping costs are compared simply on the basis of freight rates. A more satisfactory approach is to base the comparison on an analysis of vessel costs, explaining the differences resulting from route lengths and ship size preferences in terms of the real, underlying costs of providing the shipping service. Justification for this approach lies in the widespread dependence, within the aluminium industry, on proprietary vessels, or other stable, long term freighting arrangements under which the actual freight charge per tonne of material shipped is much closer to the costs borne by the vessel operator.

Based on a knowledge of present shipping practices, four sizes of ship were selected for study: 15,000 DWT, 35,000 DWT and 60,000 DWT. The fixed and variable costs associated with the operation of these sizes of bulk vessel were quantified and compared in order to provide estimates of unit transport cost per tonne of cargo on specified routes. The results shown on Tables 4 and 5 represent the real cost - under 1976 conditions - of transporting bauxite in typical sizes of ship, on the routes listed under contractul terms. The unit costs are not freight rates, or an approximation of those, although the differentials are, to some extent, reproduced in the market place.

Comparative Ocean Transport Costs Over Principal Routes between Bauxite Loading and Discharging Ports

TABLE 4

N.W. Europe

		to ROTTERDAM			
Origin	Vessel Size:	15,000 DWT	25,000 DWT	35,000 DWT	60,000 DWT
		U.S. Dollars per Tonne			
SURINAM	(Paranam)	6.10	4.70	4.20	3.70
GUYANA	(McKenzie)	6.90	5.50	5.20	4.90
JAMAICA	(P. Rhoades)	6.30	4.30	4.20	3.70
GUINEA	(P. Kamsar)	4.90	3.80	3.40	3.10
AUSTRALIA	(Weipa)	16.50	12.90	11.30	10.30

U.S. Gulf

TABLE 5

		To NEW ORLEANS			
Origin	Vessel Size:	15,000 DWT	25,000 DWT	35,000 DWT	60,000 DWT
		U.S. Dollars per Tonne			
SURINAM	(Paranam)	4.0	3.30	3.10	3.00
GUYANA	(McKenzie)	4.60	3.90	3.80	3.70
JAMAICA	(P. Rhoades)	2.40	2.10	1.90	1.80
GUINEA	(P. Kamsar)	6.30	4.80	4.30	3.90
AUSTRALIA	(Weipa)	11.90	10.80	9.40	8.40

It is not proposed to closely examine the structure of shipping costs. Essentially, the comparison is based on the three main cost elements involved in providing such a shipping service, which are:-

(i) The capital charges (including interest) associated with the purchase of the particular size, or type, of vessel.

(ii) The annual cos of operating the ship at sea, and in port, which arises from crewing, insuring, maintaining and managing such a vessel.

(iii) The expenses incurred on individual routes, and which are largely composed of the cost of fuel (bunkers) and port charges.

There is, as one might suspect, considerable variation in such costs. Capital repayments vary with price; the method and financing (particularly the period employed for depreciation), interest rates, etc., while enquiry among shipowners as to their operating expenses produces some startlingly different answers. Expenditure on fuel - by far the largest item of voyage costs - depends not only on the vessel's speed but also on the type of fuel burnt, where supplies are purchased and their price and the days per voyage and in port. Port charges (and canal tolls) are significant in overall trading costs, but can also vary considerably.

Despite these variations, the cost data used to calculate unit transport costs for selected routes is considered to be representative of average operating conditions within the bulk shipping industry in 1976. Another key variable is the time taken to complete the trip as, in addition to mileage, one also needs to know the vessel's speed. When calculating cost, it was assumed that each ship would make an average of 14.5 knots (or nautical miles) per hour - equivalent to a steaming distance of 350 miles daily. This means that the trip to the U.S. Gulf from Jamaica takes three days, whereas, at the other extreme, the voyage to Rotterdam from Australia is of a month's duration, even via the Suez Canal.

Distances, in nautical miles, between the point of origin and destination shown in Tables 4 and 5 are given in Table 6 over:-

TABLE 6

Shipping Distances Between Principal Ports

(nautical Miles)

Origin	Loading Port	Destination	
		NW Europe	US Gulf
SURINAM	Paranam	4,080	2,560
GUYANA	McKenzie	4,110	2,390
JAMAICA	Port Rhoades	4,300	1,050
GUINEA	Port Kamsar	2,980	4,500
AUSTRALIA	Weipa	10,900(S)	10,080(P)

While the unit costs presented in Tables 4 and 5, in U.S. Dollars per tonne, confirm that costs diminish with increasing size and rise with increasing shipping distance they also quantity the absolute cost advantage in replacing a small ship with a larger one. The saving will be greater on the longer hauls than on the shorter routes. It can be seen that the employment of a 25,000 ton vessel in place of the 15,000 tonners presently used for bauxite shipments from Surinam to, say, the U.S. Gulf, would, on the figures given, only result in a reduction of about 20% in transport costs, the saving amounting to slightly over U.S.$1.00 per tonne. On the longer, 4,500 mile, voyage from Guinea to the U.S. Gulf, the increased size of shipload lowers costs by $1.50 per tonne, or almost 25%, while on the very much longer haul from Australia, costs are reduced by over U.S. $3.00.

Clearly, further savings can be achieved by increasing the size still further, although these may be dissipated by the longer periods required for loading and discharging operations. Although constrained by draft restrictions at the Weipa terminals, as well as the probable need to transit the Suez or Panama Canals, Australian shippers now employ 60,000 tonners almost exclusively on the long haul to N.W. Europe, reducing the unit cost to just over $10.00 per tonne.

Present shipping practices, as far as the size of vessel is concerned, are in fact different at each of the loading ports distinguished in Tables 4 and 5. Under 1976 conditions, the theoretical unit cost of transporting bauxite to N.W. Europe would have been within the following ranges: Surinam $4.5-$6.00, Guyana $5.5-$7.00, Jamaica $4.0-$4.5, Guinea $3.0-$3.5 and Australia $10.0-$10.5 per tonne. The unit transport costs may also be expressed in U.S. Cents per tonne/mile, and while these vary from as low as 0.10 U.S. Cents on the longest hauls to 0.15 or higher on the shorter routes on which smaller vessels are operating, the average would be almost 0.11 U.S. Cents.

This appraisal of costs enables the competitive position of exporters of aluminium raw materials to be evaluated and permits an estimate of the possible saving in freight which would result if they were able to increase shipload lots. Bauxite can be supplied to U.S. Gulf alumina plants from Guinea more cheaply than from Surinam, where vessels are rarely able to leave with more than 18-19,000 tonnes on board owing to the shallow river bar. By employing vessels over 50,000 DWT to load at Port Kamsar, the members of Halco have been able to equalize transport costs with those from Surinam, even though the distance is much higher. Guinea, it will be noted, also benefits considerably from proximity to N.W. Europe and the provision of deep-water loading facilities at Port Kamsar. Australian suppliers are at a disadvantage because of the long hauls to markets other than Japan, and these can only be overcome if even larger bulk vessels are introduced into this trade to reduce transport costs still further. This would require port development to permit 100,000 ton shipments to be consigned to European or U.S. plants.

5. Sizes and Types of Bulk Vessel

Present shipping practices in the bauxite/alumina trade have been determined by many other factors besides cost, but, where practicable, the industry has applied new and more efficient methods of transport and handling. The process of change - which has resulted in a progressive increase in the sizes of bulk vessel employed on many routes - has, however, been impeded by various restraints, some associated with the problem of handling larger shiploads (such as draft limitations at ports shipping or receiving aluminium raw materials), other stemming from the nature, and usage, of the materials. Anyone associated with the industry will, for example, be aware of the need for covered storage, of the practice of blending bauxite, and the low material throughputs of individual plants and smelters, all of which affect the size, and frequency, of shipments.

For some, the solution to these problems has been to introduce specialized shipping, or employ innovative handling methods. Built to operate shuttle services between more or less fixed points of origin and destination, the "bauxite carrier" is the most highly specialized type of vessel encountered in the trade, some even possessing sophisticated conveyor-fed, self-unloading devices to overcome deficiences in the shore-based facilities. There is, however, a considerable loss of flexibility and, in practice, any bulk vessel - with, or without cargo handling equipment on board - is suitable for the transport of aluminium raw materials, provided it can be handled by the ports where loading and unloading takes place.

The question of the right type of ship is related to the size of shipload, as those over 20,000 tonnes can most conveniently be handled by vessels of the bulk carrier type including ore carriers, OBO carriers and even ore-oil vessels. For anything smaller, the shipper would probably have to consider employing a 'tweendeck' cargo ship, although there are bulk vessels available to load 10-20,000 tonne lots. As distance is a factor, one should, perhaps, make a distinction between the shorter hauls, which employ a variety of ship types including barges, and the longer routes. On the longer voyages, bulk carriers have now largely supplanted other types of shipping because of their greater efficiency, and one would estimate that bulk vessels haul over 70% of total trade in aluminium raw materials.

Extensive use of smaller, mainly "break-bulk" vessels is still made, however, in certain trades, especially those crossing the Caribbean or arising in the Mediterranean. On these short-haul routes, this type of shipping has a useful function, partly because of the shallow drafts required to load bauxite or alumina at certain ports, but also because it enables the movement of raw materials to be integrated with the movement of general cargo into the Caribbean. Among those operating such services is the Alcan group, whose subsidiary, Saguenay Shipping, operates a mixed fleet of conventional vessels, mainly under charter. Certain of these ships still ply between the Caribbean area and Port Alfred in eastern Canada with bauxite, but the principal cargo is now alumina, which originates from Alcan's two plants in Jamaica. Other examples may be cited of this type of operations, such as the service provided by Alcoa Steamship Co.

Alcoa's fleet includes two small, 15,000 DWT bulk/oil carriers designed to carry bauxite (in centre tanks) on the outward voyage from Surinam and return with either fuel oil and/or caustic soda for the alumina plant at Paranam. Like other vessles in Alcoa's fleet, these recently built ships were mainly intended to operate a shuttle service between Paramaribo and the privately operated transhipment station at Tembladora, Trinidad, and are, in fact, of barge type construction. Alcan also operates combined carriers, but the larger vessels of this type, virtually all in the 50-150,000 DWT class, have only a minor role in the bauxite trade owing to their deep-draft.

The size of ship used in the bauxite/alumina trade is possibly of greater interest than type.

The main trend over the past ten years or so has been the transition from small (i.e. less than 20,000 DWT) to medium-sized ships. Vessels of 100,000 DWT and above have been introduced into the bauxite trade but they remain the exception. Bulk carriers - mainly specialized bauxite carriers, - were able to penetrate the trade at a comparatively early date, coming into widespread use in the Caribbean area. Subsequently, with the growth of shipments from Australia and, latterly Guinea, the porportion of total seaborne trade in bauxite/ alumina transported in bulk vessels steadily increased, and is now nearly 70%.

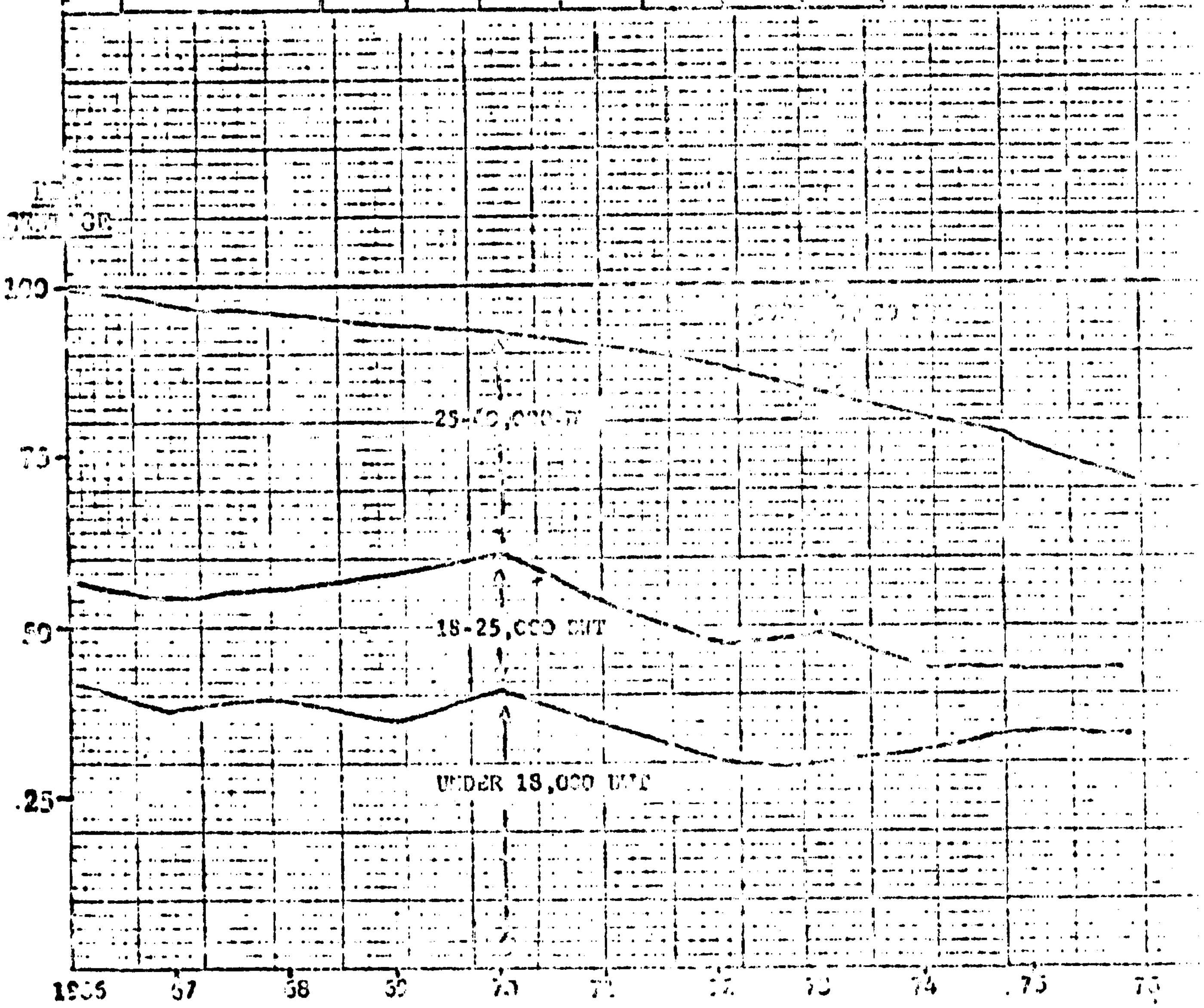
The only data on the size distribution of shipping transporting aluminium raw materials is provided by Fearnley & Eger and issued in their annual publication "World Bulk Trades". Unfortunately, it is not detailed enough to establish preferences in individual trades, merely estimating the percentage of total trade, in tonnes, handled by vessels in selected size groups. Table 7 and the accompanying graph which summarizes this data, shows that the share of the smaller mainly 'tweendeck' ships is not as low as one might have expected, remaining at over 30% through

TABLE 7

SIZES OF SHIP TRANSPORTING [illegible]

(% of Seaborne Trade in Bauxite/Alumina)

YEAR:	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Size Group: (000 DWT)											
Under 18,000	42	39	40	37	31	[illegible]	[illegible]	[illegible]	32	[illegible]	34
18/25,000	15	16	16	22	[illegible]	[illegible]	17	[illegible]	12	[illegible]	[illegible]
25/40,000	43	42	40	35	32	37	[illegible]	[illegible]	26	[illegible]	[illegible]
Over 40,000	-	3	4	6	7	10	13	17	[illegible]	[illegible]	31



SOURCE : "WORLD BULK TRADES", [illegible] to the mid 1970's. Indeed, vessels below 25,000 DWT carried 43% in 1976, compared to 53% in 1971 and 51% in 1966, this sizeable market share reflecting the large tonnages of aluminium raw materials moving short distances, or to and from ports with restricted drafts.

On the longer hauls - that is, those of 3,000 miles and longer - the trend has been to replace small and medium sized bulk carriers in the 25-40,000 DWT range with those of larger capacity in order to minimize transport costs. The statistics show that whereas the percentage of trade in aluminium raw materials carried in vessels above 25,000 DWT but below 40,000 DWT has fallen, the larger sizes have been able to increase their share from 3% ten years ago to over 30%. The participation of the larger bulk vessels, which range in size up to 80,000 DWT, or even bigger capacities, is most pronounced in the trades originating in Australia. The Australia-Europe bauxite trade alone amounted to nearly 5 million tonnes in 1976, generating a transport requirement of close to 30 thousand million tonne-miles, and, not surprisingly, shippers allocated vessels of over 60,000 DWT and above to this trade whenever possible. Even larger vessels would be used if present limitations at the ports of Weipa and Gove were removed, a bulk carrier of ± 120,000 DWT probably representing the optimum on routes to either the Mediterranean or N.W. European ports.

Elsewhere the employment of large bulk carriers in the 40-60,000 DWT category (which is estimated to have transported 17% of the total trade in bauxite/

alumina in 1976) is largely confined to the West African trade - specifically, the large volume trade in bauxite between Guinea and various European and North American ports. With the build-up of shipments from Port Kamsar, increasing reliance has been placed on the maximum size able to leave fully-laden and conveniently discharge at ports of destination, which for most routes means a vessel of at least 50,000 DWT. This policy has, of course, lowered transport costs considerably, capitalizing on Guinea's proximity to markets in Europe, as well as North America.

How the bauxite/alumina trades will evolve over the next ten years is difficult to predict but a continuation of past trends can reasonably be expected to occur. With medium and large-sized bulk carriers already participating, to a greater or lesser degree, in all the principal bauxite trades a further penetration by vessels of 40,000 DWT and upwards can be expected. Similarly, one would expect the maximum size trading with bauxite to be raised, following further port development in Australia, West Africa and other exporting countries. Shiploads of alumina will also increase in size to enable other types of ship to be replaced by bulk carriers, although it is not envisaged that individual smelters will ever be able to recieve, and store, lots much above 50,000 tonnes.

6. Port Facilities and Limitations

Both the size and, to a lesser extent, the type of vessels shipping aluminium raw materials depends ultimately on the adequacy, or otherwise, of the facilities at ports of origin and destination. Conditions at principal ports shipping or receiving cargoes of bauxite or alumina will not only determine the maximum size of ship trading with these materials but will also govern the speed with which trade is transferred to larger, more efficient, vessels.

The efficiency of ports depends on (i) the water depth alongside the berth(s), or in the approaches (ii) the average rate, in tonnes per hour, at which vessels can be loaded or discharged by the available cargo handling equipment, and (iii) the provision of adequate storage, partly to ensure quick turnaround, but also to accommodate large shipments.

Ports have, in general, undergone continuous improvement over the past decade but, even now, there are only a small number of terminals equipped to load the larger bulk vessels - defined here as ships over 50,000 tonnes capacity. The limitations at ports, or private berths, receiving shipments of bauxite or alumina are even more restricitive, the high cost of dredging berths or approach channels, of installing high capacity bulk handling equipment or providing additional storage space, preventing much needed deepening or modernisation.

Investment in improved loading facilities has been undertaken not so much on the basis of cost-benefit analysis, as with the object of enabling producers to defend their position in an increasingly competitive market by lowering transport costs, and while there are still severe restrictions in South America, necessitating transhipment, or the departure of vessels part-laden, depths of 8.5-10.5 metres are generally available at the loading end. There are, in fact, several loading ports which are open to vessels drawing more than 12 metres (or 39 feet) of water fully-laden. This depth - exceeded at major ports like Waipa and Port Kamsar - corresponds to a ship of up to 50,000 DWT, providing that the shiploading facilities permit the transfer of bauxite (or alumina) at an economic rate. Loading rates of between 3,000 and 6,000 tonnes/hour are required for large vessels, the main problem being dusting and blow-off and avoidance of wetting.

The problem encountered in north-east South America is the shallow bar at the mouths of the rivers, which limits the size of ship able to leave fully-laden to only 20,000 DWT. The possibility of developing new deeper-water facilities has been investigated but apparently without success. The various bauxite loading terminals in the Caribbean islands are accessible to medium-sized vessels of up to a maximum of 50,000 DWT, the largest tonnages being handled by the terminals in Jamaica (principally Ocho Rios and Port Rhoades). Excellent facilities are provided by Port Kamsar, Guinea - which is open to vessels of up to 60,000 DWT with tidal assistance - and major Australian terminals. Vessels of up to 70,000 DWT can berth at Weipa - reached through a seven mile long dredged channel - the depth in the approaches and at the two berths allowing even larger ships to load on favourable tides.

It is, of course, usual for bauxite loading terminals to be privately owned and used exclusively for this commodity, explaining their greater efficiency. The position at ports receiving cargoes of bauxite (or, for that matter, alumina) is somewhat different in that a large part of the trade is directed to large multi-purpose port complexes, rather than to separate terminals located alongside, or in close proximity to alumina plants (or smelters). However, when one examines the pattern of shipments it is evident that the majority of shipments are, in fact, directed to consuming plants located at, or near, tidewater with separate facilities for receiving incoming cargoes rather than to large ports linked to inland transportation systems, at which the material is transhipped to rail or barge.

Of the bauxite imported into Europe, the largest tonnage is still handled by major ports like Antwerp, Rotterdam and Emden, which possess sophisticated bulk-handling facilities, although the position has changed as new alumina plants have been located at coastal sites.

Virtually all the bauxite shipped to North America and Japan, however, passes through privately owned berths, mostly alongside alumina plants. For example, all the plants located along the U.S. Gulf coast are served by private facilities limited to vessels drawing up to 12.0 metres (or about 40 feet) laden. Each plant has, in fact, what amounts to a pre-determined pattern of bauxite supply, the ore coming from captive sources. Table 8 shows the quantities received in 1976, and the origin of shipments:-

TABLE 8

Bauxite Shipments to U.S. Gulf Coast Alumina Plants: 1976

(Million Long Tons)

To: / From:	Mobile	Baton + Rouge	Gramercy	Corpus Christi	Point Comfort	Total
JAMAICA	-	2.0	1.8	3.1	0.6	7.5
Ocho Rios	-	-	-	3.1	-	3.1
Port Kaisar	-	1.2	0.9	-	0.1	2.2
Rocky Point	-	-	-	-	0.5	0.5
Port Rhoades	-	0.8	0.9	-	-	1.7
DOMINICAN REP.	-	-	-	-	0.6	0.6
Cabo Rojo					0.6	0.6
HAITA	-	-	-	0.7	-	0.7
Miragoane	-	-	-	0.7	-	0.7
SURINAM	0.6	1.1	-	-	0.1	1.8
Paramaribo	-	0.8	-	-	-	0.8
Other Ports +	0.6	0.3	-	-	0.1	1.0
GUINEA	0.7	0.3	-	-	1.3	2.3
Port Kamsar	0.7	0.3	-	-	1.3	2.3
Total	1.3	3.4	1.8	3.8	2.6	12.9

+ includes shipments to alumina plant at Burnside from Surinam and Guinea.

Alumina shipments, arising at various locations, are more widely distributed than those of bauxite, and are frequently consigned to inland smelters, necessitating transhipment. Even so, the greater part of the trade is handled by separate, shore-side facilities owned, or controlled by aluminium companies, or their subsidiaries, which are often alongside coastal plants. Most of the smelters in Europe dependent on off-shore alumina supplies are located on, or near the coast, justifying the provision of separate unloading facilities. The same is true of those in the north-east of the United States, Japan and in other areas, such as the Near East, Africa and Latin America which are not integrated with alumina-producing facilities. The greater part of the alumina shipped to the United States, for example, is destined for smelters in the area known as the Pacific North-West (essentially the states of Washington and Oregon). Four of the nine existing smelters in the area (including the "Intalco" facility at Ferndale) are served by ports in Puget Sound - principally Tacoma, where there are specialized alumina handling facilities adjacent to the Kaiser plant. The other reduction plants in the Pacific North-West are located along the Columbia River, alumina being unloaded at Longview (Reynolds), Portland (Martin-Marietta) and Vancouver (Alcoa). While discharging rates are a limitation, vessels of up to 50,000 tonnes capacity are employed to bring in alumina from Australia, or the Caribbean.

Within Western Europe - the other major destination for alumina shipments - the largest tonnages are handled by smelters in Scandinavia (including Iceland), the United Kingdom and the Netherlands, although certain other countries such as Spain also have a sizeable import requirement. Norwegian smelters, receiving supplies from Jamaica, etc., are, almost without exception, on tidewater, and possess private shoreside facilities for handling raw materials at rates of up to 500 tons/hour. In the United Kingdom, separate provision was made for shipments of alumina when the decision was made to proceed with the construction of new smelters at Holyhead, Lynemouth (served by the port of Blyth in Northumberland) and Invergordon. There are also private facilities for receiving alumina in the Netherlands at Delfzijl (on the Ems) and Vlissingen (at the mouth of the river Scheldt).

The efficiency of many of the ports handling bauxite and alumina is more a question of the materials handling equipment available and its performance, than the physical constraints on ship size imposed by water depth, etc. Increasingly, bulk vessels of the size required rely on shore-side facilities for loading and unloading aluminium raw materials. While loading rates of up to 3,000 tonnes/hour or higher can be achieved by travelling (or slewing) shiploaders, unloading normally takes much longer.

Grabs or clam-shell units are the most common equipment at ports or terminals receiving shipments of bauxite and alumina. Discharging by this method is not only inherently slow, with 1,500 tonnes/hours about the maximum effective hourly rate, but also makes the elimination of dusting a difficult and almost insurmountable problem. The need to upgrade unloading rates is widely recognized and a great deal of research has been carried out into continuous unloaders and other innovative materials handling equipment to overcome this problem, and provide an alternative to grab discharge. Such solutions do, however, demand large capital expenditure on unloaders, conveyors, surge facilities and stacking equipment, which, in many instances, are not justified by the flow of materials into the individual alumina plant, or aluminium smelter.

Environmental considerations and the need for dust free transfer of either bauxite or alumina from shore to ship and vice-versa has also led to other developments in materials handling. These range from the "sealing" of the grab jaws to confine the free-flowing materials, through dust curtains and other devices designed to prevent pollution, to sophisticated dust-free systems. For example, the recently completed installation at [illegible], Western Australia is completely sealed and serviced by a vacuum cleaning system as well as being one of [illegible] freight loading terminals for alumina (at [illegible] tonnes/hour) ever built. Stricter pollution control requirements have also resulted in the application of pneumatic handling as a method of eliminating dusting. This is particularly important for alumina, as not only is airborne dust undesirable, but a substantial amount can be lost during transfer to the atmosphere. Unfortunately, pneumatic unloaders (or loaders) only have capacities between 100-500 tonnes/hour, which means that they have the same disadvantages of the conventional grab if one were considering the introduction of larger vessels.

Land Transport Systems

Although the bulk of this paper is concerned with the ocean transport of bauxite and alumina the importance of land transport systems must not be overlooked. Bauxite is an intrinsically low value material. It is therefore essential that highly efficient handling and transport systems are adopted in its production and delivery to the consuming plant. Often the system used to transfer bauxite from the mine site to the alumina plant or, in the case of exported bauxite, to the drying plant/stripping terminal, is one of the key factors in determining the viability of the bauxite operation (other than the quality of the bauxite and proximity to a potential market).

In considering land transportation this paper has concentrated on long distance high capacity systems. The short haul generally involving off-highway trucking or a conveyor system used to move material from the mine site direct to the alumina plant or alternatively to a central point for subsequent transhipment to a bulk handling system is usually an integral part of the mining system adopted and is not considered here.

Whilst the following discussion is confined to bauxite much of the comment applies to the transport of umina.

Other than hybrids consisting of one or more transport methods there are essentially six alternatives:-

(i)	Road
(ii)	Railway
(iii)	Trunk conveyor
(iv)	Aerial ropeway
(v)	Canal/barge
(vi)	Pipeline

To examine the economics of the alternatives is difficult as each project presents its own particular characteristics and problems involving such variables as haul distances, terrain, availability of navigable water, delivery point, etc. However, some interesting comparisons can be drawn from recent studies of alternatives considered for a particular project.

This project envisaged moving some 5M wet tonnes of material (12% moisture) over a distance of some 40KM in a straight line from mine to port. The three alternatives considered were conveyor, railroad, pipeline and barging on a newly excavated canal.

The following table shows a comparision of the capital cost and operation cost of the alternative methods considered. It should be noted that in the case of the pipeline system there are a number of almost insurmountable technical problems associated with its use. Aerial ropeway and road transport were considered inappropriate in view of the length of haul and tonnages involved.

TABLE 9

Cost Comparison for various Transportation Systems

Haul distance	**40Km**
Material	**Bauxite (12% moisture)**
Tonnage	**5 million tonnes per annum**
	(equivalent to 4.4 million tonnes dry basis)
Cost Estimates	1976 US dollars (dry basis)

System	**Material Size**	Capital Cost U$ millions	Direct Operating Costs **U$/tonne**	Capital Servicing ø **U$/tonnes**	**Total Cost U$/tonne**
Railway	-8cm	40	0.40	1.82	2.22
Trunk Conveyor	-9cm	30*	0.30*	1.36	1.66
Canal/barge	-8cm	66	0.12	3.00	3.12
Pipeline	-0.2mm	20	0.25	0.91	1.16
Pipeline	-2mm	35	0.85	1.59	2.44

ø **Based** on 20% of capital cost, to cover interest charges @ 12½% and a return of capital over 15 years, plus all ancillary financing charges.

* **Based** on figures supplied by Cable Belt Ltd., Camberley, England, for a typical installation without adverse terrain.

The canal/barge option has considerable operating cost advantages but the high and probably uncertain capital cost makes it an unlikely choice.

The two pipeline systems considered were arrived at after tests established that pumping coarse material (-5cm) was not practical due to the high pressure losses resulting from the high velocity necessary to maintain the particules in suspension. Pressure losses of the order of 280 p.s.i. per Km were anticipated. In order to handle such coarse material centrifugal pumps would have to be used providing only about 500 p.s.i. per station. Minus 2mm material could be pumped, but again at excessive capital and operating cost due to pressure losses of 160 p.s.i. per Km. The only economic alternative of minus 0.2mm resulted in a marked reduction in capital and operating costs as pressure losses of only 32 p.s.i. could be expected. Nevertheless the pipeline option was disgarded as slurry transport of bauxite creates considerable handling problems and dewatering problems at the port site and alumina plant whilst degradation within the pipeline was unpredictable without large scale testing. Although the fine bauxite product would be suitable to feed a specifically designed alumina plant it would be difficult to market the product as most existing alumina plants would be unable to handle the material.

The railway option although high in both capital and operating cost would become competitive at significantly higher tonnages say 10-12 million tonnes per annum.

The trunk conveyor utilising the well tried cable-belt system is the best alternative. It had the advantage of low capital and operating cost without the disadvantages associates with slurry systems. It offered considerable operating flexibility as the capacity of the system could be doubled at low capital cost by increasing the belt speed.

TABLE 9

World Seaborne Trade in Bauxite and Alumina

Analysis by Exporting Area

Bauxite (Millions Tonnes)

	1966	1976(P)	1986(E)
Caribbean	8.2	8.3	18.0
South America	6.6	3.9	
West Africa	0.7	9.6	16.0
Australia	0.9	7.3	8.0
Far East	1.7	2.0	2.0
South Europe	2.6	1.8	0.5
Other Areas	0.4	0.3	0.5
Total	21.1	33.2	45.0

Alumina (Millions Tonnes)

	1966	1976(P)	1986(E)
Caribbean	0.8	1.7	4.5
South America	0.7	1.6	
West Africa	0.5	0.5	2.0
Australia	-	4.5	8.0
South Europe	0.2	0.6	0.5
Total	2.3	9.1	15.0

Source: H.P. Drewry
Fearnley and Egar
Brook Hunt & Associates

Forecasts: Brook Hunt & Associates

8. **Forecast Trends in Transportation of Bauxite and Alumina**

What will be the dominant influences in the volume and paterns of trade in the period to 1986? Firstly the rate of growth in world aluminium demand is unlikely to maintain the historic average of 7.0% p.a. Although significant growth in aluminium consumption should occur in the transport, automobile, container and packaging industries (particularly canstock outside North America) these are unlikely to entirely off-set the slower growth in high volume industries such as construction and consumer goods. These factors, together with a slower growth in the world economy are likely to result in the rate of growth for primary aluminium consumption declining to between 4-4½% p.a. in the 1980's. Other significant factors which could influence world bauxite and alumina trade in the current decade include:

(i) The trend towards greater fragmentation of the world's aluminium industry with new smelter capacity being increasingly located away from the traditional areas of N. America, Europe and Japan. In particular the growing importance of South America, as a producer and consumer of both bauxite and alumina, together with the likely rise in alumina imports into Middle Eastern countries.

(ii) East-west trade in aluminium raw material is expected to increase whilst greater competition could develop between existing bauxite and aluminium producers and new sources of production in both eastern and western countries.

(iii) Despite increasing competition Australia should be able to continue expanding its dominance of the world alumina trade as shown in Table 9.

(iv) The underlying costs of transporting raw materials will continue to rise ultimately affecting competitive relationships between bauxite and alumina producers and encouraging a further rise in the alumina component of seaborne trade.

(v) Despite limitations on acceptable shiploads, due to stocking and other considerations, improvements at ports and terminals will continue enabling larger vesselsto be used with an increasing share of the bauxite trade being handled by medium and large size vessels in the 40-100,000 DWT range. Similarly for alumina bulk vessels in the 20-50,000 DWT range, particularly on longer routes, will be employed to reduce costs and improve handling efficiencies. Whilst cost and environmental considerations will encourage investment in new and improved cargo handling equipment which, in turn, will aid the progressive increase in sizes of shipload acceptable to alumina plants and aluminium smelters.

In the short term there are signs of a modest growth in international trade in 1978 despite the continuing economic problems. This hope for improvement will not, however, restore equilibrium between supply and demand for bulk shipping and this excess capacity will prevent any significant rise in freight rates. The current effective surplus in the dry bulk shipping market is some 20 million DWT which compares with a total fleet capacity of some 150 million DWT. The indicated surplus of 7½% compares with the 12% laid up capacity in the tanker market. Although it can be argued that an upterm in the world's steel industry would immediately absorb the overcapacity in the dry bulk fleet there appears little likelihood of this occurring until well into the 1980's. In the interval there is every possibility of a further decline in world shipments of metallurgical coal and iron ore. At the time of writing the Japanese are reported to be attempting to negotiate reductions in shipments from Australia of 25% for both iron ore and coking coal.

In summary the next three years or more will continue to favour those producers of bauxite and alumina with long shipping distances. In the longer term the increasingly competitive environment for alumina and bauxite producers will provide the incentive for improving efficiencies in all transport systems utilised by the industry.

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