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INDUSTRY AND DEVELOPMENT

IN UGANDA

VOLUME III

prepared for

THE GOVERNMENT OF THE REPUBLIC OF UGANDA

on behalf of

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

L. H. MANDERSTAM AND PARTNERS LIMITED

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LONDON, S.W.1

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August, 1976

VOLUME III

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BOTTLED BEVERAGES

I SUMMARY

The two breweries and the main mineral water factory in Uganda are operating at less than half their productive capacity because of shortage of foreign exchange for raw materials. Most of the raw materials are now imported. Efforts should be directed towards import substitution.

The following steps are suggested, with foreign technical assistance as needed :

(1) the development of a flavour industry in Uganda for mineral waters and food, based on locally grown materials;

(2) the development of a beer brewed from local cereals (millet, maize) or other crops for production in a modern brewery;

(3) the development of strains of malting barley which can be grown in selected regions of Uganda.

As a first step, it is suggested that the plant of Nile Breweries Ltd. at Jinja be shut down, production concentrated at Uganda Breweries Ltd. and costs thereby be reduced. Part of the Nile brewery should then be converted into a pilot plant for the production of a beer made from local crops.

II BACKGROUND

In Uganda, as elsewhere, most people have acquired a marked taste for bottled beer and for aerated beverages flavoured with alkaloids or less addictive fruit essences. These might, at first thought, be considered as typically European or American drinks, but it may be worth while to remember that beer or 'bourzah' made from malted barley was popular in Egypt in 3000 BC.

These drinks now produced in Uganda are made in European style in factories using mainly imported ingredients. Among many middle class Ugandans, they have largely usurped the place of the more traditional plantain wine known as pombe. The traditional wines are fermented in earthenware jars and drunk while still fermenting through hollow bamboo canes. They have been studied by the Department of Food Sciences of the University of Strathclyde who find them to have a far higher nutritive value than their modern filtered, pasteurized and bottled counterparts. They contain a good deal of suspended vegetable matter rich in protein carbohydrates and vitamins B.1, 2 and 3.

Because of shortages of foreign exchange with which to purchase raw materials and spare parts, the bottled beverage industry in Uganda today is operating at well below its rated capacity.

In assessing the relative needs of the country there will be questions of priority. Should beer have priority over shoes or bicycles ?

What priority should be given to beer bottles ? Boots, at present, might be considered socially more essential than beer. If more bottled beer were available, at the expense of boots and shoes, would it be the higher paid middle class who went unshod, or the Shamba boy, who cannot afford bottled beer anyway ? These are questions for people in Uganda to decide, knowing the conditions of their own country and balancing questions of employment provided and resources utilised.

II.1 Beverage Production in Uganda

Uganda has two modern breweries, both operating, as well as one firm intended to supply Chibuku, an East African bottled beer, made from local cereals (this is discussed later). There are also several mineral water bottling plants and a distillery. Time only allowed us to visit the two breweries and the principal mineral water and soft drink bottler, Victoria Bottling Co. Ltd. No reference had been made to Uganda Chibuku Ltd in Uganda, and the team only learned of its existence after their departure from Uganda. In Tanzania, Chibuku is a popular local bottled beer brewed in modern conditions at Dar es Salaam, from locally grown millet with possibly some maize added. In Kenya, Chibuku is again, the name of a local bottled beer, but we understand that in Kenya it is brewed from locally grown and malted barley by Kenya Breweries Ltd. We could find nobody who could give us any information about its production in Uganda. Among the soft drinks and mineral water factories, Lake Victoria Bottling Co. Ltd was said to be by far the largest. In normal conditions, it has about 90% of the Ugandan market. Apart from shortages of imported raw materials, both Victoria Bottling Company Ltd and Uganda Breweries Ltd were in difficulties at the time of our visit, owing to the breakdown of the carbon dioxide production plant at Jinja.

Production of Waragi, bottled beer and soft drinks in Uganda had all been increasing steadily throughout the 1960's and early seventies to reach their peak in 1973, as Table El.I shows :

Table El.I

Production of Waragi, Beer and Soft Drinks in Uganda

Litres '000s

	Waragi	Beer	Soft Drinks
1966	238	19,682	13,500
1967	258	20,594	12,098
1968	365	19,789	11,582
1969	396	21,014	12,189
1970	563	27,767	13,665
1971	598	34,962	17,284
1972	729	37,945	20,048
1973	910	45,593	15,279
1974	773	43,487	12,792

Sales of Ugandan made beer and Waragi in 1971, '72, '73 and the first three quarters of 1974 in volume and value are given in Table E1.II.

Table E1.II

Sales of Ugandan beer and Waragi

Year	Beer		Waragi	
	litres '000s	value Shs '000s	litres '000s	value Shs '000s
1971	43,922	62,661	600	8,152
1972	38,050	71,433	733	9,641
1973	45,749	104,889	895	12,240
(1974 to end Sept.)	(31,807)	(67,090)	(561)	(9,977)

From information obtained during visits to the breweries in Uganda, it is clear that production has fallen considerably since 1974. (pp 4 and 5)

II.2 Foreign Trade in Beverages in 1973 and 1974

Imports, exports and re-exports of alcoholic and non-alcoholic beverages in 1973 and 1974 are given in Tables E1.III and IV. (pp 4 and 5).

Imports are broken down into those imported from outside the East African Community and those originating within it. Most imported beverages come from outside the Community though substantial quantities of beer, (categorised as stout in 1974) and 'other non-alcoholic beverages' (perhaps Chibuku?) were imported from other EAC countries.

Exports are broken down into re-exports, and exports of Ugandan produced beverages to countries outside the EAC (mainly Rwanda and Sudan). There were no recorded exports of beverages to other EAC countries (Kenya and Tanzania) in 1973 and 1974, and in 1974 there were no recorded exports of any Ugandan produced beverages.

Total imports of alcoholic beverages before payment of duty dropped from just over 11 million Shs. in 1973 to under 5 million Shs. in 1974. Total exports and re-exports of alcoholic beverages fell from 93 thousand Shs. to 77 thousand Shs. The imports of alcoholic beverages in 1973 amounted to slightly under 10% of the value of home produced beer and Waragi.

Table El.III

Imports and Exports of Beverages 1973

Code	Description	IMPORTS							EXPORTS					
		From Outside EAC			From EAC members		Total		Re-exports		To outside EAC		Total	
		litres	value Shs	duty Shs	litres	value Shs	litres	value Shs	litres	value Shs	litres	value Shs	litres	
11.011	Soda and spa waters													
111.021	Lemonade and flavoured spa and aerated waters	699	12,530				699	12,530			10,578	34,474	10,578	34,474
111.029	Other non-alcoholic beverages	1,141	20,975	3,459	250,611	736,179	251,752	757,154			163	2,800	163	2,800
	Totals, Non-Alcoholic beverages	1,840	33,505	3,459	250,611	736,179	252,451	769,684	nil	nil	10,741	37,274	10,741	37,274
112.	Alcoholic Beverages													
112.121	Stillwines, unbottled	40,250	227,456	113,559			40,250	227,456						
112.122	Stillwines, bottled	78,086	906,903	315,341			78,086	906,903	175	9,358	-	-	475	9,358
112.123	Champagne	3,366	117,885	28,937			3,366	117,885	11	508	-	-	11	508
112.124	Other sparkling wines	7,370	69,328	24,913			7,370	69,328	117	1,425	-	-	117	1,425
112.131	Vermouths and aromatic flavoured wines, unbottled	21,088	111,353	70,280			21,088	111,353	-	-	-	-	-	-
112.132	Vermouths and aromatic flavoured wines, bottled	6,757	56,922	24,926			6,757	56,922	18	219	-	-	18	219
112.200	Cider and other fermented beverages NES	17,988	170,650	109,257			17,998	170,650	-	-	-	-	-	
112.300	Beer (incl. ale, stout, porter)	18,818	78,432	43,473	720,800	3,014,331	739,618	3,092,763	168	391	-	-	168	391
112.401	Brandy	41,420	1,511,023	2,252,036	-	-	41,420	1,511,023	48	1,662	-	-	48	1,662
112.402	Gin and Geneva	8,703	121,047	194,549	3,120	32,481	11,823	153,528	285	12,174	-	-	285	12,174
112.403	Whisky	95,006	2,192,886	3,106,475			95,006	2,192,886	397	9,511			397	9,511
112.404	Rum	416	4,802	6,998	-	-	416	4,802	40	1,440	-	-	40	1,440
112.405	Other potable spirits NES	16,057	1,342,522	316,800	780	9,445	16,837	1,351,967	14	410	5,468	56,318	5,482	56,728
112.406	Liqueurs and other spirituous beverages	17,940	1,204,742	345,170			17,940	[illegible]						
	Totals, Alcoholic	373,275	8,117,931	5,952,774	724,700	3,056,257	1,097,975	11,173,208	1,573	37,098	5,468	56,318	7,041	[illegible]
	Grand Totals	375,115	8,150,436	5,956,233	975,311	3,792,43[illegible]	1,350,426	11,942,892	1,537	37,098	16,209	93,592	17,782	[illegible]

Table El.IV

Imports and Exports of Beverages, 1974

Code	Description	IMPORTS							EXPORTS					
		From Outside EAC			From EAC members		Total		Re-exports		To outside EAC		Total	
		litres	Value Shs	duty Shs	litres	Value Shs	litres	Value Shs	litres	Value Shs	lit-res	Value Shs	litres	Value Shs
111.011	Soda and Spa waters	-	-	-										
111.021	Lemonade and flavoured spa and aerated waters	-	-	-	46	161	46	161	-	-			-	-
111.029	other non-alcoholic beverages	-	-	-	238,497	774,349	238,497	774,349	-	-			-	-
	Totals non-alcoholic beverages	-	-	-	238,543	774,510	238,543	774,510	-	-				
112.	Alcoholic Beverages	-	-	-	-	-			-	-			-	-
112.121	Still wines, unbottled	47,245	264,161	103,284	-	-	47,245	264,161	-	-			-	-
112.122	Still wines, bottled	39,723	451,469	375,278	-	-	39,723	451,469	55	1,516			55	1,516
112.123	Champagne	3,261	167,407	46,840	-	-	3,261	167,407	238	10,601			238	10,601
112.124	Other sparkling wines	4,258	38,141	37,738	-	-	4,258	38,141	226	4,117			226	4,117
112.131	Vermouths and aromatic flavoured wines, unbottled	16,124	83,798	55,579	-	-	16,124	83,798	-	-			-	-
112.132	Vermouths and aromatic flavoured wines, bottled	24,618	195,051	190,809	-	-	24,618	195,051	10	264			10	264
112.200	Cider and other fermented Beveragesm N.E.S.	5,200	28,889	33,751	-	-	5,200	28,889	-	-			-	-
112.301	Stout in bottles	-	-	-	163,238	617,523	163,238	617,523	-	-			-	-
112.309	Other beers	-	-	7,607	62	190	62	190	-	-			-	-
112.401	Brandy	26,667	1,058,395	1,061,926	-	-	26,667	1,058,395	300	12,162			300	12,162
112.402	Gin and Geneva	630	45,547	69,320	-	-	630	45,547	284	5,069			284	5,069
112.403	Whisky	58,968	1,165,686	3,020,355	-	-	58,968	1,165,686	1,681	34,099			1,681	34,099
112.404	Rum	-	-	2,446	-	-	-	-	-	-			-	-
112.405	Vodka	1,794	26,566	45,003	-	-	1,794	26,566	143	1,771			143	1,771
112.401	Liqueurs and other spirituous beverages	10,910	736,481	247,213	1,032	15,460	11,942	751,941	103	2,272			103	2,272
	Totals alcoholic beverages	239,398	4,261,591	5,301,754	164,332	633.173	403,730	4,894,764	3,045	71,871	nil	nil	3,045	71,871
	Grand Totals	239,398	4,261,591	5,301,754	402,875	1,407,683	642,273	5,669,274	3,045	71,871	nil	nil	3,045	71,871

Vodka appeared as a separate coded item in the list of imports for the first time in 1974. We had the impression during our stay in Uganda that imported beverages of every kind are in very short supply, so that imports have probably fallen further since 1974.

III. THE PRESENT STATE OF PRODUCTION

III.1 Non Alcoholic Beverages

Lake Victoria Bottling Company Ltd

This company, which we were told has a paid-up capital of slightly less than 5 million Shs., was acquired by the Government of Uganda in February 1973. It has a single factory, in Kampala, in which various proprietary mineral waters are produced from (mainly imported) concentrates sugar, chemicals and water. They are then chilled and carbonated (with carbon dioxide from cylinders) filled into previously cleaned and sterilized glass bottles and capped with crown corks. The company has about 180 employees. Its main products are Pepsi-Cola and Miranda (a lemon flavoured mineral). It also produces smaller amounts of Schweppes minerals, 'Schwop' American Ginger Ale, lemonade, tonic water and bitter lemon.

Pepsi-Cola and Miranda each have their characteristic bottle. There is a single type of bottle used for all Schweppes products which are distinguished by their labels.

We were given details of volumes and value of production of each product for 1974 and 1975, which are shown in Table El.V.

Table El.V

Lake Victoria Bottling Company Ltd

Products, Plant Capacity, Volume and Value of Production

Product	Litres ('OOOs) per year		Shs ('OOOs) per year	
	Installed Capacity	Product Volume 1974	Product 1974	Value 1975
Pepsi-Cola	9,904	6,145	14,776	8,167
Evervess	162	27	66	33
Miranda	3,234	2,414	5,804	2,881
'Schwop'	901	269	646	648
Ginger ale	102	40	95	109
Lemonade	71	18	43	54
Tonic Water	51	23	56	54
Bitter Lemon	173	125	300	109
Total		9,061	21,786	12,055

Sales in Uganda and selling prices in 1974 are given in Table E1.VI.

Table E1.VI

Lake Victoria Bottling Company Ltd
Sales in Uganda 1974

Products	Price per litre ex factory	Quantity '000 litres	Value Shs. ('000s)
Pepsi Cola, Evervess Miranda	2.57	8,516	21,851
Schweppes products	3.22	471	1,520

Production has fallen from about 2.5 million cases (each containing 24 bottles with about 200 c.c. of liquid) in 1971-72 to 1.5 million cases in 1973, 1.3 million cases in 1974 and 0.8 million cases in 1975.

The main factor restricting production is shortage of foreign exchange with which to purchase raw materials, bottles and carbon dioxide from abroad.

The low production in 1974 was caused by a shortage of bottles of reasonable quality. This was alleviated, in 1975, by the purchase of approximately 1.3 million bottles from Kenya and Singapore, but in that year the company was obliged to purchase most of its sugar abroad. Supplies of carbon dioxide (compressed, in cylinders) from the Jinja plant are insufficient and the company therefore also imports most of its carbon dioxide from Kenya.

The raw materials used by the company in 1974 are listed in Table E1.VII.

Table E1.VII

Lake Victoria Bottling Company Ltd

Raw Materials used in 1974

Source	Raw Material	Quantity	Value Shs. (000's)
Uganda	Sugar	714,740 kg	1,393,744
	Carbon dioxide	5,610 cyls	56,100
Kenya/Tanzania	Concentrates	N.A.	2,568,447
	Carbon dioxide	69,707 kg	230,033
	Crown corks	224,562 gross	727,825
	Chemicals	N.A.	40,115
Other Countries	Sugar	419,638	1,489,716
	Total		6,507,980

We were advised that the company requires a foreign exchange allocation of over 7 million Shs. for 1976, but were not clear to what production level this figure was related. The actual allocation so far received is extremely small and production is likely to be still lower than in 1975. When visited, the factory was at a standstill for lack of sugar and carbon dioxide. The plant also clearly needed a good deal of maintenance. Company officials could give no clear picture of the bottle requirements of the factory : there was said to be a tendency on the part of customers to hoard bottles, but nevertheless the factory had a large stock of empty bottles (about half a million). For a sale (and circulation rate) of a million cases a year, each with 24 bottles, and an overall loss of 5% of circulation, we would expect a bottle consumption of 1.2 million per year, with an average weight per bottle of 420 grams. We were told that the loss of bottles in the factory itself was under 2% on the circulation rate, so that our estimate of the rate of loss at 5% on circulation may be high. On the other hand, special factors in Uganda tend to increase the present loss of bottles in circulation. We noted shortage of bottle openers, in hotels and bars. One popular method of opening a bottle is to use a second one which is held inverted. The crown cork of the bottle to be opened is then carefully prised off with that of the other. This method requires a special skill and, until the required technique is acquired, many bottles are broken. Teeth and door fasteners are also used to remove crown cork tops.

Proprietary mineral water bottles are also appropriated for many other purposes including the handling of non-proprietary brands of beverages.

Bottles, however, are a less important requirement among the imported inputs to the factory than sugar and concentrates. It is here that the greatest savings could be made by using indigenous products. Restoration of sugar production to its former level is high on the list of Uganda's priorities and clearly there should then be no need for Uganda to import sugar for her mineral water manufacture. Consideration should also be given to the use of local natural flavours, in place of imported flavouring compounds, which are apparently obtained mainly from Kenya.

We suggest that there is considerable scope in Uganda for the development of a small flavouring industry based on home grown materials for foods as well as beverages, and that this would be a worthwhile project for outside technical assistance.

III.2 Beer

Uganda Breweries Ltd. in Kampala is the larger of the two breweries.

II.2.1 Uganda Breweries Ltd

The Company has a paid up capital of nearly 46 million Shs. Ownership is mainly Kenyan and Tanzanian, with a very small holding (less than 1%) by Ugandan private capital. Two types of beer are brewed: Bell, a British type top fermented ale, and Pilsner, a bottom fermentation lager. The brewery has a total installed capacity of 36 million litres per year. Volume and value of sales in 1974 are given in Table El.VIII. (p.9).

Table E1.VIII

Uganda Breweries Ltd. Sales in 1974

Product	Ex-factory price Shs./litre	Volume sold litres	Value Shs.
Bell (light ale)	7.28	26,042,054	189,568,153
Pilsner	7.6	1,370,634	10,416,818
Total		27,412,688	199,984,971

The number of employees has apparently risen from 480 in 1974 to between 600 and 650 now, although production has dropped to about 5000 crates per day, each containing 25 half litre bottles. This amounts to about 18 million litres per day.

Quantities, prices and value of raw materials used in 1974 are given in Table E1.IX.

Table E1.IX

Raw Materials used by Uganda Breweries Ltd
in 1974

Origin	Material	Unit	Unit price Shs.	Quantity bought	Value Shs.
Uganda	Sugar	kg	2.44	590,090	1,439,820
	Water	litres	0.06	9,800,000	587,800
	Electricity				778,960
	Labels	1000 pieces			71,260
Kenya	Crown corks	gross			1,198,680
Australia	Malt	kg	3.04		9,151,880
Belgium	Hops or hop extract	"	66.08		752,880
Denmark West Germany France, UK Yugoslavia	Adjuncts				136,140
					14,117,420

Sugar now has to be imported. There appears to have been a partial switch to Kenyan malted barley since 1974. Suggestions have been made to develop and grow a suitable malting barley in Uganda. Barley can be grown in Kigesi and on the slopes of Mount Elgon, but the climate in Uganda appears too even to suit the usual malting barleys grown in Europe. Since beer is a very popular drink in Uganda in spite of its high price, it is recommended that technical assistance should be made available for the selection and growing of malting barleys in Uganda and, if this is successful, for malt production also. It is however unlikely that hops can be grown successfully in Uganda.

One raw material not discussed is carbon dioxide. Although the brewery should in theory produce a surplus of carbon dioxide over that required to carbonate the beer before bottling, in practice this does not happen because of numerous leaks on the covers of vessels. At present carbon dioxide is being imported from Kenya, because there is not enough available from the plant at Jinja (which has broken down). If a concerted effort were made to locate and rectify the leaks on the plant, this import of carbon dioxide could be avoided.

The bottles used are standard half litre 'Eurobottles'. At the present annual rate of bottle circulation, 36 million with a loss of 5% on circulation, bottle requirements should be 1.8 million per year. Requirements last year were higher, owing to the poor quality of the bottles then produced by East Africa Glass works at Kampala.

II.2.2 Nile Breweries Ltd, Jinja

This brewery, now nationalised, was formerly owned by the Madhvani group. It has total assets valued at approximately 40 million Shs. It is about three quarters of the size of Uganda Breweries Ltd, and produces lager beer only, by a bottom fermentation process for which the soft water of the Nile is very suitable. The brewery has a capacity of 7,500 crates (each with 25 bottles) per day when operating on a 5 day week. At present it is operating at less than half capacity, i.e. at a rate of 3,000 crates per day on a 4 day week, producing about 7.5 million litres of lager per year. Most raw materials are imported (as with Uganda Breweries) but Nile Breweries tend to use malt exclusively instead of part malt and part sugar. (According to brewery officials, there would be little economy, at today's prices, by substituting sugar for part of the malt used).

The brewery is faced with many problems of maintenance and replacement of equipment, much of which is old and obsolete. Approximately three million Shs. are needed to replace old and worn equipment, such as lakeside water pumps and a 22 year old ammonia refrigeration compressor. The brewery also needs a part-load standby electrical generator valued at Shs. 140,000 Shs. for emergency supply when UEB power fails in heavy electrical storms. We were told that such failure had happened on several occasions, causing loss of brews valued at considerably more than the cost of the emergency generating equipment.

Despite the age of the brewery it is self sufficient in carbon dioxide. If a special effort were made to eliminate gas leaks, the brewery could provide a surplus of carbon dioxide, some of which might be supplied to mineral water manufacturers.

In 1975, 3.2 million standard half litre bottles - not of the best quality-were bought abroad at a cost of 2.8 million Shs. (87.5 cents). The breakage rate is higher on new bottles (about 10%) than on used bottles (2.5 to 3%) from which the weak bottles have been eliminated. If the quality of the bottle were better, the breakage rate should not be more than 4% on new bottles. Bottle usage at the present time is estimated at two million a year or 800 tons of bottles a year.

II.2.3 General Suggestions on Breweries

In broad terms, both breweries are operating at far below their rated capacities through lack of foreign exchange with which to purchase raw materials from abroad. The right direction for the breweries therefore lies in import substitution. Most countries brew their alcoholic beverages from home grown crops, and there is no reason why Uganda should not be able to do the same.

As a first step, we suggest that the Nile brewery should be closed. Production should then be concentrated at Uganda Breweries in Kampala. This would greatly reduce the costs of overheads. It might be possible to make some of the plant and equipment at Jinja available as spares for the Kampala plant; but too much should not be expected of this as the breweries are dissimilar in many ways.

As a second step, we would recommend that part of Nile Breweries be converted to serve as a pilot plant for the development of a beer grown from Ugandan hops. Millet, plantain and maize are all possible raw materials. If this suggestion were adopted, the best technical staff would be kept at Jinja, together with a skeleton operating and engineering crew. The team might be strengthened by foreign experts with experience in the brewing of beers from alternative crops and in their marketing.

In Tanzania, the millet beer or Chibuku is very popular and millet might well be the first choice for Uganda, since it is grown extensively in certain parts of the country. The final choice of raw materials can only be decided when a successful product has been developed in the pilot plant at the Nile factory and been accepted by the beer drinking public.

The raw materials and brewing conditions must also have been sufficiently standardized to ensure that the same result can be guaranteed in successive batches. If and when that stage is reached the Nile brewery could be modified for Chibuku production and modernized at the same time. It will be several years before this situation is likely to be reached. There would be time enough then to decide whether to retain Uganda Breweries Ltd as a barley beer brewery or whether to switch this also to Chibuku.

It is also suggested that some effort should be devoted to the development of malting barley in Uganda, as beer brewed from it will probably always find a ready market.

APPENDIX E2

BUILDING MATERIALS

I. SUMMARY

Modern non-traditional building materials are used in Ugandan towns and large villages on main roads but the rural mass of the population still uses traditional materials, reeds and murram block, sun-dried bricks and unsawn timber.

The burnt clay (brick and tile) and cement industries in Uganda are discussed in this Appendix. The brick and tile industry, which uses good quality local clays, and agricultural wastes or wood as fuel, is in a relatively healthy state. There is scope for establishing similar but smaller brickworks in other parts of the country (eg. West Nile) because of the high cost of transporting bricks from existing brickworks (e.g. Uganda Clays near Kampala). Suitable ball clays for brick making appear to be fairly widely distributed in Uganda (particularly in swampy areas).

The cement industry faces serious technical and financial problems. It needs technical assistance and capital to overcome them (especially in overcoming the problems of No.1 kiln at Hima and to complete and commission No.2 kiln there). The industry must develop local wood fuels as an alternative to the use of expensive imported fuel oil. The long term future of the cement industry in Uganda is in doubt,owing to the scarcity of suitable limestone deposits.

As a matter of long-term policy, there is a case for encouraging greater production and use of burnt clay products and treated timber, restricting the use of cement and concrete to purposes such as dam building, for which it is essential.

A project proposed by the Central Materials Laboratory (whose services appear to be under-utilized) to study, develop and demonstrate low cost housing for rural areas deserves greater support and encouragement.

II. BACKGROUND

II.1 Traditional Materials

Traditional materials in Uganda, as in most of Africa, are mud wattle daub, murram blocks, stone and sun-dried bricks for walls, trunks and branches of trees, papyrus and grass thatch for roofs. In heavy rain, the traditional roof soon leaks and starts to disintegrate. Water seeps through to the walls, softens the clay and in time washes it out. Damp unprotected timber soon decays or is attacked by termites and other insects.

II.2 Innovations

The most widely used innovation is corrugated galvanized iron, introduced at the turn of the century for roofing. This protects traditional walls and timber, as well as the occupants, from rain.

It has been made for several years in Uganda by Uganda Baati Ltd. in Kampala, and Uganda Steel Ltd. at Tororo, from imported raw materials, although its production has declined in recent years owing to foreign exchange problems. Figures are given in Table E2.I along with those of cement.

Table E2.I

Production of Cement and Corrugated Iron Sheets in Uganda[1]

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1973
Corrugated iron sheets tonnes	10,094	9,473	9,910	11,632	11,914	14,341	12,860	5,139	3,964
Cement '000 tonnes	122	140	155	173	191	205	166	143	153

The making and use of fired clay bricks and tiles, lime mortar, and sawn timber is usually first associated with Christian missionaries in the nineteenth century[2]. Cement manufacture commenced later in 1955, and asbestos cement sheet, pipe and guttering shortly afterwards. Insulated electric cables have been made since 1967. Paints, plastic pipe for plumbing, nails and fastening, and door and window frames, have been produced in Uganda for a number of years. A great many materials required for modern buildings (copper water pipes, door locks, sanitary fittings) still have to be imported.

II.3 Town and Country Housing

Housing standards in Uganda show great contrasts. While most town houses are provided with electricity, piped water and main drains, and are of modern materials, the bulk of the rural population lives in scattered dwellings of more or less traditional materials, without piped water, electricity or sewers.

II.4 Rural Housing Development

Rural development and housing usually go together. There is probably a general desire among peasants for better housing, but few can afford to build a modern house. A revolution in rural housing will have to be accompanied by a great increase in communal living and this makes it easier to provide water and electricity. Churches, schools, hospitals, administrative offices and stores usually spearhead the change to modern building materials. There is a need for low cost modern rural housing in Uganda and for training of builders. A project to develop, demonstrate and test low-cost rural houses had been proposed by the Central Materials Laboratory, Kampala, but this so far seems to have been unanswered. High transport cost of building materials in the countryside is but one problem of rural housing.

III. BURNT BRICKS, TILES AND OTHER CLAY PRODUCTS

III.1 Uganda Clays Ltd

This appears to be the main brick company in Uganda. It produces a range of extruded hollow bricks, roofing tiles, ridges, hollow blocks, hollow floor sections, pipes, channels and grilles (for garden walls, etc). The works are at Kajansi 13 km south of Kampala, on a 200 acre site which has large deposits of excellent ball-clay. Both are owned by the Westomat Group (Swiss) which started and still manages similar businesses in Kenya and Tanzania. The site together with a primitive brickworks, was bought by the Westomat Group in 1956. They proceeded to construct a new continuous Hoffman kiln from refractories produced on the spot. The Hoffman kiln was commissioned in 1958, with clay handling and conditioning equipment, a Morondo extruder capable of forming several different hollow bricks and blocks and a drier for drying the extruded bricks before they are loaded into the kiln. The kiln is not only thermally efficient but also uses inexpensive coffee husks as fuel. These are bought from the coffee processing plant in Kampala. The works and all equipment bought for it have been planned and selected for ease of maintenance. Its progress has been one of steady development and it has suffered less from the 1972 "economic war" than most industries. Employee relations appear good; we were informed that employees have assisted in building their own (brick) homes. The present production rate of bricks and tiles, and other ball-clay products is 2,000 tonnes/ month compared with a nominal plant capacity of 25,000 to 30,000 tonnes per year. There appeared to be an undue proportion of second quality or off-specification bricks, the price of which does not appear to be controlled.

The revenue from sales of bricks and tiles, in 1975, was 6 million Shs. (i.e about 240 Uganda Shs.per tonne, which is very low). Although we did not get quantitative information on all financial matters, we considered that the company should be profitable. But the situation is an artificial one because, we were told :

1. profits have not been allowed to be repatriated for several years;

2. the official selling prices are frozen; but because demand exceeds supply and there is little or no local competition, an unofficial market has developed in bricks and tiles, which even extends to the second-hand.

It is possible that Westomat would prefer to sell the brickworks to the Government and be appointed solely as technical consultants.

In 1975, the company were allowed to import spare parts and replacements for lorries and excavators worth 250,000. Shs.and plant and machinery spares worth 400,000 Shs.although this was barely half their requirements. Transport of bricks to Kampala and of coffee husks from Kampala is now very expensive. Former exports to Kenya have ceased owing to local market demands and transport problems. It seems that the main cost of bricks in many parts of Uganda is the transport cost, rather than the cost of brick manufacture.

III.1.1 Refractories Gobott

Uganda Clays has a sister company, Gobott, on the same site, set up to make refractory bricks from kaolinite (quarried when Entebbe airport was constructed) and glazed wall and floor tiles. This plant is not yet operational owing to delays in construction (mainly import difficulties). The company also has access to other Uganda minerals for special refractories, topaz, kyanite and white kaolin. Many products which can be made on this plant when it starts up, especially boiler furnace bricks, are now imported.

III.2 Other Brickworks

The following other brickworks in Uganda[3] are listed but details about them are not available.

Table E2 II

Other Listed Brickworks in Uganda

Name of Works	Address	District
Pecamega (White Fathers Mission)	P.O.Box 150, Mbarara	Ankole
Semu Baryaha	P.O.Box 52 Kabale	Kigese
Saint Josephs College	P.O.Box 123 Gulu	Acholi

A spokesman of the Ministry of Information told us that a brickworks has been established by the Chinese on the site of their Kibemba rice scheme to produce 50,000 bricks per day using firewood as fuel. This plant would be of comparable size to Uganda Clays' works.

There appears to be considerable scope for the production and use of fired clay bricks, tiles and other products in Uganda and the industry should be encouraged with technical and financial assistance.

IV CEMENT - UGANDA CEMENT INDUSTRIES LTD

Cement is made in Uganda exclusively by Uganda Cement Industries Ltd. at its two works at Tororo and Hima. The company was incorporated in December 1952, 85% of the ordinary shares being held by UDC, 10% by the Development Finance Company of Uganda Ltd, and 5% by other shareholders. The primary purpose of the company was to provide cement for the Owen Falls dam at Jinja; a 50,000 tonne/year plant was built at Tororo. This was followed by an asbestos cement plant at Tororo in 1955, to make sheets and low-pressure pipes. A second kiln at Tororo started production in 1957, with a capacity of 100,000 tonnes/annum.

A second cement factory was built at Hima in Western Uganda starting with a 100,000 tonne/annum kiln which started production in 1970. It was then decided to build a second kiln with a capacity of 200,000 tonnes/year of cement. Most of the equipment was delivered and erected in 1972 and the second kiln was due to start production in 1973. Because of disputes with Vickers, the contractor, over payment and over responsibility for the collapse of part of the factory roof, the second kiln has not yet been completed and remains idle.

IV.1 Tororo Works

The raw materials at Tororo are carbonatite (a volcanic limestone) and shale (both obtained within a few miles of the works) and small amounts of imported fluorspar and gypsum. Fuel oil is used to fire the kilns although, until recently when supplies stopped, wattle charcoal from Kenya was used as fuel for the smaller kiln.

The carbonatite at Tororo contains too much phosphate, magnesia and iron for normal cement production and the amount that can be used as such is limited. It may be possible to improve the quality of the material by flotation or other treatment, but little work has been done on this. Fluorspar is added to counteract the effects of phosphate, but even so the cement is slow to set and of low initial strength, although in time that rises to a satisfactory level. The cement is more suitable for dams than general construction purposes, where its slow setting characteristics cause delays. Most of the usable carbonatite at Tororo has now been exhausted and present explored reserves there will last barely five years. Reserves of rather better material have been found at Bududa (4 kilometres north-east of Tororo). While the quality is not known with certainty, it appears to be enough to keep the Tororo factory running for several years. The reserve is covered with 50 feet of over-burden making the cost of quarrying high. Adequate reserves of shale are available at the Malaba river 13 kilometres south of Tororo close to the Kenya border.

IV.2 Hima Works

At Hima, the raw materials are sedimentary limestone, shale and imported gypsum. The kilns are fired with fuel oil. There is a large limestone deposit close to the works. At least 14 million tonnes are suitable for cement; that is enough for 28 years' production from both kilns running at full capacity. Half the deposit lies below the water table and its quarrying will be somewhat expensive. Another suitable limestone deposit has been found 13 kilometres away near the rail crossing of the Dura river, although this may not exceed two million tonnes.

There are adequate reserves of shale within a few kilometres of Hima. The one originally chosen for cement production contains 20 to 30% of limestone. Owing to difficulties in processing it, another deposit three kilometres from the works and free of limestone is used. Unfortunately all shale in the area has a high alkali content: 1.5% of sodium oxide and 2.5% of potassium oxide. This has an adverse effect on the preheater of the kiln and the high sulphur content of the fuel oil makes matters worse. Efforts to find a shale of lower alkali content in the neighbourhood have not been successful.

The Hima limestone and shale give a very quick-setting cement. To give a satisfactory setting time at least 5% of gypsum must be added to the clinker before grinding. This was originally imported from Tanzania, but now from Kenya at 331 Shs. per tonne delivered. Shortages of gypsum have nevertheless caused shut-downs of the plant. Efforts have been made to find other sources of gypsum; even air-freighting it from Libya has been considered. A workable deposit is said to have been found near Kasese, although experienced geologists in the area are sceptical.

IV.3 Production, Problems and Costs in 1972[4]

By the beginning of 1972, Tororo was producing cement at the rate of 144,000 tonnes per year, i.e. at over 90% of capacity, but production at Hima from the one operational kiln was only 60,000 tonnes/year, ie. 60% of capacity. Various mechanical problems were the causes, particularly clogging and blocking of the preheater ducting caused by the volatile and fusible alkali salts formed from the shale. This resulted in frequent stops and starts.

Table E2 III

Direct Costs of Cement Production at Tororo and Hima 1971 and 1974 (Tororo) 1975 (Hima)

		1971						1974	1975
Item	Unit	Units per tonne of Cement		Unit Costs Shillings		Cost per Tonne of Cement Shillings		Cost per Tonne of Cement Shillings	
		Tororo	Hima	Tororo	Hima	Tororo	Hima	Tororo	Hima
Fuel Oil	Gallon	21.8	27.6	0.89	1.23	22.7	34.0	78.3	10.3
Charcoal	Ton	0.027	-	160.0	-				
Fluorspar	Ton	0.001	-	591.0	-	4.6		12.7	
Gypsum	Ton	0.02	0.47	130.0	155.0	2.5	7.34	7.7	17.6
Power	kWh	124.0	150.0	-	-	15.4	21.90	19.5	25.3
Paper Bags		20.0	20.0	0.54	0.75	10.8	14.63	21.3	29.3
TOTAL						56.0	77.87	139.5	175.7

The nominal cement price from 1966 to 1971 was unchanged at 249 Shs per tonne ex works. Direct production costs in 1971 at Tororo and Hima are given in Table E2 III. (p.19). Unit costs were higher at Hima owing to higher transport costs. The use of charcoal at Tororo was more economical than fuel oil (though this is not shown in the table). Use of fuel and power at Hima per tonne of cement were excessive because of the intermittent operation. The labour force at Tororo was excessive in relation to output: 13 man-hours per tonne of cement at Tororo, compared to 5 man-hours per tonne common elsewhere in Africa, although rates of pay were low by most standards.

Maintenance at that time was somewhat in arrears at Tororo, though the plant was in fair condition for its age. Improvements in preventive maintenance, supervision and financial control were needed.

Kiln 1 at the Hima plant was still in the throes of teething troubles in 1972. The main trouble was clogging and blockage of the preheater ducting referred to earlier. Urgent assistance from the contractor Vickers, or other experts, was required to resolve these troubles and enable the plant to reach full capacity. The management of the company as a whole needed strengthening at top technical level. Close contact was needed with an overseas organisation deeply involved in cement manufacture and with up-to-date experts, who could second a technical manager or consultant to the company.

Financially, the company was under strain in servicing the construction of the Hima factory and was in need of 30,000,000 Shs. to 50,000,000 Shs. of new capital. At that time, it was the company's intention to bring the second Hima kiln into production as soon as possible and to shut down Tororo placing it on a care and maintenance basis for a few years, during which time the two Hima kilns would be able to supply the whole Ugandan market and any profitable exports, e.g. to Rwanda, eastern Zaire and southern Sudan. It then appeared that the demand for cement in Uganda was bound to rise fairly rapidly, the result if nothing else of the low per capita consumption at that time. (See Table E2.IV).

Table E2 IV

Cement Consumption, kg per head in selected countries, 1969[5]

Europe	450
North America	341
Central America and West Indies	139
South America	112
Asia	60
West Africa	162
East Africa (overall)	19
Kenya	31
Tanzania	24
Uganda	20
Ethiopia	7

While there were obvious social and political reasons against closing the Tororo works, there were two strong general reasons for doing so.

1. It did not make economic sense for the company to carry the overheads of two factories when it could only sell the production of one, particularly when it was faced with a liquidity problem and needed new capital.

2. By operating at Tororo when the demand could be met from Hima, the reserves of limestone would be unnecessarily depleted. They are already low and permanent closure will be inevitable in the not far distant future.

IV.4 The Situation between 1972 and 1975

The situation in 1972 has been described in some detail as it is essential to an understanding of the present position.

Today, with Hima 2 still not operating, the same problems remain, and in a more acute form. Although some limited additional reserves of useable carbonatite at Tororo have been proved since 1972, they are now being quarried and at present rates of production will be exhausted by about 1980. One possibility suggested is to dismantle the Tororo cement works when Hima 2 comes into operation and to renovate and rebuild it close to the new limestone reserves at Bududa, 64 kilometres to the north west. It would start operating again when the demand in Uganda outstrips both Hima kilns by a sufficient margin. We doubt whether this would be economic.

Uganda Cement Industries Ltd. has had its troubles since 1972.

Several senior expatriate staff due to leave during 1972, were not replaced and provision for other supervision was not made. The roof of the raw materials yard at Tororo collapsed early in 1973 because cement dust, allowed to accumulate on it, had caked and set after rain.

The resulting death and injury among workmen in the building and damage to the gantry crane put the works out of operation for several months, and strained the company's financial position further. The roof of the Hima factory collapsed in August 1973, putting that factory out of action for four months. Warnings had been given to the Company management, in 1971, that dust which was being discharged to the atmosphere (through non-operation of the electrostatic precipitator) should not be allowed to build-up, settle and harden on the roof. This loss of production caused further financial difficulties.

The company was forced to default on its payments to the main contractors who ceased work at Hima and left the second kiln and production line uncompleted. Relevant figures for the production, imports and exports of cement from 1971 to 1974 are given in Tables E2V and E2 VI. (pp 22 and 23).

Table E2 V

Ugandan Domestic Production and Sales and Inter-Community Imports of Cement (from Kenya) 1971 to 1974[6]

Year	1971	1972	1973	(1974)*
Domestic Production, tonnes	205,110	166,084	142,675	116,765
Sales of domestic Production, tonnes	204,851	162,975	140,159	114,586
Imports from Kenya Shs. thousands.	1,680	5,891	1,068	nil

Note * First three quarters only

Table E2 VI

Imports and Exports of Cement Outside and Inside East African Community 1973 and 1974[7]

		1973		1974	
		tonnes	'000 Shs	tonnes	'000 Shs
Outside EAC	**Imports (total)**	56	32	89	143
	Home consumption	21	24	88	140
	Duty	-	3	-	3
	Re-Exports	nil	nil	nil	nil
Inside EAC	**Imports (from Kenya)**	5310	1073	1921	683
Total Imports		5366	1105	2010	826
Exports	**Rwanda**	10352	2587	12160	3064
	Zaire	200	52	8	2
	Sudan	1696	457	469	121
Total Exports		12248	3096	12637	3187
Balance (Exports-Imports)		6882	1991	10627	2361

The fall in production at Hima and Tororo in 1972 and 1973, caused by the collapse of the roofs, was arrested in the first three quarters of 1974. In spite of the troubled history there was a surplus of exports over imports in 1973 and 1974.

Production of cement at Tororo, in 1974, was 87,134 tonnes, and production at Hima, in 1975, was 47,760 tonnes. Direct costs per tonne of cement in each case are included in Table E2.III. (p.19) for comparison. For Tororo it had risen two and a half times. The increase resulted partly from higher costs of raw materials etc. (power costs had not risen) and partly from lower production rates, frequent stoppages and less efficient operation.

IV.5 Distribution and Sales

Uganda Cement Industries Ltd. have sales depots at Kasese, Mbara, Kampala, Jinja, Mbale, Gulu and one is planned for Arua. The selling price from these depots was held at its previous level of 250 Shs.per tonne until 13 June, 1974, when it was increased to 340 Shs.per tonne. It was again raised to 511/80 Shs.per tonne on 18 October, 1974, at which level it has been held. The price includes a sales tax of 26/50 Shs. per tonne. Discounts of up to 45 Shs.per metric tonne are given to buyers collecting from Tororo and Hima. Imports of cement are now prohibited, except with a special permit which is rarely given. With a greatly reduced supply of cement in the country, and an unsatisfied demand, mainly for private house building, a considerable unofficial market has built up. Some cement is said to be smuggled into Rwanda and eastern Zaire.

IV.6 Finances

We were unable to obtain a full statement of the company's position, but we were informed that after making a small profit in 1973, it made a considerable loss in 1974 and an even larger one in 1975.

IV.7 The Present Situation

Uganda Cement Industries Ltd is clearly in serious difficulty, financially and in almost every other way. The position, particularly at Tororo at the end of 1975, was described in the Report of the UNIDO Programming Mission.[8] The picture given, if anything, may be optimistic. When the Tororo plant was visited, in March 1974, it was shut down because the fuel oil tanks were empty. This is, apparently a common occurence caused by shortage of foreign exchange. The clinker used was outside specification for P_2O_5 and iron contents, (and it was doubtful whether the cement itself still complied with BS 12). Fuel oil consumption had risen from 22 gallons per tonne of cement in 1971, to between 30 and 39 gallons per tonne. The frequent stopping and starting of the plant had accelerated wear in the kilns. The broken heat resistant Polysius preheater grate plates are cast from a special high chrome alloy, and could not be made at UGMA at present, as the metallurgist and analysts had left that company. The foundry has virtually no technical supervision and the electric melting furnaces are out of order. The winding of the variable speed motor driving the operating kiln had burnt out: the motor had been replaced by a fixed speed motor which caused shock loading on shafts and gears when starting up. The inlet to the kiln was now also suffering from the problem of clogging by alkali salts that was first experienced at Hima.

In this case it was thought to be caused by the high sulphur content of the fuel oil.

The milling equipment for meal and clinker on the other hand appeared to be in good condition. The laboratory was well staffed and supervised and the senior technical staff at the works appeared competent, but faced with difficulties quite outside their control.

The Hima works when visited later in the month was also closed because of a power shut down, (power supplied from UEB, Owen Falls station). The power was restored later in the day but failed the next day while the cement plant was being started up. All the problems referred to in 1972 still remain. In addition, the lining plates of the feed mill are worn out, and the shell itself is exposed to wear. Its motor had twice burnt out (but had been rewound by Kilembe Mines). Most instruments, particularly temperature and draught gauges (supplied by Honeywell) were out of order. The instrument engineer at Hima had apparently had no previous training or experience with these instruments. The bucket conveyor for clinker was in a bad state of repair and could now only handle 200 tonnes/day (compared with 300 tonnes/day required at full capacity). New motors and gear boxes may be needed to bring it up to design capacity. Bricks ordered in 1974 to reline the operating kiln had still not arrived.

It seemed clear that cooperation from Vickers, the former contractor, is required not only to enable the second kiln to be commissioned but also to investigate and rectify faults on the first one. Negotiations were stated to be under way with an Italian firm to complete and commission the second production line at Hima, with assistance from Vickers, but finance is the main problem.

IV.8 Recommendations for the Future

The Ugandan Government is reported to want a third cement works in the north of Uganda. An Austrian firm has been engaged to carry out a feasibility study, including a geological survey of available limestone and shale. So far, all the limestone in the north which has been examined has too high a magnesium content for Portland cement. Geologically, Uganda seems unlikely to have any large limestone deposits apart from those round Lake George, at Hima. The long term prospects for the manufacture of Portland cement are not encouraging.

The reasonable priority would be immediately to rehabilitate the Hima No.1 plant, complete Hima No.2 and commission it. A thorough survey of Uganda Cement Industries' business was made in 1972 by the Commonwealth Development Corporation assisted by F.L. Smidth & Co., cement machinery manufacturers and consultants from Denmark. It is suggested that Smidth be asked to re-assess the situation today and make fresh and detailed recommendations covering all aspects of the Company's business.

The heavy costs of fuel oil in foreign currency are a burden which the Company can ill afford. In the Fuel and Energy Appendix (pp 82-101) we propose that a 26 square kilometre eucalyptus plantation be established in the hills and valleys north west of the plant to fuel the Hima works. It is suggested that the wood could be used as such for fuel after chipping and drying, but even if it had to be converted to charcoal, there would still be a considerable saving over the use of fuel oil, and the drain on foreign currency would be checked. It is recommended that this proposal be taken up as a matter of urgency, since the first harvest of fuel from the plantation will not be obtained in fewer than seven years from the date of planting. In the interim, probably enough timber would be cut in clearing the area before planting to eucalyptus to supply Hima for a year or two.

We further recommend that the flue dust collected in the electrostatic precipitators at Hima should be examined, to see if it is worthwhile to separate the soluble salts in it for use as a potassium fertiliser. The shale is understood to contain more potassium than sodium; recovery of potassium from cement flue dusts is now being practised in other countries where the potassium content of the feed materials is high enough.

In Appendix E6, Fertilizers and Chemicals, (pp 64-68) we note the possibility of producing fluorspar at TICAF from the vent gases of superphosphate manufacture. We also noted that gypsum will be produced as a by-product of triple superphosphate production when this is eventually manufactured there. Both of these products are now imported into Uganda, as ingredients in cement manufacutre. TICAF and Uganda Cement Industries Ltd should clearly get together over these chemicals.

APPENDIX E

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APPENDIX E3

COBALT PROJECT

I SUMMARY

A scheme has been in existence for many years to extract and market a cobalt concentrate from pyrite which is separated from the ore at Kilembe. The pyrite contains 1.44% cobalt, 38% iron and 45% sulphur as well as some copper and nickel. It has accumulated into a dump at Kasese now containing about 700,000 tonnes and being added to at the rate of 200 tonnes per day. There is no market for cobalt in Uganda and a suitable foreign partner is considered essential for the project. Several potential partners have shown interest. It has apparently always been assumed that a cobalt plant would be at Kilembe or Kasese.

In spite of the good price of cobalt on the world market, it will be difficult to implement the scheme successfully unless, at the same time, the sulphur in the pyrite can be utilised to produce sulphuric acid and can be used within Uganda. This opportunity will arise when the fertilizer plant at Tororo is expanded. The scheme would be even better if the iron oxide could be used for iron making, e.g. at Jinja.

Consideration of the cobalt extraction process and transport costs suggests that it would be preferable to locate the cobalt project at Tororo, bringing the pyrite there by rail from Kasese. The alternative of siting the plant at Kilembe/Kasese would involve transporting the sulphuric acid and iron oxide produced in the process from Kasese to Tororo and Jinja respectively. This would add about 5 million Shs. per year to the transport costs. It is recommended that the cobalt, fertilizer and possibly iron making projects be treated as an integrated scheme and evaluated by independent consultants to arrive at the best all round solution.

It is also recommended that modifications be made as soon as possible to the mill at Kilembe to increase the recovery of cobalt containing pyrite from the ore mined, since at present a substantial part of the cobalt is being returned with low-grade material to fill the mine.

II CURRENT POSITION AND BACKGROUND

A dump of cobalt-containing pyrite, with the composition shown in Table E3.I has been accumulating at Kasese as a by-product of the mill operations of Kilembe Mines Ltd for the past 20 years.

Table E3.I

Composition of Pyrite Dump at Kasese	
Component	% weight
Cobalt	1.44
Copper	0.49
Nickel	0.17
Iron	38
Sulphur	45
Gangue Minerals	14.9
TOTAL	100.0

The dump, which contains nearly 700,000 tonnes, is increasing at a daily rate of 100 to 200 tonnes, according to production at Kilembe mine. Recovery of this material could be increased by 30 to 40% by fairly minor modifications to the mill at Kilembe.

Utilization of the cobalt is a long standing aim of the company (see page 37). Its exploitation however needs careful planning and timing to bring maximum benefit to the country. Besides cobalt, the other constituents in Table E3.I could in favourable circumstances be recovered and utilized at a profit as part of a scheme integrated with cobalt recovery.

II.1 World Market for Cobalt

The price of cobalt for April 1971-76 is charted in Figure E3.I (p.38). Price has nearly kept up with general inflation and demand has recently outstripped production. The main uses are :

1. as an alloying component in heat resisting alloys; permanent magnets, tools and wear resistant alloys;

2. as a catalyst ingredient, especially for removal of sulphur from petroleum and coal;

II.2. World Production of Cobalt

Production in non-communist countries in 1972, 1973 and 1974 is given in Table E3.II

Table E3.II

World Cobalt Production 1972-1974

Tonnes contained Cobalt

Country	1972	1973	1974
Zaire	13,043	15,052	17,545
Zambia	2,053	1,944	1,962
Canada[1]	1,549[2]	1,854[2]	2,084[2]
Germany	457	370	356
Morocco	1,529	1,378	1,644
United States		73	
Finland	803	1,010	812
Others	166[2]	169[2]	147[2]
TOTAL	19,600	21,850	24,550

Note (1) Including British production from Canadian ores

Note (2) Approximate

Production is expected to have risen by 1978 to over 32,000 tonnes as new plants in the Philippines, Australia and Zaire came on stream. Uganda's projected production of 1000 tonnes/year would be 4% of the total in 1974.

II.3. Cobalt Recovery Schemes

All schemes incorporate the following broad steps, though details of each vary.

1. Pyrite Roasting. The pyrite is roasted in air in controlled conditions to give soluble sulphates of cobalt, copper and nickel. The iron is converted to ferric oxide and most of the sulphur to sulphur dioxide.

2. Water Extraction. The roast is extracted with water to dissolve the soluble sulphates.

3. Metal Separation and Concentration. The metals contained in the solution from 2 are separated by hydro-metallurgy and concentrated to forms (e.g. calcined cobalt oxide) acceptable to the metallurgical and chemical industries.

This general scheme has important consequences (which have to be appreciated) for the recovery and use of the other components of the pyrite.

1. Sulphur removal by roasting must come first.

2. The only possible use for the sulphur dioxide in the roaster off-gas is by conversion to sulphuric acid in a special plant next to the roaster.

3. The roasted pyrites cannot be stored in the open exposed to the weather without loss of cobalt.

4. The iron oxide only becomes available as a source of iron for a smelter after the pyrite has been roasted and the soluble salts have been extracted from it.

5. The products of these operations, sulphuric acid, cobalt, copper and nickel concentrates and iron oxide mixed with gangue are over twice the weight of the original pyrite. The weight of the sulphuric acid alone is greater than that of the pyrite.

Most schemes envisage the processing of about 250 tonnes per day of pyrite (82,500 tonnes per year) to give a cobalt concentrate with 920 tonnes/year of contained cobalt, as well as 230 tonnes/year of copper. The capital cost of such a plant at Kilembe in 1970 was estimated at about 44,000,000 Shs. The annual profit on cobalt and copper was estimated at between 9,000,000 and 10,000,000 Shs. (including 9% interest on capital, but without loan repayment). The plant would have employed 175 full time workers. This scheme assumed that the sulphur dioxide is discharged with the flue gases to the atmosphere and that the final extracted roast (mainly ferric oxide) is accumulated as another dump which might possibly be used in the future. The amount of sulphur dioxide discharged to the atmosphere would be three or four times that now discharged at Jinja and would provoke objections.

II.5 Foreign Partners

A foreign partner has always been considered necessary for the cobalt project to provide :

1. a guaranteed market for the product;

2. technical expertise in design and operation;

3. capital, or assistance in raising it.

Several firms have shown interest, among them Falconbridge (Canada), Kuhlman Pechiney (France), Outokumpu Oy (Finland) and Krupps (W.Germany). No agreement has yet been reached with any one of them. Conditions now appear rather less favourable to an agreement than in 1970.

III CURRENT PROSPECTS

Prospects for the cobalt project hinge largely on utilization of by-products, particularly sulphuric acid. Such utilization depends on many factors, among them the location of the roaster.

III.1 Sulphuric Acid

Up to 100,000 tonnes per year of sulphuric acid (98%) could be produced from the roasting of 82,500 tonnes per year of pyrite. The only sulphuric acid plant in Uganda is at Tororo with a capacity of 10,000 tonnes per year. It uses imported sulphur from Iran at an estimated price at Tororo of 700 Shs. per tonne. The sulphuric acid is used mainly for single super phosphate production (SSP) from apatite of which there are very large deposits at Tororo. The phosphate fertilizer is sold mainly in the east of Uganda, with exports to Kenya. There were plans in the late 60's, in which ICI Ltd were involved, to increase phosphate fertilizer production at Tororo by up to 5 times. According to these plans, phosphoric acid, triple superphosphate (TSP) gypsum and ammonium and/or phosphate would be made as well as SSP (Gypsum is a by-product of phosphoric acid and TSP manufacture).

These plans could utilize about 50,000 tonnes/year of 98% sulphuric acid, providing it could be produced competitively. (If the sulphuric acid were too expensive, an alternative electrothermal process would be used). The only other uses for sulphuric acid in Uganda are small: e.g.. pickling sheet steel before galvanising, and acid for lead accumulators. In time, production in Uganda will reach and exceed 100,000 tonnes per year, but the only medium term prospects for its production and use are at Tororo. The utilization of the sulphur in the pyrite must perforce be tied up with this outlet. The price of sulphur in world markets is low (about $45/ton f.o.b. Iran port), and it would not pay to sell sulphuric acid produced in Uganda for use at places more than a few hundred kilometres from the point of production. Without going into questions of the fertilizer market in Uganda and western Kenya, or of foreign technical and financial participation, we suggest that it would be to the benefit of Uganda to increase production of phosphate fertilizers and that, subject to reasonable safeguards, foreign partners might be ready to assist technically, commercially and financially.

III.2 Iron Oxide (See Appendix E.10, p 123-4, Iron and Steel)

The embryonic steel industry in Uganda is in the south and east of the country in Jinja, Kampala and Tororo. The only plant in Uganda capable of utilizing iron produced by the smelting of iron ore oxide is East African Steel Corporation at Jinja. The steel-making plant there is uneconomically small and should be enlarged (or replaced by a larger one) before other steel-making plants elsewhere in Uganda are considered.

If the iron oxide residue from the extracted pyrite roast were suitable for smelting (a question which needs further investigation), the 250 ton/day roaster discussed as the basis of the cobalt project could provide enough iron oxide to produce approximately 25,000 tonnes/year of iron. This is the same order of magnitude as Jinja's requirements.

III.3 Plant Location and Transport Considerations

Hitherto it always seems to have been assumed that the cobalt project would be located in the Kilembe/Kasese area, under the direct control of Kilembe Mines Ltd. There is no reason why this should necessarily be so, particularly in view of the following paragraph (111) of the Report of the Commission of Inquiry on Kilembe Mines Ltd, October 1975. "It is the Commission's view that the cobalt project must be revived. The management should be divorced from the management of Kilembe Mines Ltd and should be treated as a special development project like Lake Katwe Salt Project."

Three sites for the plant are considered here taking into account transport and other requirements.

1. Kilembe - Kasese
2. Jinja
3. Tororo

It is assumed that transport is by rail and that all exports (and imports) with countries outside the East African Community pass through Mombassa.

Rail distances in kilometres between the various locations and Mombassa are given in Table E3.III. (p.34). Rail freight rates would depend on the type of goods and distance travelled. For minerals carried in bulk, the average rate appears to be about 0.16 Shs./tonne kilometre. The rate for sulphuric acid, which must be carried in special rail tank cars would be appreciably higher. The tank cars would normally have to make the return journey unloaded. It is assumed that impure sodium carbonate, to be obtained from the Lake Katwe salt project,would be used to precipitate cobalt as carbonate in the process and that the total transport cost of the material per tonne kilometre per year is the same as that of the cobalt concentrate per tonne kilometre per year. Since the sodium carbonate would join the railway at Kasese at one end and the cobalt concentrate would leave at Mombasa at the other, the total transport costs of sodium carbonate plus cobalt concentrate are approximately the same wherever the plant is situated on the line. (If the Katwe soda was unsuitable or insufficient, and Magadi soda were employed, then the transport costs for soda plus cobalt concentrate would be lowest for a plant located at Tororo).

Table E3.III

Rail Distances, Kilometres

	Kasese	Kampala	Jinja	Tororo	Mombasa
Kasese	-	343	434	570	1670
Kampala	343	-	91	237	1337
Jinja	434	91	-	146	1246
Tororo	570	237	146	-	1100
Mombasa	1670	1337	1246	1100	-

It is assumed that initially there is a need for 50,000 tonnes per year of sulphuric acid at Tororo and that the cobalt plant is sized to meet this demand, irrespective of its location. The plant would be half the size of the cobalt project which was evaluated in 1970. It would require 41,250 tonnes of pyrite per year and produce 29,000 tonnes/year of 70% iron oxide. Only the transport of pyrite, sulphuric acid and extracted roast (iron oxide) need be considered.

Case 1 Plant in Kasese - Kilembe Area

There is no rail transport for pyrite. 50,000 tonnes/year of 98% sulphuric acid must be transported 570 kilometres to Tororo. Estimating the freight rate at 0.30 Shs./kilometre the annual freight cost would be 8,500,000 Shillings. The extracted roast (70% iron oxide) would be stockpiled at Kasese. If it were required at Jinja there would be an additional transport cost of 29,000 x 430 x 0.16 Shs./year.

= 2,000,000 Shs. per year

giving a total of 10,500,000 Shs. per year

Case 2 Plant at Jinja

41,250 tonnes per year of pyrite would be freighted 434 kilometres to Jinja at 0.16 Shs. per tonne kilometre = 2,900,000 Shs./year and 50,000 tonnes per year of 98% sulphuric acid would be freighted 146 kilometres from Jinja to Tororo at 0.30 Shs./year = 2,200,000 Shs./year.

Total = 5,100,00 Shs./year.

The 70% iron oxide would be produced where it would be used and it can be stockpiled there until required.

Case 3 Plant at Tororo

41,250 tonnes per year of pyrite would be freighted 570 km from Kasese to Tororo at a rate of 0.16 Shs. per tonne km

= 3,800,000 Shs./year

If required, the iron oxide would be freighted back from Tororo to Jinja at a cost of 29,000 x 146 x 0.16 Shs./year

= 700,000 Shs/year.

giving a total freight cost of 4,500,000 Shs./year. (Otherwise the iron oxide would be stockpiled at Tororo).

The three cases are summarized in Table E4.IV on the following page.

Table E.4 IV

Estimated Annual Freight Costs of Cobalt Project, for treatment of 41,250 tonnes pyrite per year, with sulphuric acid utilization at Tororo

'000 Shs. per year

Plant Location	Kasese	Jinja	Tororo
Without iron oxide utilization	8,500	5,100	3,800
With iron oxide utilization at Jinja	10,500	5,100	4,500

Not only is a plant at Tororo preferred on economic grounds. On practical grounds it is preferable, since it obviates the need for any bulk rail movement of sulphuric acid in Uganda. It is also the site of the only chemical works in Uganda where experience, skills and knowledge are available, particularly of sulphuric acid manufacture.

REFERENCES

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4. "The Recovery of a Cobalt Concentrate from Kilembe Pyrite - Part I and II" by Falconbridge Metallurgical Laboratories, Canada 1970.

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6. "Study of the Projects Drawn up at the Request of Kilembe Mines Ltd" by Ugine Kuklmann, France 1972.

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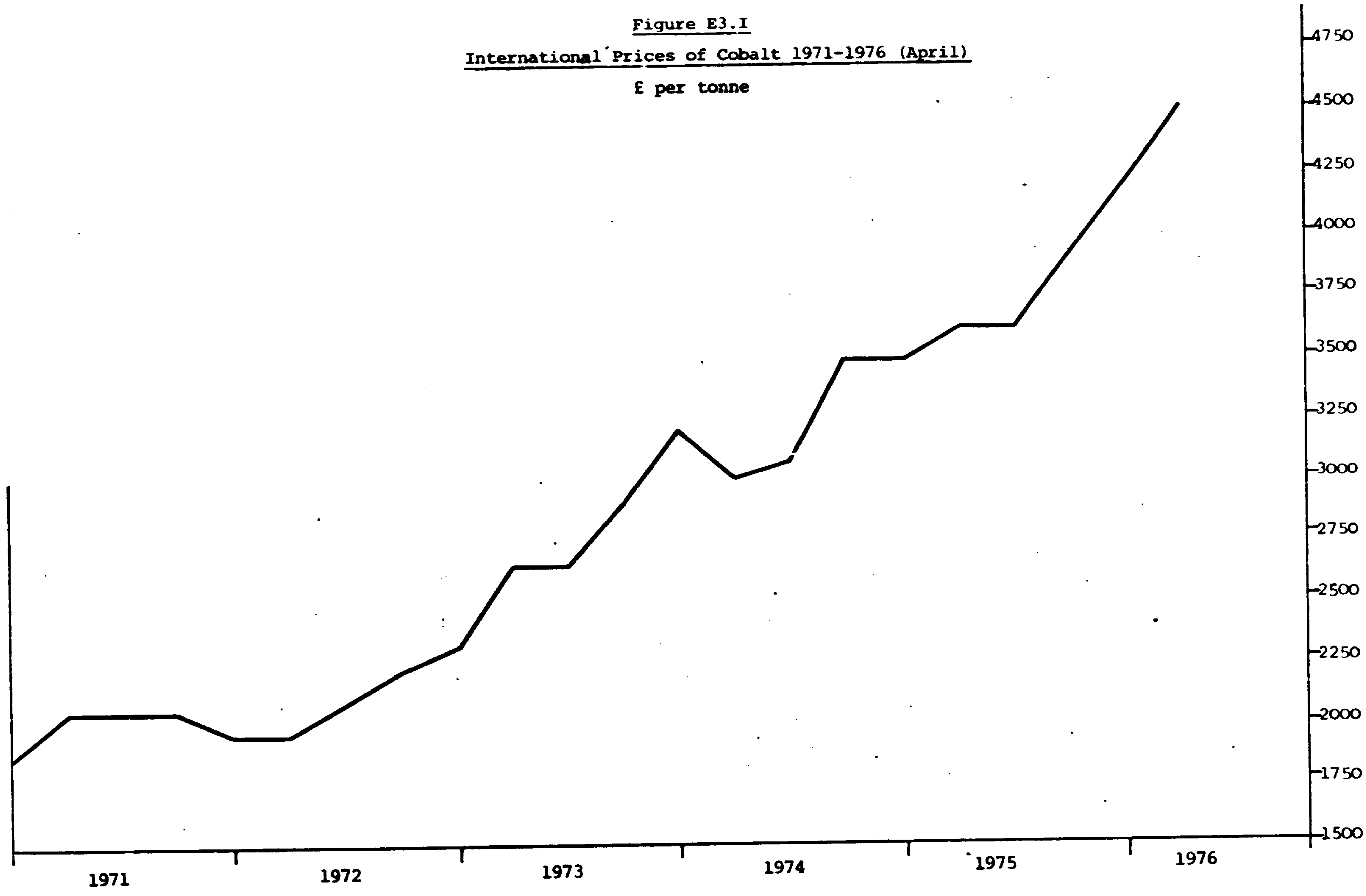
9. "Preliminary Report on Commercial Utilization, of Kilembe Pyrite" J. Crnicki and B.Radosevic, Kilembe Mines Ltd 9th Feb, 1976.

10. Progress Report on the Cobalt Plant, Kilembe Mines Ltd Hatch and Associates, 1970.

Figure E3.I

International Prices of Cobalt 1971-1976 (April)

£ per tonne



APPENDIX E.4

COPPER

I. SUMMARY

Kilembe Mines Ltd, the government-owned copper mining company faces acute financial and operating problems resulting from the world surplus of copper and resulting depressed prices (which, however, recovered somewhat recently). An investment in the order of Shs.150 million is needed to modernise and re-vitalize the mine and smelter and raise production to its original level of 16,000 tons/year of copper. It is not expected that the copper price will revive sufficiently for this to be very profibable until the 1980's. It is suggested that the best course might be to close down the mine and smelter now and put them on a care and maintenance basis; meanwhile to try to raise the capital to modernise the mine and smelter in order to restart operations in the early 1980's. Some suggestions for alternative employment for those dependent on Kilembe Mines Ltd are made.

II. BACKGROUND

Kilembe Mines Ltd, which exports its entire production as unrefined blister copper is the only medium or large-scale metal ore mining and processing company in Uganda. The mine has been in production since 1956, following completion of the extension of the railway to Kasese, 8 miles away. The ore is a mixture of chalco-pyrite and cobaltiferous pyrite. Reserves in 1960[1] were estimated at about 15 million tons of which 8 million averaged 2.3% copper and 0.18% cobalt. Reserves now proven are approximately 6 million tons at 1.85% copper. The company's geologists believe that the true reserves may be nearer 30 million tons at this copper content but these have not been fully explored.

Mining is carried out at two mines between 3300 and 6800 ft., Kilembe (older) and Bukangama (started 1967). The standard open cut and fill method is used, with adits and shafts. Timber (a high quality hardwood) from the company's own saw mill at Nkombe is used to line the shafts. 500 cu.m of timber are used monthly, and cannot be recovered. The rock is hard and fairly dry. Stop bolts with steel plates and wire mesh are used for roof support. Ore production is now approximately 50,000 tons/month, with 500 metres per month of development. Output is restricted by the age of the machinery and equipment and the shortage of spares. Voids are filled in with sand and tailings from the mill which are pumped in as a thick slurry, the water draining quickly. At the mill, the ore is separated into a concentrate containing 28% to 29% copper which is dried and transported by rail to the smelter at Jinja. A large dump (about 700,000 tons) of cobaltiferous pyrite from the mill has accumulated at Kasese. The possible utilization of this material is the subject of Appendix E.3., pp 28-38.

The smelter has an electrically heated furnace, (5.5 MVA) which has reached the end of its useful life [2], and an air blown converter. The smelter presents an environmental problem from the intermittent discharge of sulphur dioxide to the atmosphere, causing damage to vegetation within a three mile radius. This however would be very costly to eliminate or recover, since the gas is discharged in large quantities over short periods. The smelter was sited at Jinja in 1955, before the present electric grid to Kasese had been constructed, to ensure power supplies from Owen Falls station, although this now results in excessive transport costs for the concentrate between Kilembe and Jinja. At present, the smelter is beset with maintenance problems of every kind and an investment of around Shs. 15 million is needed to put it into good working order at its original capacity of 1,400 tons copper per month.

If a new smelter were being planned today, it is more likely that it would be located at Kilembe. This would reduce transport costs between Kilembe and Jinja by about 30 million Shs., since copper rather than 29% concentrate would be transported, and railed direct to Mombasa without off-loading for processing at Jinja. It is also likely that an electrolytic rather than a thermal smelter would be employed [3]. This should give all round technical and economic advantages, as well as producing a purer grade of copper some of which could be sold and used in East Africa. Before large amounts of capital are committed to renovating the existing smelter, a thorough study of the alternative of an electrolytic smelter at Kilembe should be made.

At present, the metal is sold to refiners as blister copper containing 80 grams gold and 70 grams silver per tonne. Refiners pay on the basis of the LME spot cathode price on delivery, less a refinery charge of £105 per tonne, plus a gold premium which at present amounts to approximately £60 per ton. In other words, Kilembe Mines Ltd, receives a price of £45 per tone lower than the LME price as well as paying freight charges on concentrate from Kilembe to Jinja and on blister copper from Jinja to the (European) refiner. Exports from 1971 to 1974 inclusive are shown in Table E4.I.(p.41). Imports of copper in the various forms used in engineering into Uganda and the whole of East Africa in 1973 and 1974 are given in Table E4.II.(p.42). From these data it does not appear that there is at present very much scope for refining copper and marketing refined copper in Uganda or indeed in any of the three member countries of the East African Community. (This position might change if a large electrification programme were embarked on in Uganda and if it were decided to employ copper cables for distribution and produce them locally).

The value of copper on the international market, in real terms and in relation to other metals, has fallen steadily since 1965, despite some cyclical peaks and troughs in demand. This has affected copper producers all over the world. Most of them made a loss in 1975, after a few months of profitable operation during the commodity boom of late 1973 and early 1974. Until early 1975, 70% of the share capital in the company was owned by Kilembe Copper Cobalt Ltd, of Toronto, 20% by the Commonwealth Development Corporation and 10% by the Uganda Development Corporation. Major breakdowns of the smelter at Jinja, in

Table E4.I

Copper Exports, Unrefined (blister)[4]

Year	1971	1972	1973 (1)	1974 (1)
Quantity, tonnes	16,807	14,141	9,715	9,001
Value '000 Shs.	137,730	112,785	109,520	120,653

Note. (1) Exports were markedly lower in the last quarter of 1973 and the first quarter of 1974 due to shut down of the smelter for emergency repairs.

Table E4.II

Net Imports of Copper into Uganda [5]

ar' East Africa 1973 & 1974

Classi-fication	Description	Uganda				East Africa			
		1973		1974		1973		1974	
		tonnes	Shs. '000S	tonnes	Shs. '000S	tonnes	Shs. '000S	tonnes	Shs. '000S
682.1	Unwrought	nil	nil	nil	nil	27	311	31	508
682.2.1.1.	Bars, rods, angles and sections	142	1,728	119	2,308	836	10,259	814	14,730
682.2.1.2.	Wire	94	980	77	1,291	281	2,977	449	6,934
682.2.2.0.	Plates, sheets strips	1	11	1	20	37	557	90	1,697
682.2.3.0.	Foil	nil	nil	nil	nil	nil	nil	2	82
682.2.4.0.	Powders & Flakes	nil	nil	nil	nil	5	169	5	189
682.2.5.0.	Tubes, pipes, blanks and hollow bars	3	82	51	757	49	890	124	2,647
682.2.6.0.	Tube fittings	2	35	1	19	54	1,743	61	1,711
TOTAL		242	2,834	249	4,395	1,289	16,906	1,576	28,516

late 1973, practically halted production of blister copper for 8 months when prices were at a record level (over £1,000 per ton). After the collapse of the copper price in 1974, the overseas investors sold their interest in the Company to the Ugandan Government for 22.1 million Shs. although only 5 million Shs. (from the company's overseas cash account) have actually been paid.

Discussions with senior company officials revealed that the company's maintenance budget had been severely cut in 1972 and it appears that the maintenance of the mine and machinery had been falling behind for at least two years before the Government's take-over. A serious management and financial crisis developed after the take-over in 1975. In late 1974, there were 150 European staff at Kilembe, only about 20 are there now. There is a current shortage of well qualified mechanical and electrical engineers at Kilembe (mainly for maintenance of underground workings) as well as of a metallurgist, production supervisor and foremen at the Jinja smelter.

Some remakable repairs have been effected in the workshops at Kilembe but there are shortages of every kind of machinery and equipment both at Kilembe and at Jinja. To ensure continued production at Kilembe and at Jinja, and to raise production to its previous level of 16,000 tons/year of copper, company officials advised us that an immediate capital injection of approximately £10 million is needed for spares and renovation, together with an annual allowance of £2 million in foreign exchange for spares and maintenance.

In February 1975, shortly after the take-over, the company had the following liabilities:

Bank overdraft	17 million Shs.
Creditors	9 million Shs.
Taxes	7 million Shs.
Employee Benefits	6 million Shs.

By September 1975 the bank overdraft had risen to 43.5 million Shs. and interest payments alone (at 11%) amounted to 400,000 Shs. per month.

III PRESENT AND FUTURE PROSPECTS

These has been some revival in LME copper price this year (now standing at about £800 per tonne), although this was partly caused by the fall in sterling. It seems that a LME copper price of £900 to £1,000 per tonne is needed to enable the company to break even (including interest payments on bank overdraft). World copper stocks at present are estimated at over two million tonnes or half a year's production. World consumption this year is at best likely to recover to the 1974 level. With little anticipated change in production, consumption will only exceed production by around two hundred thousand tonnes. Thus any significant decline in stocks will probably be delayed until 1977. In the longer term, the current low investment in copper mining may well cause serious supply problems (and consequently higher prices) in the 1980's.

One course that has been suggested is to close down all production at Kilembe and Jinja and put them on to a care and maintenance basis until urgently needed spares are imported to enable full production to be resumed in a year's time or more, assuming also that prices will have recovered sufficiently for the operation then to be attractive. The major difficulty in shutting down the mine is that there is little other industry in Kilembe. About 3,000 workers are directly employed by Kilembe Mines Ltd, and a community of 30,000 is dependent on the mines for a livelihood. Closure of the mines cannot be contemplated without considering alternative employment for these people but that problem will have to be faced later if not sooner, when the ore is exhausted. Temporary closure now, while the company is losing money and ore reserves are being exhausted, will at least preserve the remaining reserves so that they can be mined in the future at a profit.

IV. ALTERNATIVE EMPLOYMENT POSSIBILITIES

The following alternative employment possibilities are suggested,

IV.1 Activities already within scope of Kilembe Mines Ltd

IV.1.1 Cement Copper Production

Small amounts of cement copper are at present produced by treatment of mine and mill drainings with scrap iron; the cement copper settles out as a powder in tanks or ponds and is collected and dried. The powder contains about 70% copper and can be sold as such. There is scope for extending this to the treatment of low-grade ores and tailings at Kilembe and smelter slag at Jinja. The costs involved are low. The amount of copper which could be recovered in this way may, however, be rather limited (perhaps to a few hundred tonnes per year) and the employment offered would also be limited.

IV.1.2 Utilization of Timber from Saw Mill

The timber now being cut at the Nkombe saw mill and used in the mines is said to be a good quality hardwood (mahogany according to one mine official) with possible uses for furniture and building. Joinery and furniture-making workshops could probably be developed at Kilembe, to provide employment for 50 to 100 workers.

IV.1.3 Lime Kilms

Kilembe Mines Ltd, have opened their own lime quarry at Hima and designed and built their own vertical lime kilns. These produce lime for which there is a good demand in Uganda. The possibility of extending this activity should be considered.

IV.1.4 Workshop Utilization

Kilembe Mines Ltd, have some of the best mechanical workshops in the country and excellent craftsmen. Even if the mines were temporarily closed for modernisation, pending an improvement in the copper market, the workshops could undoubtedly be utilized to a fair extent in the modernisation programme. They could also probably be used to produce plant and equipment required for other industries such as for the Katwe salt project, the cement works at Hima, mining equipment required for tin and wolfram ores in Kasese, plant for TICAF at Tororo, and even for the sugar mills at Kakira and Lugazi.

IV.1.5 Pyrite Utilization, Cobalt, Sulphuric Acid and Iron

This important project is discussed separately in Appendix E3. (pp28-38) While the project appears economically attractive, it is doubtful whether it should be located at Kasese. On grounds of transport costs, it is shown to be better to locate it at Tororo, assuming that the sulphuric acid produced were used in an expanded fertilizer plant at Tororo. But although the cobalt project might not provide direct employment at Kilembe, it would place a premium on the pyrite produced as a by-product. This would increase the profitability of copper mining at Kilembe, and might justify its continuation in circumstances where the mine would otherwise be shut down.

IV.2 Activities outside the Scope of Kilembe Mines Ltd

IV.2.1 Establishment of Fuel Wood Plantation for Hima Cement Works

We have strongly recommended in Appendix E8,(pp82-101)) of this report than an eucalyptus plantation of about 26 square kilometres be established without delay in the valleys of the foothills N.W.of Hima cement works to provide cheap fuel for the cement works replacing costly fuel oil imports. Labour for the work of ground preparation, construction of dams and/or haulage lines or roads, houses and buildings for staff and planing the young trees could without doubt be brought from Kilembe: peak employment would be provided in the first or second year.

IV.2.2 Iron Ore Mining

An iron or steel project might be based on haematite deposits near the railway in N.E.Ankole, or in Kigese. Exploitation of either of these deposits would require a large, skilled workforce for which Kilembe miners should be very suitable, although the distances would be too great to allow them to travel daily from Kilembe.

IV.2.3 Tin and Wolfram Ore Mining in Kigese and South Ankole

There is scope for expansion of these activities as discussed in Appendix E11, pp 126-150. Again the experience of Kilembe miners should be invaluable.

IV.2.4 Extension and Modernisation of Railway

The Kampala-Kasese railway is in poor condition and needs modernisation. An extension to the south-west of the country (e.g. Kabole) would be required if the iron ore reserves there were to be exploited. Men with experience of rock blasting and large scale earth moving would be in demand.

IV.2.5 Lake Katwe Salt Project

This project will provide a certain amount of employment during the next two years in the construction and subsequent operation of the plant, though it is a little far for daily travel from Kilembe.

IV.2.6 New Hydro-Electric Station on Mubuku River

Kilembe is supplied with power both from its own hydroelectric station at Ibanda on Mubuku river (6.4 MVA) and from the Uganda Electricity Board's supply from Owen Falls. In dry periods, the power available from Ibanda falls to 4.7 MVA and when the mine and mill at Kilembe are running at full capacity, the demand rises to 9 MVA. If an electrolytic smelter were built at Kilembe and the mine and mill ran at full capacity the demand would rise to 14 MVA. It is unlikely that UEB could meet the demand with present generating capacity and distribution lines, particularly when the second cement kiln at Hima comes into operation. There may thus well be a case for an extension to the hydroelectric station on the Mubuku river where less than half the potential head available is utilized for power.

Extensions to the present Mubuku power scheme could be effected in two phases:

1. establishment of a larger dam and reservoir to enable the present station to run at full capacity all the year round;

2. building a second station on the river.

Any such schemes would have to be undertaken in collaboration with UEB. The schemes could, however, provide employment during the construction phases, (two to four years) for a hundred or more workers from Kilembe, possibly several hundred at the peak period.

V. WORLD SITUATION

V.1 Production

Copper is mined in over 50 countries throughout the world. Over 80% of world mine production is however, concentrated in the 10 producing countries, listed in Table E4.III (p.48). Mine output which had increased rapidly prior to 1975, at over 10% per annum and averaging over 90% of capacity, fell by over 9% in 1975 to an estimated 7.4 million tonnes.

Refinery production, including secondary copper, which experienced a similar growth in output between 1971 and 1974 also declined by over 9% to 8.3 million tonnes in 1975. (See Table E4.IV p.49).

Inflation and the depression of the world economy have resulted in the postponement or cancellation of new projects to increase capacity. The Philippines which supplies over 200,000 t.p.a of concentrates to Japan has abandoned several schemes for implementation in 1976. In Canada rising costs have deferred a decision on a mine in Ontario while plans for a smelter in Quebec have been shelved.

Members of CIPEC, Chile, Peru, Zaire and Zambia however, are believed to be going ahead with government backed projects, but in Chile's case only an improvement in efficiency is planned. The net result of reduced demand and low price in 1975 has been to cut back planned increases in mine capacity for operation in 1980 from 2.8 to 1.2 million tonnes.

V.2 Consumption

Most copper is consumed as refined metal, 70% by wire mills and 30% by brass mills. It is widely used throughout industry. Its applications are found in a vast range of goods from wiring, car radiators and refrigerators to piping, power cables and roofing. An approximate analysis of industrial consumption by industry sectors is:

electrical machinery	48%
construction	16%
general engineering	16%
transport industry	12%
domestic & miscellaneous uses	8%

Table E4.V (p.49) shows apparent world consumption of refined copper between 1971 and 1975. Between 1971 and 1973, consumption was increasing at about 11% p.a. but in the following two years it fell by 17% to 7.3 million tonnes. The most marked recession in demand was experienced in the U.S.A. where consumption fell by 800,000 tonnes between 1973 and 1975. Thus the U.S. market was responsible for over 50% of the fall in world consumption.

Table E4.III

World Mine Production of Copper 1971 - 1975

'000 tonnes

Country	1971	1972	1973	1974	1975 est.
U.S.A.	1,381	1,510	1,588	1,446	1,302
U.S.S.R	990	1,050	1,100	1,130	N/A
Chile	708	716	735	898	820
Canada	654	720	815	826	720
Zambia	651	706	717	698	663
Zaire	406	437	490	500	460
Australia	173	180	222	257	221
Phillipines	198	214	221	226	N/A
Peru	212	217	220	213	185
Papua New Guinea	100	124	180	193	N/A
Other	994	1,160	1,226	1,362	N/A
Total	6,467	7,034	7,514	7,749	7,378

Table E4.IV

World Production of Refined Primary and Secondary*

Copper - 1971-1975

'000 tonnes

Region	1971	1972	1973	1974	1975 est.
Europe	1,237	1,273	1,373	1,447	1,400
Africa	846	943	991	1,052	943
America (ex.U.S.A.)	992	1,087	1,043	1,248	1,225
Asia	757	858	1,000	1,068	878
Australia	162	174	178	196	190
U.S.A.	1,780	2,049	2,098	1,938	1,700
Sino-Soviet Bloc	1,541	1,687	1,813	1,914	1,950
Total World :	7,314	8,070	8,498	8,863	8,286
of which primary	13.0%	12.0%	12.2%	13.9%	14.2%
" " secondary	87.0%	88.0%	87.8%	87.1%	85.7%

Table E4.V

Apparent World Consumption of Refined Copper 1971-1975

'000 tonnes

Region	1971	1972	1973	1974	1975 est.
Europe	2,366	2,496	2,648	2,686	2,419
Africa	59	66	87	92	85
America (ex.U.S.A.)	400	459	490	607	498
Asia	910	1,062	1,326	996	903
Australia	111	103	124	124	110
U.S.A.	1,830	2,029	2,219	1,994	1,410
Sino-Soviet Bloc	1,628	1,741	1,843	1,936	1,900
Total World	7,350	7,985	8,786	8,443	7,325

Source: Amalgamated Metal Corporation.

* recovered from scrap

As mine and refinery production have not been reduced to the extent of the fall in consumption, there has consequently been an enormous growth in stocks. It is estimated that world stocks of copper are between 2 and 2.5 million tonnes.

Demand is expected to recover in 1976 to possibly the same level reached in 1974, 8.4 million tonnes. In the longer term, given the high level of stocks plus the currently reduced level of capacity additions, it will not be until 1980 that available supply and demand will be more finely balanced.

V.3. World Trade

The major participants in the international trade of copper at different stages of processing (ore and concentrates, blister and refined copper) are summarized below in Table E4.VI.

Table E4.VI

World Trade in Copper in 1973

'000 tonnes

Level of Processing	Exports		Imports	
Ore and Concentrates	1,042		964	
	Canada	33%	Japan	74%
	Philippines	20%	W.Germany	13%
	Papua	17%		
Blister Copper	760		697	
	Zaire	29%	Belgium	32%
	Chile	21%	U.S.A.	20%
	Peru	19%	W.Germany	17%
Refined Copper	2,496		2,573	
	Zambia	25%	W.Germany	16%
	Chile	16%	U.K	15%
	Belgium	13%	France	15%
	Canada	12%	Japan	12%

It is seen that the bulk of world trade is in refined copper owing to the higher added value obtained in producing centres - especially in those countries distant from the main consuming areas.

V.4 Prices

Average prices of copper wire bars on the London Metal Exchange between 1971 and April 1976 are charted in Figure E4.1 (p 52) together with the level of stocks. A general relationship is evident, the price of copper being inversely related to the level of stocks. In April 1974, when L.M.E stocks stood at only 11,000 tons, copper prices reached nearly £1300/tonne. Two years later copper prices are just over £700/ tonne having recovered from a low of £520, while stocks have risen to 450,000 tonnes.

The influence of price on production costs was critical during 1975 when the price remained below £650/tonne. At this figure it is considered that nearly 50% of all mines are uneconomic. Prices appear to be improving in 1976 and are expected to continue to do so as the world economy gradually picks up.

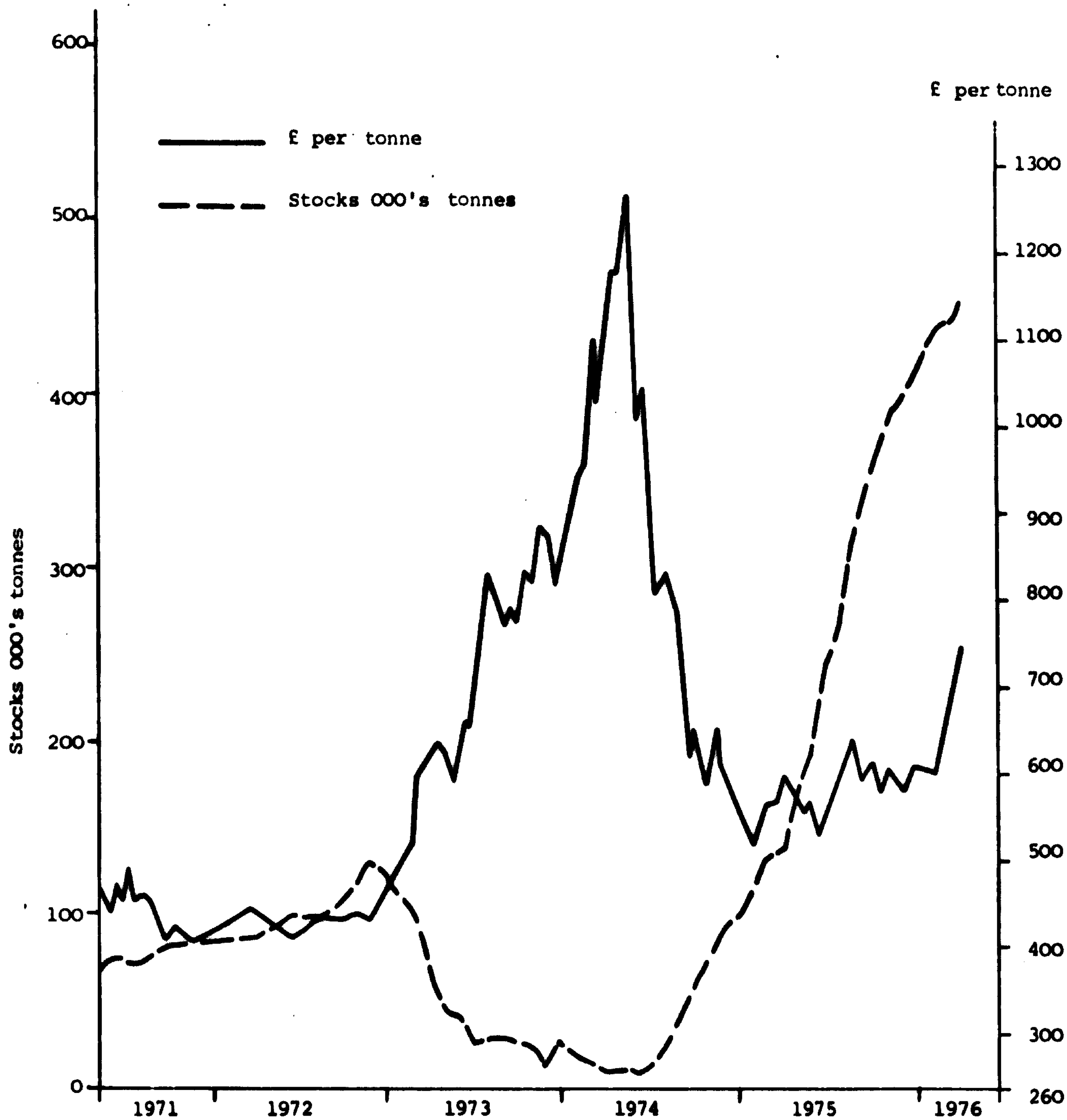
It has been suggested in the U.S.A. however, that the price of copper will need to be £1,000/tonne to justify new investment in copper mining. Present stock levels and spare capacity enforced through cut-backs in production in 1975 and continuing in 1976 would make such a price unlikely. It is thought that it will not be achieved before 1978.

There is therefore a strong possibility that much investment in new capacity to meet demand recovery will be sufficiently delayed to create supply shortages and consequently new record prices for copper in the early 1980's. This will perpetuate the cyclical trend caused by the inflexibility of production to respond to changing market conditions.

Figure E4.I

London Average Weekly Prices of Copper Wirebars

1971 Apr - 1976 Mar



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APPENDIX E.5

NOTES ON ENGINEERING MAINTENANCE AND MANUFACTURE OF SPARE PARTS

Visits to Ugma Steel and Engineering Corporation Ltd, Lugazi, and Uganda Oxygen Ltd. Kampala

I. SUMMARY

Most of the foundry at Ugma, the largest department, is closed because of breakdowns of equipment which could not be repaired locally. This in turn has led to low utilization of its machine shop. The factory is also very short of key technical staff in certain areas (metallurgists, foundry technicians and mechanical draughtsmen) The technicians, however, could only be effectively utilized if the foundry itself was in working order.

Uganda Oxygen Company, which makes welding gases used in Uganda, is producing these on plant and equipment which have reached a dangerous condition because of delays in obtaining the necessary materials and spares required to maintain them. These delays are all attributed to the country's shortage of foreign exchange.

II INTRODUCTION

The Report of the UNIDO Programming Mission draws attention (Section 1.10) to the need for 'rehabilitation and development of the metal working and engineering industry'. It emphasises strengthening capabilities for repair and manufacturing spare parts. To gain some insight into this requirement, we paid brief visits to the two works.

Ugma Steel and Engineering Corporation Ltd. fits closely into this category. Uganda Oxygen Ltd is a service industry supplying welding and cutting gases, oxygen and acetylene, made in Uganda. It imports and distributes other gases, hydrogen and argon, and gas and electric welding equipment.

III UGMA STEEL AND ENGINEERING CORPORATION LTD. LUGAZI

Ugma started life as the maintenance shop for the Mehta group of companies. In 1960, it became a separate company established to manufacture spare parts and do repairs for other companies on a jobbing basis.

At present, it has no Board of directors and its status is uncertain. For foreign exchange, it applies through the managing director of Uganda Sugar Factory Ltd. Lugazi. The factory is under the control of an acting manager (the only graduate engineer in the company) assisted by a production planning engineer and a newly appointed chief accountant. We understand the present manager to be the fourth the company has had since 1972.

III.1 Organization and Staff

The company had the following departments and numbers of personnel when visited in March, 1976.

Table E5.1

Ugma Employees

Department	No. of Employees
General Aministrator including personnel and accounts	51
Drawing Office	Nil
Pattern Shop	13
Foundry	108
Laboratory	Nil
Machine Shop	56
Fabrication Shop	53
Agricultural Implements Plant	35
Construction Department	15
Mechanical and Electrical Maintenance	20
Sales	6
TOTAL	357

The most striking fact about the company is its extreme shortage of qualified engineers and total lack of draughtsmen, metallurgists, inspectors, foundry technicians and laboratory staff. We were informed that the company formerly had a training department which had since been disbanded.

We understand that there are no suitable courses in mechanical drawing in Uganda and no degree courses in metallurgy. The technical colleges apparently give adequate training for machine operators, who on leaving college usually become supervisors rapidly. We had the impression that UGMA had been through a difficult and demoralizing period, since it has been expected to carry out work beyond its capability and to maintain and provide spare parts for Lugazi Sugar Factory, when most of its own foundry equipment was out of order and could not be repaired. This situation has made it difficult for the company to give service to other customers. Because of the shortage of finance and frequent changes in management, several key technical personnel (draughtsmen, metallurgists) have left for better paid jobs.

III.2 The Foundry

The department with the greatest problems was the foundry which has ferrous and non-ferrous sections operating on a jobbing basis. Most of the essential equipment had been out of order for a long time. Ferrous castings had not been made between May and November 1975 for various reasons, including an absence of coke.

There seemed to be no shortage of either pig iron or scrap used for ferrous castings. Pig iron, bought in 1971, was still in the store. The scrap yard had a skull-breaker (the only one in Uganda) which could not be used since its electromagnet had been out of order for a long time.

The ferrous foundry had:

> one 15 ton cupola with a burnt out motor, which has been out of order for two years;
>
> one 5 ton cupola, in barely usable condition owning to worn refractory lining and lack of replacements;
>
> 4 small oil fired furnaces with crucibles, each with a capacity of 25 kg, which were brought into operation in November, 1975;
>
> one sand mixing machine, which had broken down beyond repair. (Sands were therefore mixed by hand).

The pattern makers were probably competent, though suffering from lack of drawings, inspection and proper direction. There was a large and full pattern store. The patterns were mostly of wood, but there did not appear to be any system of indexing. The laboratory (set up mainly to control the foundry) appeared to be reasonably equipped with mechanical and physical testing equipment, as well as analytical apparatus but there was no staff. (It was intended to have one qualified metallurgist and four or five technicians and analysts). The non-ferrous foundry had one melter able to produce small castings of brass or bronze up to about 100kg.

There appeared to be no control other than guesswork of the composition of the metal being cast, either ferrous or non-ferrous. The company was relying on the expected return of a German engineer, who had installed some of the equipment several years ago, and the arrival of two Hungarians, expected in April 1976, to get the idle equipment working and operating again or to provide for replacements.

To all intents and purposes, the foundry had been non-functional for about a year when we visited Ugma. We later heard that the Busoga Growers Cooperative had a functional foundry not far away.

III.3 The Machine Shop

This was well equipped with lathes, shaping machines, milling machines, radial and vertical drills, planing machines, slotting machines, a vertical and a horizontal borer. Most of this equipment was lying idle because of the lack of castings to machine.

III.4 Heat Treatment

The factory had a small annealing furnace (2ft x 2ft x 2ft, internal dimensions) which was operational, although the atmosphere could not be controlled. A larger furnace (6 foot cube interior) purchased by the Mehta group before 1972 was still lying unused in the stores.

Case hardening could not be carried out because the last of the case hardening compound had been used several months ago. More was said to be on order. The factory had a furnace for heating large (imported) cast sleeves for the rolls of the cane crushers at Lugazi so that they could be shrunk into existing roller shafts. At least one sleeve recently fitted had split as it cooled down. This seemed to be the result of lack of experience and knowledge.

III.5 Fabrication Shop

The fabrication shop had a full programme making standard trailers for transport of sugar cane. The steel plate, bars, sections, springs, wheels and tyres were all imported. Our quick impression was that the work was competent and reasonably managed in the circumstances. But here, as elsewhere in Uganda, welders were working without goggles.

III.6 Agricultural Implements

Ugma have a similar though smaller production line to that at Uganda Hoes Ltd, with mechanical forging machines for the production of agricultural hoes. The raw material was rolled flat bar from East African Steel Corporation Ltd. This production line was operating at nearly full capacity.

III.7 Discussion

Although we comment on the lack of technical staff at the foundry it is clear that even if such staff had been employed, there was little that they could usefully have done while so much of the foundry equipment was out of order, unless they could have found a way of repairing it themselves. If the equipment had been in order, it could not have been operated efficiently without supervisory staff able to check and test the quality and composition of the castings. In our view the lack of trained and experienced technical personnel is a far more basic problem than the fact that so much of the foundry equipment is out of order.

The only sections of the factory which were working near to their normal capacity (the fabrication shop which was making standard trailers and the agricultural implements plant which was making standard hoes) were not making any spares.

From our visit to Ugma, we believe that a good deal more thought and planning will be necessary if UGMA is to assume a central role in the supply of spare parts to Uganda's industries. One-off spares can be very expensive; it could be much cheaper to buy these from the original suppliers. Local batch production of frequently needed parts, castings for looms for example, should be economic, but only after careful design work. Highly skilled staff would be necessary, and perhaps UGMA's greatest contribution could be in the standards it could set and the training it could provide. We do not question the potential usefulness of Ugma. Had Ugma been able to supply the spares needed by Lugazi sugar factory, Lugazi would probably be working today. But as things stand, the company could not maintain or replace the defective parts in its own foundry equipment, which were among the most vitally needed spares in the whole country at the time of our visit.

Although no definite arrangements had been made, it seemed that Ugma is likely to be fully engaged over the next three years in the rehabilitation of the Lugazi sugar factory, perhaps as subcontractors to whatever firm or organisation undertakes the main work. We would advise that Ugma's services be utilized as far as possible in this way, and that the company's foundry equipment be restored to working order so that it can be used to maximum advantage.

If, however, Ugma could be divorced from the sugar factory, it would probably make better economic sense to gear both the foundry and the machine shop to the production of standard products (such as centrifugal pumps), which might be sold outside as well as within Uganda, rather than using it purely as a jobbing foundry for the (extremely expensive) production of spares on a one off basis. Where there is a regular need for particular spares in a worthwhile number such as sleeves for the cane rollers of sugar mills it would be best to negotiate a licensing arrangement with the main manufacturer, so that they can be made with the benefit of that company's experience.

It would obviously have been instructive to have studied the history of Ugma from 1960 to 1972, when it apparently operated as a supplier of spares to other companies on a jobbing basis, but the time and the opportunity were not available.

Summarily, the first need is to define Ugma's function and then to equip the company for the task. In practice, Ugma appears to be too closely connected with the sugar factory to be able to operate independently. This may well have contributed to the present problems. We would therefore advise that an independent study be made of Ugma's function, organisation and relation to the sugar factory, with particular reference to the foundry. The problem is too complicated to admit of hasty solutions.

Pending the outcome of such a study, assistance is needed in the following areas.

1. Practical and theoretical training for Ugandans in technically advanced countries as metallurgists, mechanical draughtsmen, foundry technicians and engineering inspectors;

2. provision of basic training in these subjects in Uganda;

3. rehabilitation of the Ugma foundry, including the provision of expatriate staff to supervise and carry out repairs and supervise initial operation again. Possibly areas 2 and 3 could be merged.

IV UGANDA OXYGEN COMPANY LTD

It is owned 100% by East African Oxygen Ltd. itself a subsidiary of British Oxygen Company Ltd. Paid up Capital is Shs. 3 million. Statistics for 1974 follow in Tables E5II-E5VI.

Table E5.II

Uganda Oxygen Company

Capacity & Production; 1974

Product	Installed Capacity m^3/year	Actual Production m^3/year	Product Value Shs	Expected Production 1975 m^2
Oxygen	200,000	138,144	1,657,7000	150,000
Acetylene	100,000	56,000	1,232,000	75,000
Compressed air	200,000	500	5,000	1,000
T O T A L		194,644	2,894,700	226,000

Table E5.III
Uganda Oxygen Company
Sales; 1974

Market	Product	Average ex factory price Shs/m^3	Quantity sold m^3	Value of sales Shs.
Local	Oxygen	10.2	134,144	1,657,700
Market	Acetylene	19.7	56,000	1,232,000
	Compressed air	9.7	500	500
Other countries	Oxygen	10.2	1,000	10,200
Rwanda	Acetylene	19.7	2,000	39,400
T O T A L				2,831,000

Table E5.IV
Uganda Oxygen Company
Fixed Assets; end 1974.

Machinery and Equipment	385,140 Shs.
Factory buildings	821,160 Shs.
Motors and other Vehicles	118,980 Shs.
Office Furniture and Fittings	86,600 Shs.
Cylinders	529,060 Shs.
	1,940,940 Shs.

Table E5.V
Uganda Oxygen Company
Permanent Employees; 1974 (Wholly Ugandan)

Category	Male	Female	Total Wage Bill Shs
1. Managerial	3	1	220,000
2. Qualified Technicians	3	nil	72,000
3. Skilled (on job)	38	2	428,460
4. Drivers	2	nil	13,200
5. Unskilled Workers	10	nil	54,000
T O T A L			787,660

Table E5.VI

Uganda Oxygen Company

Raw Materials, Imported; 1974

Description	Price Shs/kg	Quantity kg	Value Shs
Acetone	8.5	7,000	60,000
Calcium carbide	2.5	200,000	500,000
Caustic soda	3.0	2,000	6,000
T O T A L		272,000	566,000

Foreign exchange requirements for 1975, including new plant and replacements, total Shs. 2 million.

IV.1 Products

The statistics given above refer only to items made on the spot. The company also imports and retails several items whose manufacture in Uganda would not be economic.

IV.1 Items made on the spot

1 Industrial Oxygen 99.75% min) compressed in standard

2 Medicinal Oxygen 99.5% min) cylinders

3 Acetylene compressed in cylinders, with acetylene and charcoal.

4 Liquid Nitrogen. Small amounts sold to dept of Veterinary Sciences, Makerere University.

IV.1.2 Items Imported and Resold

A. Gases

1 Nitrous oxide, for hospitals

2 Argon (to Kilembe Mines for welding)

3 Nitrogen

4 Hydrogen

5 Freons, 12 and 22.

Items 1 to 4 are supplied compressed in bulk cylinders from BOC's other factories, and filled into smaller cylinders in Uganda. Item 5 is bought from Dupont Chemical Company in disposable cannisters.

B. Hardware

Welding machines, gas and electric
Welding and cutting torches
Welding rods, various types
Anaesthetic and resuscitation equipment

IV.2. Technical Service

Uganda Oxygen Company has one technical service engineer who advises customers on welding methods and problems and arranges training courses for Ugandan welders in the training school run by its parent company in Nairobi.

IV.3. Discussion

The senior staff of the company, who were all Ugandans, appeared well trained and competent. The factory has a small air separation plant, a plant making acetylene from calcium carbide, a cylinder filling department and a cylinder and valve testing department. Though fully functional, the plant was suffering from arrears of maintenance which, in our view, could adversely affect its safety and lead to serious accidents. We were informed that the main reason for this lack of maintenance was the company's inability to obtain spares and replacements, either within the country or from abroad.

We noted the following examples:

1 holes in the factory floor were unfilled - we were told this was because of a shortage of cement in the country;

2 gas cylinders had not been painted with their distinguishing colour paints for a long time. Some had not been painted at all, thus leading to mistakes in identifying the contents. This we were told resulted from non-availability of the right coloured paints in Uganda;

3 missing nuts and bolts on pipe flanges. Again we were told that this was owing to delays in supply because of a shortage of foreign exchange;

4 lack of rubber cushions for unloading gas cylinders from trucks;

5 acute shortage of protective caps on cylinders to prevent damage to cylinder valves in transport, etc;

6 a make-shift intercooler on a gas compressor had been improvised to keep the plant in operation when the original intercooler failed. The works manager was most concerned about the safety of the improvised cooler which could not be guaranteed to withstand the pressure.

In all cases, shortage of foreign exchange and delays in procurement were given as the reasons for shortcomings. The situation was thought to be improving as the authorities were now aware of the importance of this plant to engineering and maintenance work in Uganda, although much of the manager's time was said to be spent in lobbying approval of orders for spare parts from abroad.

While the factory is producing satisfactorily at present, the situation leaves no room for complacency. It could easily deteriorate and there is serious risk that a major accident could occur, causing the factory to be closed. We felt we were only witnessing the early stages in the run down of an industry, such as had occurred earlier in several others, (e.g. East Africa Glass Works Ltd). We appreciated the pressures under which many factory managers are living particularly the pressure to keep production going at all costs even when it is known that the plant is not in a safe state to operate.

We have drawn the situation to the attention of the safety manager of British Oxygen Company Ltd in the hope that his company may be able to do something to alleviate the situation.

APPENDIX E6

FERTILIZERS AND CHEMICALS

I. SUMMARY

The only significant manufacture at present is that of single superphosphate from local apatite by Tororo Industrial Chemicals and Fertilizers Ltd (TICAF) at Tororo. This itself is small and its entire production (now probably about 15,000 tonnes/year) is readily sold in Uganda at prices above the world levels. (Imports are effectively controlled by restrictions on foreign currency). A serious problem of this operation is the low recovery (25%) of apatite (calcium fluor-phosphate) from the ore during concentration, so that 75% is wasted or degraded. A detailed on-the-spot technical study of the entire concentration process (both at the quarry and at the factory) is needed as a matter of urgency to conserve raw material, and this should be done before a large plant is designed and built.

The Lake Katwe Salt Project is discussed here, as well as plans to expand fertilizer production and manufacture other chemicals. There is considerable scope for the chemical industry in Uganda. The main constraints are shortages of trained and experienced personnel, capital and foreign exchange for plant and machinery.

II. BACKGROUND

Clear dividing lines cannot be drawn between chemical and other process industries where by-products of one are the raw materials of another. This survey, based on a very limited study, tries to indicate areas to which more attention should be paid.

Because of its landlocked position and the high transport costs for imported goods, Uganda presents opportunities for the manufacture of inexpensive chemicals for which raw materials and markets are available locally. Single superphosphate production by TICAF at Tororo is the only one of importance now being carried out and this is on a very small scale. The only significant project now being implemented is the Lake Katwe Salt Project.

II.1. Lake Katwe Salt Project

The main details of this project, given in the report of the UNIDO Programming Mission are shown in Table E6.I. (p.67). At present Uganda imports virtually all its domestic salt for table and cooking use, about 30,000 tonnes per year from the UK, USSR and Aden. Imports are subject to a 60% duty in addition to high transport costs. Other requirements for animals, fish preserving, treatment of hides and skins, and other industrial uses are met mainly by crude Katwe salt. It is expected that the entire 50,000 tonnes/year of sodium chloride to be produced will be completely used in Uganda. There is a limited use of potassium chloride as a fertilizer (on tea estates) in Uganda, but there will probably be an excess when production starts and export markets will have to be found until the Ugandan market is more developed. 'Burkeite', a mixture of sodium sulphate and carbonates, may find a use in the cobalt project, but production will not be large.

Although the backers of this scheme have a second stage of the project in mind in which the plant will be enlarged and the electrolysis of sodium chloride added (to give caustic soda, chlorine, bleaching solution and hydrogen) they are in no hurry to pursue this until the inevitable teething troubles of the present stage have been surmounted. With this we agree. The only point in the present project which we suggest could usefully be re-examined is the use of oil-fired boilers, owing to the high cost of fuel oil and the potentially low price of fuel wood. (See Appendix E8, Fuel and Energy, p.91).

II.2. Tororo Industrial Chemicals and Fertilizers Ltd.
Present Operations, Single Superphosphate (SSP) Manufacture

Features particularly noted during a brief visit to the plant in March 1976 are given in Table E6.II, (p.68).

The plant is a very small one and was built mainly as a pilot plant to gain experience before building a commercial sized unit planned for the late 1960's. The most unsatisfactory feature is the low recovery of apatite in the concentration plant, partly at the mine and partly in the factory. Recovery was poor from the outset and has deteriorated further due to poor performance of the flotation cells. As a result, two thirds or more of the phosphate in the ore mined are lost and downgraded, and only about 25% recovered as 41% P_2O_5 material. A thorough technical study of all the concentration steps is needed in order to reduce the loss to an acceptable level before a larger plant is designed.

Hydrogen fluoride formed by reaction between apatite and sulphuric acid appears to escape to the atmosphere. In principle this could be recovered as fluorspar by reaction with lime (solid or slurry). A few hundred tons/year of fluorspar are at present imported as an ingredient for the cement works next door.

The price of SSP was raised, in 1974, from 20 to 35 Shs. per 50 kg bag and again to 50 Shs. per bag in late 1975, which seems to be well above world prices. At the present production rate (probably less than 60% of capacity) there is no difficulty in marketing the limited amount of SSP made in Uganda, largely since it is impossible to import because of foreign exchange difficulties.

III. **PROSPECTS**

III.1. **Fertilizers**

In principle, it should be possible to produce phosphatic fertilizers at Tororo on a large scale at well below world prices. The availability of by-product sulphuric acid from a cobalt project would assist this.
The real requirements for phosphate fertilizers in Uganda are difficult to judge and extensive trials are needed to gain a clear picture. There were plans in the late 1960's to increase production of soluble phosphate at Tororo by five times. The plans involved the production of wet process phosphoric acid and Triple Superphosphate; gypsum (needed for the cement plant at Hima) would have been a by-product. A policy of cheap, locally produced and, if necessary, subsidised fertilizers would appear sound for Uganda, a primarily agricultural nation. Yet it would be difficult to envisage expansion of phosphate fertilizer production now in Uganda, in the depressed condition of the world market, and with the lack of local expertise and capital. There is a case for involvement both of Ugandan growers and of a foreign partner specialising in fertilizers in the

management, if not ownership, of the company.

Production of nitrogenous fertilizers based on hydrocarbon feedstocks seems unlikely in Uganda because of high hydrocarbon prices, but the possibilities of nitrogen fixation by electrical means are worth study.

Potassium chloride, to be produced at Lake Katwe, will probably supply most of the country's needs for potassium fertilizer, though small amounts of sulphate might be produced by reaction with sulphuric acid for use on crops such as tobacco. It might also be possible to recover potassium salts from the flue dust from the Hima cement works, as is being done increasingly elsewhere.

III.2. Other Chemicals

There is considerable scope in Uganda for the production or processing of chemicals for local needs from local raw materials. The constraints are those common to other industries, and in other developing countries: shortages of technical, managerial and entrepreneurial skills, of experience, of capital and of foreign currency, especially for plant machinery and spare parts. The establishment of a tannery will create a limited need for chemicals. A rubber plantation, if established, would create a need for acetic acid and other chemicals. The former could be made as a by-product of charcoal production. There is scope for the formulation of insecticides, herbicides, fungicides and wood preservatives from imported ingredients, thereby saving considerably on the cost of importing already formulated products. The use of oils, such as castor and sesame, could be greatly developed for medicine, soap, lubricants, plastics, oil cloth and other purposes. Other chemicals with local uses could be made by electro-chemical or electro-thermal reactions through the use of cheap hydro-electricity. Before these possibilities can be followed up, a better investment climate must be created. A feasibility study made several years ago on an electro-chemical industry could not be discovered anywhere in Kampala. Wider appreciation of the benefits of a chemical industry and better relations with foreign partners are essential for the industry to grow and flourish.

Table E6.I

Lake Katwe Salt Company Ltd.

Incorporated	1975
Ownership	UDC 100%
Products	
Sodium Chloride	50,000 tonnes/year (mainly home consumption)
Potassium chloride	17,000 tonnes/year (fertilizers - part export)
'Burkeite'	sodium carbonate - sulphate mixture - smaller quantity
Commissioning date	1978
Contractors	Thyssen Rheinstahl Technik, Dusseldorf
Foreign exchange required	D.M. 45.2 million
Source of Capital	
Loan W. German Govt	D.M. 26.2 million
E.A.D.B. and others	balance
Raw Material	L. Katwe brine
Utilities	
Power	2 mW (from UEB, with diesel stand-by)
Fuel	imported fuel oil

Table E6.II

Tororo Industrial Chemicals and Fertilizers Ltd.

SSP Manufacture

Equity shareholders	
Majority	UDC Ltd.
Minority	Fertilizer Corporation (USA) and Falconbridge (Canada)
Started production	1962
Management	Autonomous (by ICI till 1972/73 under special agreement).
Capacity	
SSP	30,000 tonnes/year
Sulphuric Acid	10,000 " /year
Condition of Plant when visited	
1. Apatite mining and concentration	Operating. Good purity product (41% P_2O_5) but low recovery about 30% - due partly to worn impellers of flotation cells and resultant poor agitation.
2. Sulphuric acid production	Shut down due to lack of imported sulphur. Plant just operational but in poor state due to non-arrival of imported spares. Concrete badly eaten round bases of vessels and foundations suspect.
3. SSP production	Shut down due to lack of sulphuric acid. Superficially in better state than sulphuric acid plant.
Product	
Price	50 .Shs per 50 kg bag
Soluble P_2O_5	21.5% W
Free acid	less than 3%

APPENDIX E7

FOOTWEAR TYRES, LEATHER AND RUBBER

I SUMMARY

Uganda has one modern and well run footwear factory which supplies about 80% of the internal market and has a capacity of 14,000 pairs per day. Production is now only 25% of capacity owing entirely to restrictions on foreign exchange for raw materials and spares; it could be rapidly revived if these restrictions were lifted. Uganda also makes bicycle tyres (tubes and outer covers). Output has fallen to about 33% of its peak in 1971, for the same reason, although it could probably not pick up again as rapidly as footwear for several reasons, including a shortage of bicycles in the country.

A scheme has been approved and is going ahead to build a tannery at Jinja to process about half of the hides and skins now exported; 50% of the production will be semi-finished wet blue chrome leather for export and 50% will be finished leather, mainly for use in Uganda to replace present imports of leather for footwear.

The footwear and cycle tyre manufacturers are interested in establishing a small modern rubber estate near Masindi to supply natural rubber for their own needs. Despite the collapse of the small natural rubber industry in 1972, owing to abnormally low prices, we believe that conditions have now permanently changed in favour of natural rubber production, and that the proposal should be encouraged.

II INTRODUCTION

These subjects are conveniently grouped together. The footwear industry as represented by Uganda Bata Shoe Co Ltd is well organized, and can make a wide assortment of footwear. Its output is restricted by shortage of imported raw materials, (leather, rubber and plastics) due to lack of foreign exchange. The tyre industry represented by Dunlop East Africa Ltd is struggling against odds to maintain its production of a limited range of bicycle tyres and inner tubes. There is at present no large tannery in Uganda, and the bulk of hides and skins is exported. An industry is now planned, with Arab finance and management, and contractors for the building of a tannery are being selected. There is virtually no natural rubber produced in Uganda, but in view of high world prices, which are likely to continue indefinitely, the establishment of a small rubber industry (for shoes and tyres) is being considered.

III FOOTWEAR

Time only allowed a visit to the largest producer, Uganda Bata Shoe Co of Kampala, believed to produce 80% of the footwear made in Uganda. The main information gleaned is given in Table E7.I(p.71). The factory employs modern mass production methods which are efficient though the work is repetitive and monotonous. Working conditions were as good as any found in Uganda. Close technical liaison with the world wide chain of Bata factories maintains a high standard of efficiency and best utilization of raw materials, over 90% of which are imported. The entire output of the factory is readily sold in Uganda at controlled prices, and there is an unofficial market for its products at considerably higher prices. A wide range of footwear of various types and materials can be produced, and it is largely owing to this factory that Uganda today is well shod compared with most African countries.

The main constraint on production is imported raw materials, leather, PVC, rubber and chemicals and miscellaneous materials for which less than 10% of the foreign exchange required was allocated last year. The company is in favour of leather and rubber production in Uganda, and put forward its own tannery scheme before the Arab proposals were adopted. (There is only scope for one tannery in Uganda at present). Although rubber only amounts to 15% of total imports compared with 35 to 40% for PVC, the proportion of rubber used could be raised considerably at the expense of PVC if local rubber of suitable quality were available.

IV TYRES

All car and heavy vehicles tyres and inner tubes are imported, but owing to restrictions on foreign exchange, there is an acute shortage in Uganda and prices have sky-rocketted.

Only one company, Dunlop East Africa Ltd, makes bicycle tyres and inner tubes in Uganda at its Jinja factory. The name of the company now seems a little anomalous since most connections with the parent company were severed in December 1972 when the company was nationalized by decree and expatriate staff left. Liaison (largely unofficial) with the former parent company is still maintained in certain areas, especially in the supply of raw materials and spare parts for machinery. Dunlop East Africa Ltd (in common with other companies) imports and sells tyres, sports goods and other products and the value of sales in recent years is given in Table E7.II, p.72.

Table E7.I

Uganda Bata Shoe Company Ltd

Ownership	100% Canadian parent company.	
Factory built	1966	
Factory doubled	1972	
Production, pairs/day	Capacity	Actual Present
Moulded shoes and boots	8,000	nil
Built up shoes	6,000	3,500
TOTAL	14,000	3,500
Personnel, present production	250	
Sales and administration	150	
TOTAL	400	
Top managers	Mainly European- Belgian, Italian Swiss, French and British.	
Staff training	Promising Ugandan staff sent abroad for training.	
Raw Materials	Source:	% of value of total raw materials at full production
Cotton cloth	Ugandan	5
Leather	imported	30 to 35
PVC	imported	35 to 40
Rubber	imported	15
Chemicals and miscellaneous Shoe eyes, etc	imported	10
Cost of imported raw materials on full production	36.0 million U shs/year	
Raw materials imports in 1975	2.8 million U shs for whole year	
Shifts worked	Present 1	Full production 3

Table E7.II

Sales in Uganda of Dunlop East Africa Ltd

'000 Shs.

Year	Local Manufacture	Imports	Total	Local Manufacture as % of total	Shifts Worked
1971	8,159	6,894	15,053	57.6	2 to 3
1972	11,632	8,556	20,188	57.6	2 to 3
1973	11,745	7,868	19,614	54.9	2 to 3
1974	19,469	6,590	26,059	74.7	1 to 2
1975	6,736	5,604	12,640	53.2	1

In spite of the rise in value of sales in 1974, the volume sold fell owing to a steep rise in prices. The volume fell further drastically in 1975, because of a shortage of foreign exchange allocated.

Essential details of cycle tyre and tube production are given in Table E7.III p.73. The factory machinery was mostly in fair working order, though improvisation had been resorted to here and there and some machine operations are being carried out manually. There appears to be a tendency to use excessive quantities of fillers in the tubes and tyres to make the rubber go further, to the detriment of quality. The average life of a bicycle tyre outer cover was said to be 6 months and of a tube 10 months. To explain these short lives,it was stated that bicycles are used for the transport of heavy loads, e.g. bales of cotton weighing up to 300 kg and that most wheels are bent with spokes broken or missing.

It is evident that the factory cannot operate properly without an adequate supply of raw materials and spare parts. While the staff appeared to be competent and making the best out of a difficult situation, production would clearly benefit from closer contacts with the former parent company, perhaps as consultants.

The management of the company was as anxious to see a rubber industry established in Uganda as Bata, and would like to participate in the equity. In 1974,the company used 225 tonnes of natural rubber, 50 tonnes of reclaimed rubber, 39 tonnes of rubber crumb (reclaimed) and nearly 60 tonnes of synthetic rubber at a total cost of about 2 million Shs.

The cotton fabric used for the manufacture of cycle tyre outer covers is of unbleached cotton and bought from India. For full production it would cost 2.4 million Shs/year. It might be possible to make similar or at least suitable material in Uganda perhaps on one of the jute looms at Mbale. Better results would be obtained with any cloth if it were first treated with a vinyl pyridine latex to improve bonding to the rubber.

Table E7.III

Cycle Tyre and Inner Tube Production

Dunlop East Africa Ltd. Jinja

Started	1964, Majority holding by Dunlop
Nationalized	1972-73 under UDC caretaker control
Present	Controlled through Min of Ind and Power
Products	
Tyre covers	28" x 1½" - 3 brands 26" x 1¼" - 1 brand
Inner tubes	28" x 1½" - 2 brands 26" x 1¼" - 1 brand
Rubber solution	for tyre repairs
Rubber adhesive	for PVC tiles, joinery
Staff & Personnel (all Ugandan)	Managers 3, Office staff 16 Maintenace workers 12 Drivers 2 Foremen 3 Production workers 60 Formerly 150 production workers when on 3 shift production.
Prices, ex factory, tubes	31/60, official retail 44/-
covers	11/10, official retail 15/50
Raw Materials	Over 90% imported. Natural, synthetic and reclaimed rubbers, complex mixture of chemicals and additives, special cotton fabric bead wires, valves, solvents.
Foreign exchange allocation	Required for full production, 1976 8,570,000 Shs. Received Jan to mid-March 1976, 600,000 Shs.

V LEATHER

Most cattle hides, goat and shee skins in Uganda are suspension dried and exported, and there is as yet no large scale tannery. In 1970, a study was made by UNIDO of the feasibility of a Tanning Industry in Uganda. Several parties have since shown an interest in establishing tanneries in the country. Some of the more serious are listed in Table E7.IV (p.75). Those of AFARCO Ltd (AFRO-ARAB Company for Investment and International Trade) and Bata International Shoe Co are mutually exclusive, and the Ugandan Government has decided in favour of the AFARCO project, which includes Kuwaiti, Libyan and UDC interests. A feasibility report was made by R.H.Sanbar Consultants of Beirut in association with P.A.Management Consultants Ltd, in 1974. On the basis of this study the finance has been raised and Government approval given. A site has been acquired at Jinja, and tender documents have been issued to short listed contractors.

V.1. Availability and Quality of Hides and Skins

The regional distribution of cattle hides and goat skins in Uganda is given in Table E7.V.(p.78). 50% of the hides come from W.Buganda, E.Buganda, Busoga and Teso. 60% of the skins come from Ankole, Busoga, Toro and Kigesi. In 1972,there were an estimated 4.6 million head of cattle and 0.9 million head of sheep, both of which had been increasing at about 5% per year. The goat population which has been declining was officially estimated at 2.0 million in 1974, although this is low in relation to figures on hide counts given by the Department of Veterinary Services and Animal Industry in Table E7.VI. (p.78).

Approximately 33% of sheep and goats and 12.5% of cattle are slaughtered annually.

There is a large discrepancy between the statistics of goat skin purchases given by the Ministry of Agriculture and Animal Resources (in line with the skin counts given in Table E7.VI) and F.A.O. estimates of goat slaughterings, which are only about half this figure. The East African Community Trade statistics are in line with those of the MAAR. It is possible that the discepancy results from unrecorded imports of goat skins from neighbouring countries. The probable annual availability of hides and skins of export quality is,

hides	400,000
goat skins	1,200,000
sheep skins	200,000

Table E7.IV

Serious Tannery Proposals in Uganda

Name of Company	Proposed Location	% of Ugandan Hides and Skins Required
AFARCO	Jinja	About 50
Universal Leather Co Ltd	Jinja	About 50
Bata International Shoe Company	Jinja	70
Export Import Company	Jinja	Unknown
Eriya Manya Company	Jinja	10

Uses and ratings of Ugandan hides and skins according to Sanbar are given in Table E7.VII.p 78. The cattle hides being smaller than European cattle hides will have less application in upholstery. While only a small percentage will qualify for full grain and clothing leathers, their grain defects and damage can be disguised by a buffed finish. A reasonably stable level of supplies is expected throughout the year, though some peaking may be expected in the first quarter. Average prices and export duties in 1973 - 1974 for hides and skins are given in Table E7.VIII, p.79 (they are somewhat higher now). Higher export duties may be required in the initial years of tannery operation.

V.2 **Basis of Tannery**

The tannery will be based on the sale of 50% of its output (mainly exports) as semi-finished wet blue chrome leather and 50% as finished leather , mainly for the home market.

The capacity is understood to be 280,000 cattle hides/year (54% of Uganda's total production) 560,000 goat skins/year (47% of Uganda's total production).

Key data based on 1974 prices are given in Table E7.IX.(p.79). Costs of raw hides and skins and sales revenue of semi-finished skins at 1974 prices are given in Table E7.X (p.79).

The tannery is based on well accepted and conservative lines using modern equipment and practice. It is expected to earn a modest return on capital, about 12.5%, if no tax holiday is allowed.

Operating costs for a tannery producing 140,000 finished cattle hides as well as 140,000 semi-finished hides and 560,000 semi-finished goat skins as estimated by Sanbar Consultants are given in Table E7.XI (p.79). A total labour force of 328 is expected.

V.3 **Some Opportunities and Pitfalls**

The tannery proposal appears to be both detailed and soundly based. If anything, it has probably underestimated the size of the Ugandan market for finished leather, which includes not only boots and shoes, handbags and cases, but also leather for industrial purposes including rollers for cotton gins. We understand that approximately 2000 rollers are used annually in cotton ginneries, each 900 mm long and 180 mm diameter consisting of a number of blue chrome leather discs pressed together on a metal shaft between circular plates at each end. These are now all imported from India, and might use about 6000 hides per year.

Some of the chemicals required by the tannery could be supplied from Ugandan sources, salt, lime, sodium carbonate and sulphuric acid, though the quantities are all quite modest. Dyes, tannins and finishes will initially all have to be imported, though there may be scope for producing tannin from wattle bark as is done in Kenya.

Effluent treatment and disposal must be carefully studied, particularly in relation to users of Nile water downstream of the tannery, such as Nile Breweries Ltd.

Some form of technical cooperation with a modern and well established tannery outside Uganda is desirable in the early years of operation. It is essential that the company be assured of its foreign exchange requirements for chemicals, machinery spares etc.

Table E7.V

Regional Distribution of Hides and Skins

% of hides		% of goat skins	
W.Buganda	18	Ankola	18
E.Buganda	12	Busoga	15
Busoga	10	Toro	14
Teso	9	Kigesi	13
Ankole	8	W.Nile	8
Busisu/Sebei	8	Lango	6
Lango	6	Teso	4
Toro	5	Bugisu/Sebei	4
W.Nile	5	Masaka	4
Other Regions	19	Other Regions	14
TOTAL	100	TOTAL	100

Table E7.VI

Thousands of Cattle, Goat and Sheep Slaughtered

Year	Abbatoir slaughterings			Total Hide Counts		
	Cattle	Goats	Sheep	Cattle	Goats	Sheep
1970	130.1	-	-	512	1179	220
1971	125.5	117.9	39.2	526	1121	221
1972	170.6	19.3	41.4	485	1142	203
1973	148.7	96.3	39.6	543	1189	179
1974	185.1	105.7	42.0	547	1492	239

Table E7.VII

Sanbar Estimates of Ugandan Hide and Goatskin Quality and Uses

	Hides	Goatskins
First Rate	20	40
Second Rate	40	40
Third Rate	40	20
Uses	Shoe leather sandals, lower priced handbags	Wallets, watch straps Fancy goods, Ladies shoes and sandals

Table E7.VIII

Average Prices and Export Duties in 1973/74 for Ugandan Hides and Skins

Shs. per 100 kg

	Cattle hides	Coat skins	Sheep skins
Average price	743	2040	
Export duty	26.85	64.50	34.85

Table E7.IX

Key Economic Data US $

Capital Expenditure	
Fixed Capital	2,481,000
Capital Replacements (78.82)	496,000
Stocks of Raw Materials & Chemicals	1,041,000
TOTAL	4,018,000
Sales Revenue at full Capacity	5,355,000
from wet blue chrome production	3,339,000
from finished leather production	2,016,000
Operating Costs at full Capacity	4,125,000

Table E7.X

Cost of Raw Material and Sales Revenue

$ per piece

	Raw Material	Sales Revenue
Cattle hides	7.19	14.5
Goat skins	1.46	3.00

Table E7.XI

Estimated Operating Cost of Tannery

	$ per year
Raw Materials	2,830,800
Labour	280,000
Chemicals	660,200
Services	348,300
Total	4,125,300

VI RUBBER

Uganda at one time had a small natural rubber industry. All that now remain are a few small estates near Masindi, totalling less than 400 hectares. Most of them have been abandoned and are growing wild. One small 'estate' of about 100 hectares at Margashu is said to be still producing, but the trees are very old and not of a high yielding variety. Essential requirements such as acetic acid, cutting knives and stainless steel trays are not available. The rubber industry in Uganda, which had been struggling for some time, virtually collapsed in 1972 when the price of natural rubber fell to under 12 p per kg, the lowest since 1949.

Since then the world rubber market has changed completely. About three quarters of the world's rubber is synthetic and derived from petroleum. The price of synthetic rubber is related to crude oil prices, which rose by a factor of 4 during 1973 and 1974, and seem unlikely to fall significantly (See Appendix E8, p.82, section II.) The price of natural rubber after rising to 55 p per kg in 1974 fell later in the year to 26 p, and has since climbed back to between 40 p and 50 p per kg. There is an obvious floor to synthetic rubber prices of around 40 p per kg which is supported by petroleum prices. This in turn will keep up the price of natural rubber which has the smaller share of the market. Another factor firming natural rubber prices is the continued political tension in S. East Asia.

Uganda requires about 500 tons/year of rubber for boots and shoes, and could use probably twice this figure or more in place of PVC if indigenous rubber of proper quality were available. Rubber is even more essential for tyre manufacture. The present bicycle tyre factory at Jinja requires about 350 tons/year of natural rubber, and could probably utilize 500 tons/year by cutting back on synthetic rubber. Rubber requirements in Uganda would mount considerably if larger tyres were manufactured.

There appears to be a case for reviving Uganda's small rubber industry, at least for supplying the internal needs of the country. We understand that certain species of high yielding trees, not available when Uganda's rubber industry was first established, are quite suitable for the climate at Masindi, which is judged to be the best in the country for rubber production. Uganda Bata Ltd., Dunlop East Africa Ltd, and UDC are interested in a joint venture in this area, with a small modern rubber plantation of a few thousand hectares. They have proposed to the Ministry of Industry and Power that a feasibility study be undertaken by leading experts in this field, the Rubber Research Institute of Malaysia, at Kuala Lumpur. We understand that Bata would be prepared to sponsor this study, subject to agreement by the Ugandan Government. We believe there to be a very good case for proceding with the study. It must, however, be pointed out that of all plantation industries rubber is one of the most demanding in terms of skilled attention and inputs of essential materials and chemicals. Provided the project is not too ambitious, and is limited in the first instance to supplying the domestic market, we believe it should be encouraged. The prospects of producing natural rubber for export are more doubtful.

When planning a rubber plantation consideration should also be given to the eventual utilization of the old rubber trees for fuel wood or charcoal. This does of course depend on the presence of a regular fuel demand in the area, but such an outlet might go a long way towards the costs of replanting on a regular basis when trees have reached the end of their useful life.

APPENDIX E8

FUEL AND ENERGY

I. SUMMARY

Oil prices quadrupled during 1973 and 1974 and Uganda therefore needs to make greater use of wood as fuel and of electricity for industrial power, rail locomotion and high temperature industrial process heating. Our main recommendations are:

1. the establishment of a eucalyptus fuel wood plantation N.W. of Hima of approximately 26 km^2 to supply fuel wood for the cement factory, replacing imported fuel oil;
2. greater emphasis on electrical heating instead of fuel oil for high temperature process heating such as glass making;
3. re-negotiation of the 1954 agreement to supply 30 MVA to Kenya as soon as demand in Uganda outstrips available supply. The price paid by Kenya was fixed in 1954 and is very close to the current generating cost.

II. GENERAL

The costs and availability of fuel and energy are necessarily important elements in Uganda's economy. They must be considered in a global context as well as in a purely Ugandan. Although Uganda has potentially good indigenous fuel and energy supplies, considerable investment is required for their development, production and utilization. A large part of Uganda's current fuel needs is met by imported petroleum products, the prices of which have risen more in recent years than those of Uganda's main exports, coffee, cotton and copper. The problem of a rapid fourfold increase in oil prices, coming soon after the changes in technical management made in Uganda in 1972, has seriously complicated the country's economic difficulties.

Although the oil crisis was immediately caused by the Arab - Israeli war of 1973, its roots lie deeper. It is the inevitable outcome of the rapid depletion of the world's petroleum reserves. The crisis followed a period of many years of stable oil prices and rising world consumption, during which the USA changed from being an exporter to a major importer of petroleum and most West European countries increased their petroleum consumption at the expense of coal. Had the oil crisis not come in 1973, it would inevitably have come a few years later. Most experts expect the bulk of the world's petroleum reserves to be exhausted within 60 to 100 years and so it is reasonable to assume that the previous era of cheap and plentiful oil supplies is a thing of the past. The development of new oil fields and lower world consumption may result in short periods of over-supply with lower prices, but such respites can only be temporary.

World reserves of solid fossil fuels, coal, shale, lignite and tar sands may be expected to last for a few hundred years more. They are likely to provide a source of liquid hydrocarbon fuel for use in transport, though at a higher cost than the previous cost of petroleum products. After that, the main source of fuels is likely to be vegetable matter. There is no shortage of vegetable matter, for about 150,000 million tons of carbon are fixed each year. The problems are the difficulty and expense of collecting it and converting it to a useable fuel. It is doubtful how far atomic energy will play any significant part in the world's transport. High hopes once held for the widespread use of atomic energy for power generation have dwindled with the realization of (1) the long term problems inherent in the handling and disposal of large amounts of radio-active waste which will take thousands of years before it becomes harmless, and (2) the limited reserves of uranium in the earth's crust.

Against this world background, Uganda is fortunate to have long-term prospects of perpetual and renewable energy resources: hydro-electric power, solar energy, timber and other agro-based fuels. These fuels were the subject of a symposium at Makerere University in 1974.[1] Only the most obvious fuel and energy sources are discussed in the present study. Uganda's main long-term advantages in fuel and energy are:

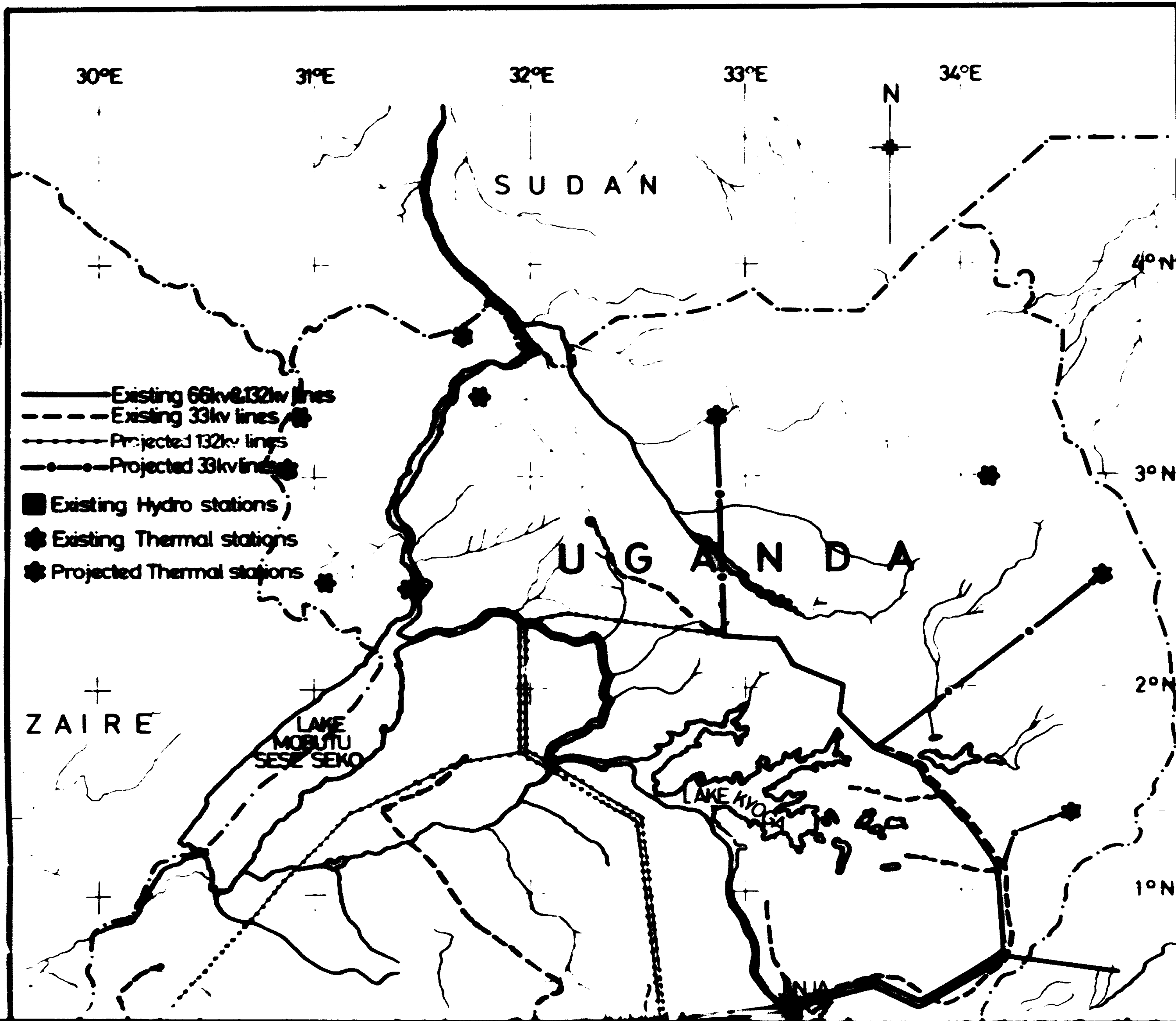
1. Uganda has for the most part a warm but not excessively hot climate requiring neither domestic space heating nor air conditioning both of which make significant demands on fuel and energy;

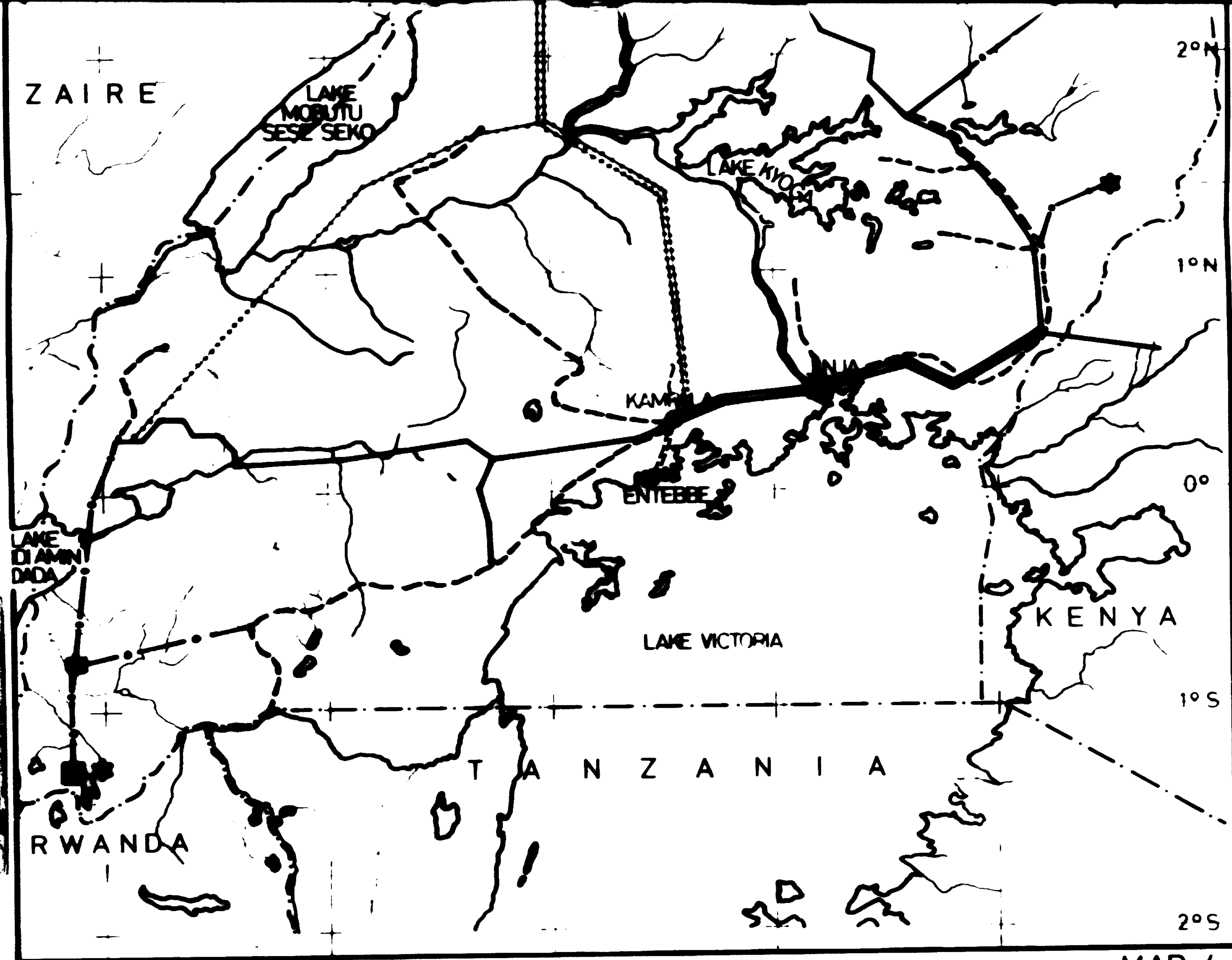
2. Uganda has large untapped reserves of hydro-electric power, mainly through harnessing the 500 metre descent of the Victoria Nile between the levels of Lake Victoria and Lake Mobutu Sese-Seko. This project is capable of generating continuously well over 2000 MVA compared with the present installed capacity of 150 MVA at the Owens Falls station;

3. conditions in Uganda are favourable to the use of solar heaters for domestic hot water all the year round, thereby saving fuel and electricity. Such heaters are now widely used for example in Cyprus, Israel and Kenya;

4. Uganda has considerable areas of under-utilized land whose soil and climate appear suitable for sustained high rates of growth (over 50 tonnes dry weight per hectare per year) of crops which may be utilized as fuel (e.g. eucalyptus and other woods). The figure includes 500 to 1000 km^2 of recoverable swampland out of some 5000 km^2 of swamp;

5. in unreclaimed swampland and shallow lakes, Uganda has an enormous potential to grow algae all the year round at high growth rates (50 to 125 tonnes dry weight per hectare per year). This material might be converted biologically to methane in good yield.


30°E
31°E
32°E
33°E
34°E
N
SUDAN
UGANDA
ZAIRE
LAKE MOBUTU SESE SEKO
LAKE KYOGA
4°N
3°N
2°N
1°N
Existing 66kv&132kv lines
Existing 33kv lines
Projected 132kv lines
Projected 33kv lines
Existing Hydro stations
Existing Thermal stations
Projected Thermal stations



MAP 4.

UGANDA
ELECTRIC POWER.

> Although so far this process is only being used industrially on a small scale, a great deal of effort is being put into large scale development in the USA and other countries as a solution to the growing hydrocarbon crisis.[2] The United Nations Energy Programme is also actively involved in biologically produced methane. We understand that a recent survey by Dr. Winter has recommended its use in Kenya. Large-scale exploitation can be envisaged, in which the methane is purified, compressed and distributed by pipeline in the same way as 'natural gas'. Methane could even be used for road transport, provided the necessary investment were made, though it is far less suitable for this purpose than liquid fuels.

The above-average prospects for future energy supplies contrast sharply with present conditions in Uganda where hydro-electric power, though available at a low price for industrial use, has shown no growth over the past five years. It is scarcely used by the masses. Low purchasing power, low housing standards (frequently unsuitable for the installation of electrical wiring) and scattered dwellings have retarded rural electrification. The supply of domestic electricity is confined mainly to towns and large villages on main roads. At the same time, the country is faced with a heavy burden of foreign exchange for the purchase of petroleum-based fuels used for transport and industry. Wood (and to a lesser extent charcoal) are used as domestic fuel (for cooking and water heating) and for some industrial purposes (steam raising, brick making). Other agricultural wastes, such as coffee husks, are also used as fuel. Large users of industrial fuel, such as cement works, were designed to use fuel oil almost exclusively.

Before considering possible economies in fuel utilization, the present utilization of electricity, petroleum-based fuels and wood and charcoal is considered in more detail.

III ELECTRICITY

The bulk of Uganda's electricity is supplied by the Uganda Electricity Board (UEB), mainly from its 150 MVA hydro-electric station at Owen Falls, and 8 small diesel stations averaging 500 KVA installed in outlying towns which cannot be economically supplied from Owen Falls. There is also a small hydro-electric station at Kabale. Kilembe Mines Ltd has its own hydro-electric station at Mobuku of 6.4 MVA nominal capacity fed from a glacier on the Ruwenzori range. The station is connected into the UEB network so that in times of surplus it can supply Kasese Town and in times of shortage Kilembe Mines can draw on UEB supply. Several industries have their own diesel generators to maintain emergency supplies for essential services during power failures caused by lightning, bush fires or careless tree felling.

The existing and projected distribution lines are shown on Map 4. The Owens Falls scheme was installed at a capital cost of £17 million of which £8 million was spent around 1954. The average generating cost at Owens Falls is slightly under 4 Uganda cents per kwH, including depreciation and interest charges on a World Bank loan. This compares with a cost of over 30 cents/unit for the diesel stations.

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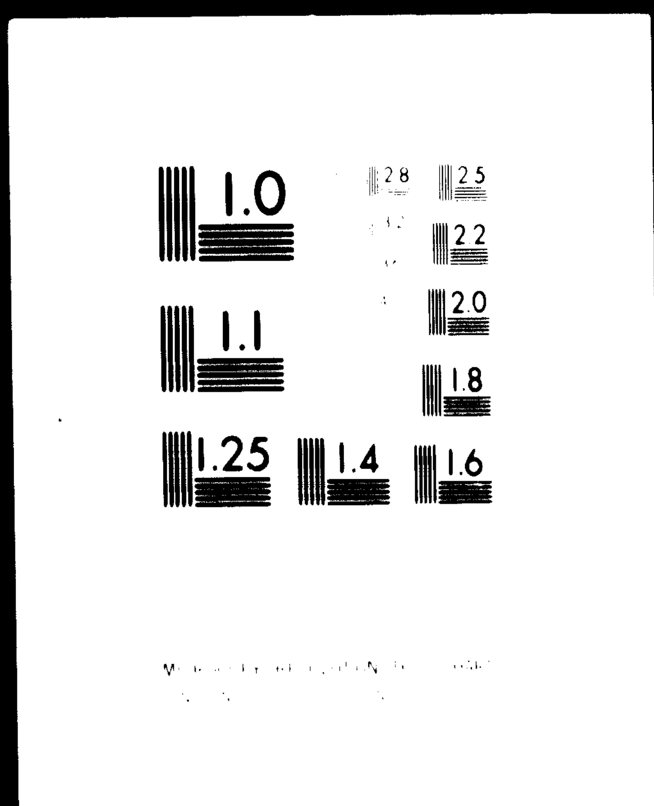

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Under a 50 year agreement signed in 1954, Kenya is entitled to take 30 MVA bulk supply at somewhat less than 4 Ugandan cents/unit. Until 1975, Kenya was also taking 'spill units' from Uganda at off-peak periods, but owing to maintenance needs at Owen Falls, which reduced its available output by about 25 MVA, the sale of spill units to Kenya was terminated. Units generated from 1970 are given in E8.I (p.86)

Table E8 I

Electricity Generation in Uganda

Millions of Units Generated

Year	1970	1971	1972	1973	1974	1975
Hydro Diesel	729.9 4.6	813.0 3.8	797.4 4.4	788.5 4.9	778.7 6.5	
Total	734.5	816.8	801.8	793.4	785.2	(750)

Tariffs which have been held steady for many years, are given in Table E8 II together with tariff income, consumers in each category, units sold and average consumption.

Table E8 II

Electricity Tariffs, Income, Units Sold & Consumers, 1974

	Tariff cents/unit	Tariff Income Shillings	Consumers	Units Sold	Average per Consumer
Domestic Tariff	30.96	23,775,738	52,476	76,794,462	1,463
Hotels, clubs	29.88	6,347,874	1,211	21,245,412	17,544
Flat Rate, Commercial Power and Heating	44.12	10,157,294	7,276	23,873,494	3,281
Commercial and Security Lighting	59.83	16,069,497	17,714	26,855,103	1,516
Street Lighting	31.56	2,054,316	108	6,509,769	60,276
Industrial Power (standard tariffs)	22.98	28,179,739	310	121,786,450	392,588
Industrial Power (special tariffs)	10.00	12,125,320	10	121,184,200	12,118,420
Meter Rents		581,054			
Total Ugandan Sales	average 24.78	99,290,832		397,948,890	

III.1 Problems of Rural Elctrification

Reasons why the number of domestic consumers is so small, in a total population of over 10 million, were summarised by UEB in a paper prepared in 1971 for the World Bank.[3]

" (i) Over 90% of the population live in rural areas.

(ii) The average density of population is 120 per square mile and half the population live in areas with less than 50 per square mile.

(iii) Ugandans are slow to turn away from their age-old way of living to community living.

(iv) The distance between dwellings makes electrification very expensive.

(v) The trifling cash income of most of the population makes it difficult for them to pay for electricity. (Rural dwellers for the most part use electricity simply for lighting and perhaps a kettle and more rarely an iron).

(vi) Capital for the development of electicity has to come entirely from our revenue surplus and, therefore, is severely restricted".

The report emphasises that the first requirement to enable rural electrification to develop more quickly is to provide the conditions necessary to bring about community living, e.g. by encouraging the growth of cooperative societies, establishing new administration centres and building hospitals and schools. The report comments that "there is no industrial use of electricity in villages and very little used for agricultural purposes. Electricity for water pumping and irrigation appears to be the most promising area for use in agriculture and for this a new flat rate of 15 cents/unit is offered...... Our distribution map shows that what we are really doing is to gradually extend existing lines from urban areas and thus penetrating to the rural areas a little at a time every year".

III.2 Expansion of Electricity Supply

Consideration of the expansion of Uganda's electricity supply may appear somewhat academic during a period when demand has been dropping for several years, even though it is clear that extensive maintenance of Owen Falls station is needed, merely to prevent supplies from falling below their present level.

III.2.1. Supplies to Kenya

Before considering new generating capacity in Uganda, the present supply contract with Kenya needs examination. Kenya is at present supplied with 30 MVA at a price lower than the cost of generation at a new hydro-electric station. This agreement, made with no provision for inflation, could be reviewed. Probably the only reason why it has not so far been discussed is that Uganda has not hitherto been fully able to use this power. Once there is a reasonable prospect of steadily rising demand in Uganda, it might be appropriate to initiate discussions with Kenya about the agreement.

III.2.2. Expansion at Jinja

Owing to lack of space, the Owen Falls station cannot be expanded further on the west side of the Nile although the flow of water is sufficient for an additional 60 MVA to be generated there. This is because the station was based on average flow of 5000 m^3/second calculated according to Nile Waters agreement of 1929. Since it was built, the actual flow has averaged 1200 m^3/sec. It is now agreed by all technical officers of the various Nile authorities that a guaranteed minimum flow of 630 m^3/second can be relied on for power generation at Owen Falls. UEB have therefore proposed that the next expansion take the form of an additional 60 MVA station on the east bank at Owen Falls at a capital cost of £7,000,000. The Ugandan Government have plans to develop new industries in the West Nile province, and consider that the main additional demand will come from that area. UEB are in the course of completing a new 132 KV transmission line to Lira (for the new Russian-built cotton spinning mill) and it will have surplus capacity. UEB proposed that the West Nile province should be fed initially by an extension of this distribution line from Lira, a distance of about 150 miles at an additional cost of £1,500,000. This combination of a new 60 MVA station at Owen Falls plus a new distribution line would seem to be the cheapest way of supplying initial needs of the West Nile area.

III.2.3. Future Generation for Northern Provinces

If the north is to develop industrially, there will be a longer term need for more generating capacity on the Nile much nearer to the region than Jinja. No fewer than 5 possible schemes have been considered. There are three possible sites on the Victoria Nile and two on the Albert Nile.

III.2.3.1. Sites on the Victoria Nile

There are three possible sites where independent stations could be built. The first at Kabalega Falls can readily be phased. The second and third at Ayogo and Chobe would need large dams to be constructed at the outset.

III.2.3.1.1. Kabalega Falls

This possibility probably involves the least capital cost and would enable an eventual output of 500 MVA to be reached in 3 stages.

1 by a tunnel (with no dam) to an underground station below the falls. A 90 MVA guaranteed capacity would be obtained at a capital cost of £18 million, including special measures to preserve the amenities;

2 a dam would be built with a second tunnel to an enlarged underground generating station;

3 the number of generators would be increased to bring the total capacity of the station up to 500 MVA.

This scheme has been extensively debated between conservationists and industrialists. We incline to the view that the final scheme proposed by UEB would preserve the natural amenities and not detract from the tourist attractions of the falls, through which an adequate flow will be preserved. It has been argued that the more rapid erosion which will occur if a hydro-electric station were not constructed would soon reduce them to a series of rapids.

III.2.3.1.2. Ayogo

The site is 25 km up river from the Kabalega Falls. The project would involve constructing a dam below a series of rapids. The capital cost would be considerably higher than the first alternative, because of the size of the dam. The capacity would be about 500 MVA.

III.2.3.1.3. Chobe

The site is some further 30 km upstream near the Karuma Falls. It has roughly the same generating potential as at Ayogo.

III.2.3.2. Sites on Albert Nile

III.2.3.2.1. Mutir (North of Pakwach)

The gradient of the river,which is navigable here, is far less than that of the Victoria Nile. Only modest heads could be created by a dam. The main attraction of this site is its closeness to Arua. A drawback is that the scheme would probably necessitate raising the bridge at Pakwach, which would prevent direct navigation between Pakwach and Nimule.

III.2.3.2.2. Fula Rapids (Inside Sudan border)

A dam and hydro-electric station built about 9 km inside Sudan would allow up to 500 MVA to be generated, as a joint venture for use by both countries. This has the advantage to Sudan of providing a basis for flood control for the long projected scheme to canalize the Sudd and settle it.

For Uganda, the project could improve the navigability of the river between Nimule and Lake Mobutu Sese Seko. It also has the advantage that costs would be shared.

III.2.3.3. Discussion of Sites

We understand that the Ugandan Government has already decided on the Ayogo site, although UEB is more in favour of Kabalega. We suggest (as possibly a more promising alternative) a joint scheme with Sudan at Fula rapids with the costs to be shared between both countries.

III.2.4. Rail Electrification [4]

Cheap transport, both internally and to Mombasa, is essential for Uganda's development. This can no longer be based on petroleum fuels (whether for road or rail). The only solution which presents itself is through electrification of the railway, using hydro-electric power, the bulk of which would have to be generated in Uganda. The initial cost is bound to be high and may be difficult to justify on present traffic loads. But unless a bold and imaginative approach is adopted, the situation is more likely to deteriorate than improve.

IV. FUEL WOOD AND CHARCOAL

No accurate figures are available about the amount of wood used for fuel. Most of it is cut and used domestically. Estimates range from 10 million to 15 million cubic metres per year, yielding about 10 million tonnes/year of air dried wood (12% moisture) with a gross calorific value of 4,444 calories per gram. This compares with 7,500 calories per gram for charcoal or 11,000 calories per gram for fuel oil. The amount of wood cut and used for fuel in Uganda appears to be equivalent to about 4 million tonnes per year of fuel oil. The wood is mostly used very inefficiently on open fires. It is impossible to attach any meaningful value to this fuel since most of it is cut and used by peasant families with negligible incomes. Charcoal is at present used almost entirely as a domestic fuel in urban areas and in rural areas where there is insufficient wood. It is cheaper than wood to transport per unit of heating value and a more satisfactory fuel for cooking. The quantity of charcoal used is unknown, but is certainly small compared with the total use of wood as fuel. It is produced mainly by primitive methods.

Until recently, charcoal produced in Kenya, in more modern kilns, was imported to Uganda for use in the cement kilns at Tororo at a price of 265 Shs. per tonne. This figure is still generally used in discussing the price of industrial charcoal.

V. PETROLEUM FUELS

Sales of petroleum fuels in 1973, average current list prices, and the value of sales in 1973 at current list prices are given in Table E8 III. Data on country-wide sales since 1973 were not available at the time of writing; though sales appear to have dropped by about 12%. The fall, however, is compensated by the absence of certain products such as LPG in the 1973 lists. Large users are, of course, able to negotiate discounts (probably up to 20%) on the list prices, but these again are quickly eroded by inflation.

Table E8 III
Sales of Oil Fuels in Uganda

Products	Sales (1973) litres ('000)	Average List Price March 1976 Shs/litre	Value of '73 Sales at Current List Prices Shs '000
Motor & aviation spirits	145,807	2/80	408,259
Kerosene & turbo fuel	95,829	1/68	160,992
Diesel fuels	84,868	2/37	201,137
Fuel Oil	70,677	1/126	79,582
Total	397,677		849,970

The annual sales of petroleum fuels thus amount to approximately 850 million Shs. per year. . The major sales are of motor spirit and diesel oil which are used for tranpsort. Their consumption may be expected to rise if the economy recovers. Possible scope for short term economies may lie in :

1. increased use of rail transport; the purchase of wood-burning locomotives and, in the longer term, rail electrification;

2. use of producer gas generators on heavy road vehicles, employing wood or charcoal as fuel;

3. revived use of water transport, with wood burning steamers;

4. revived use of animal transport.

When discussing the use of petroleum-based fuels, the possibility of discovering commercial oil or natural gas in Uganda should not be overlooked. Earlier reports support this possibility.[5]

The most recent report[6] refers to a hopeful preliminary study made by Petro-consultants on behalf of Comoro Exploration Ltd within the concession area, to the south and east of Lake Mobutu Sese-Seko. It has not been possible to obtain any more recent information about these studies. It appears that they were suspended before definite conclusions were reached. The distance of the potential oil fields from the sea and other factors have probably inhibited a more thorough and energetic exploration progamme by the companies most likely to discover and develop petroleum in Uganda.

VI. COMPARISONS BETWEEN ELECTRICITY, FUEL OIL AND WOOD IN UGANDA

Most industrial processes in Uganda require fuel - e.g. for steam raising, for melting steel for casting, heating steel billets for rolling,or various steel objects for forging, for melting glass, for making cement, firing bricks, and other purposes.

Wherever wood or agricultural wastes are available locally and can be employed, they are likely to be the cheapest fuels in Uganda today. This may be seen from a study on fuel for the cement industry in Uganda in section VII of this Appendix. (p.94).

A large industrial user, who is unable to use wood (e.g. steel rolling or glass melting), may have to choose between electricity and fuel oil. For high temperature applications (i.e. above 800°C) electrical heating is likely to be more efficient thermally. When fuel oil is used a large proportion of the heat is lost in the flue gases (up to 50% in the case of glass melting).

VI.1. Low and High Temperature Industrial Furnaces

As calculated examples, it is assumed that a steam boiler (A) and a glass melting tank (B) each require a continuous supply of 1 million kilo-calories per hour. The factories can buy electricity at the special tariff rate of 10 cents/unit; The price of fuel oil (S.G. 0.94, gross calorific value 10,800 calories per gram) is assumed to be 1,020 Shs. per tonne. This implies a discount of 15% on the list price of 1,200 Shs. per tonne.

The assumed efficiencies of heat utilization are given in Table E8 IV.

Table E8 IV

Efficiencies of Heat Utilization for Fuel Oil and Electricity

	Boiler A	Glass Melting B
Fuel oil heating	85%	55% (no regenerator)
Electrical heating	96%	90%

The hourly requirements of fuel oil and electricity are given in Tables E8V and E8VI.

Table E8 V

Hourly Requirements of Fuel Oil

	A. for Boiler	B. for Glass Tank
Total Heat liberated kilo calories/hour	$\left(\frac{10^6}{0.85}\right)$	$\left(\frac{10^6}{0.55}\right)$
Fuel required, tonnes per 24 hour day	$\frac{24 \times 10^3}{0.85 \times 10,800}$ = 2.592	$\frac{24 \times 10^3}{0.55 \times 10,800}$ = 4.04
Daily Cost Shs.	2,644	4,121

Table E8 VI

Hourly Requirements of Electricity

	A. for Boiler	B. for Glass Tank
Total Heat liberated kilo calories/hour	$\left(\frac{10^6}{0.96}\right)$	$\left(\frac{10^6}{0.90}\right)$
Electricity required kwH per 24 hour day	$\frac{24 \times 10^3 \times 1.162}{0.96}$ 29,050	$\frac{24 \times 10^3 \times 1.162}{0.90}$ 30,980
Daily Cost Shs.	2,905	3,098

The capital cost of an oil fired heating installation is usually higher than one using electricity and serving the same purpose, because of the cost of oil storage tanks, pumps, flues and refractories, and the higher structural costs. Analysis shows that electrical heating is cheaper than the use of fuel oil for all high temperature applications and probably (at least) breaks even for low temperature applications such as steam raising, although for that the use of wood or agricultural wastes is almost certain to be cheapest.

VI.2. Factory Power

The economic advantages of electricity over petroleum fuel in Uganda are still stronger when the need is for power rather than heat. As an example, we may take a load of 500 H.P. which is required for 8 hours out of 24. This might be supplied by a squirrel cage AC motor with an average overall efficiency of 88% or by a diesel engine using imported gas oil with an average overall thermal efficiency of 40%. Two electrical tariffs are considered, (A) the standard industrial tariff of 22.98 cents per unit typical of small industrial users and (B) the special industrial tariff of 10.00 cents per unit typical for large industrial users. Diesel oil is costed at the list price Table E8.III, (p.90) of 2/37 Shs. per litre less an assumed discount of 10%. It is assumed to have a specific gravity of 0.90 and a gross calorific value of 10,800 calories per gram.

1. Electricity Consumption

The electricity consumption per day

$$= \frac{8 \times 500 \times 0.7455}{0.88} \text{ KwH}$$

= 3389 KwH per day.

The daily electricity costs are,

A. 779 Shs. per day at 22.98 cents per unit, or

B. 339 Shs. per day at 10 cents per unit.

2. Diesel Oil Consumption

The daily consumption of diesel oil is

$$\frac{8 \times 500 \times 641.62}{0.40 \times 10{,}800 \times 0.90} \text{ litres}$$

= 660 litres.

The daily cost of diesel oil is therefore

600 x 2.37 x 0.90 Shs.

= 1,280 Shs.

Since most industries requiring a 500 HP drive for 8 hours per day will be of a size which qualifies for the special electrical tariff, the fuel costs for the diesel engine are seen to be nearly four times the power cost of an electric motor, which also requires far less maintenance.

VI.3. Alternatives to Diesel Oil and Power

There are several fields in which alternatives to diesel oil power might be explored.

(1) Vegetable Oils

It might in some instances be possible to examine substitution of locally produced vegetable oils for imported diesel oil with resultant savings. This is suggested mainly by prices quoted for certain vegetable oils, notably castor, in the 1973 statistical abstracts for Uganda.

(2) Farm and Estate Traction

Both electrification and the use of wood fired steam engines may find wider use for cultivation and haulage on farms and estates. Unfortunately the equipment is now less readily available than the diesel tractor.

(3) Rail Locomotion

Until electrification is possible, the interim use of steam locomotives fired by wood might be considered. The Katanga-Lobito railway, by which copper is exported from Zaire, uses exclusively steam locomotives fired by eucalyptus logs. The trees are grown in plantations beside the line. Some steam locomotives are used in Uganda, but the water supply along much of the line is inadequate.

VII. FUEL ECONOMY IN THE CEMENT INDUSTRY

VII.1. Charcoal versus Fuel Oil

Uhart concludes in a special report[7] that charcoal could be produced from eucalyptus plantations located near to the cement factories at Tororo and Hima and delivered to the factories at a cost well below the price of the equivalent amount of fuel oil. The bill for imported fuel oil could thereby be reduced by 65 million Shs. per year at 1974 prices. During the 7 or 8 years taken to establish the plantations, charcoal could be produced from trees felled to clear the ground for eucalyptus.

He also considers the application of charcoal to iron ore reduction in Uganda (an industry not as yet established on a large scale).

Uhart's report also considers many of the problems of the use of charcoal as fuel for the cement industry. Mr. Francis, chief engineer of Uganda Cement Industries Ltd at the Tororo works, compared[8] the use of oil and charcoal in 1974 and strongly recommended the production and use of charcoal at both factories on economic grounds.

Francis' own estimates of the savings to be gained from the use of charcoal with all kilns at both works operating at design capacity are given in Table E8.VII. They differ somewhat from Mr. Uhart's figures and in particular show a smaller consumption of charcoal than Uhart calculated.

Table E8.VII

Fuel Oil and Charcoal Consumptions & Costs at Cement Works

Plant	t/a of cement	Charcoal		Oil		Savings Shillings/ year
		tons/ year	Shillings per year	tons/ year	Shillings per year	
Tororo kiln 1	36,000	6,500	(1) 1,722,500	4,300	(3) 3,375,500	1,653,000
Tororo kiln 2	72,000	13,000	3,444,500	8,600	6,531,000	3,086,500
Hima kiln 1	90,000	15,000	(2) 5,025,000	10,000	(4) 8,400,000	3,750,000
Hima kiln 2	180,000	30,000	(2) 10,050,000	20,000	16,800,000	6,750,000
Totals	378,000	64,500	20,242,000	42,900	35,106,500	15,239,500

Notes on Table (1) & (2) Based on 265 Shs. per ton at Tororo, 335 Shs. per ton at Hima; these were apparently the prices of imported charcoal from Kenya before these imports were stopped. Calorific value of charcoal 6,000 to 6,500 k cals/kg. (3) & (4). Based on fuel oil price of 785 Shs. at Tororo, 840 Shs. at Hima. Fuel oil S.G.0.94 at 20°C, S. content 2.57.

Francis makes further comments on the use of charcoal, which we have elaborated.

(1) The use of charcoal is based on a gross calorific value of 6,000 to 6,500 k calories per kg. This seems quite a conservative figure. Uhart quotes 7,500 k calories per kg, a figure confirmed by Marks Handbook for Mechanical Engineers (7th ed.p.7-18).

(2) Only Tororo kiln 1 is at present able to burn charcoal. The others could be converted by the addition of feeders and pulverizers. Francis deals somewhat lightly with one important requirement of charcoal: the need for a large covered area for storage and an elaborate sprinkler system. Charcoal has an unfortunate tendency to self ignition

particularly when it has become wet (through rain) and then dried out again.

(3) The rather low production figure given for the Tororo kilns is a consequence of the poor quality of the local limestone used. With better limestone, production might be increased by 20%.

(4) When Kenya wattle charcoal was used, the cement quality was quite as good as when using fuel oil. (Uhart had feared some deterioration on quality using charcoal).

(5) Francis has fears over the volatile content of eucalyptus charcoal, apparently on the grounds that the volatile oils will pass through the cement kiln and condense in the preheater or cold end of the kiln, causing caking of the ground and mixed feed. These fears are in our opinion groundless - a view shared by cement manufacturers in the United Kingdom. Fuel and air enter a kiln together at the hot clinker where the fuel burns, passing counter-current to the solids. The temperature over at least half the length of the kiln is sufficient to ensure combustion of organic matter present, so there is little doubt that all volatile oils remaining in the eucalyptus charcoal will burn in the kiln.

Since 1974, fuel oil prices in Uganda have continued to rise, and the need to switch to a locally produced fuel, which is cheaper than fuel oil, has become more acute.

Uhart was convinced of the need to grow and harvest plantations near to the cement works (and other large users of charcoal) in order to ensure a long-term and continuous supply of charcoal and low transport costs. Uhart's views on this subject are quoted below.

"The largest problem associated with such a large production of charcoal (170,000 to 185,000 tonnes per year) is the ability to secure a continuous supply of raw materials".

"The total volume of wood required for the total production of charcoal will be 0.9-1.1 million m^3 per year, based on a unit consumption of 5-6 m^3 of wood per ton of charcoal or a 21-25% yield, depending on the type of kiln used".

"This amount of wood could be obtained from about 300,000 - 400,000 ha of tropical forest on a sustained yield basis if the growth rate of the natural forest is about $3m^3$ per ha per year. If necessary part of the supply could also be obtained from savannah woodlands having a yearly growth rate of 0.5 m^3 per ha, or from eucalyptus plantations having a growth rate of about $20m^3$ per ha per year. In the last case a total area of 45,000 - 55,000 ha of eucalyptus plantations would be required".

"It has been pointed out earlier that the total forest reserves controlled by the Forest Department consist of about 820,000 ha of Tropical High Forest and approximately 780,000 ha of savannah woodlands. The total forest area available seems therefore more than sufficient to ensure this level of charcoal production provided that the transport distances are not too high and that all other demands for firewood and other requirements can be satisfied at the same time".

"It is shown that the Forest reserves near the Tororo cement factory can produce continuously a minimum of about 30,000 tons of charcoal per year if forest reserves are established to replace the natural forest after cutting, and near Jinja at a distance less than 40 km from the plant a potential yearly production of about 140,000 tons of charcoal exists. For the Hima plant location there are no specific data available but according to the Forest Department the wood supply would not be a problem, based on the existing natural forest and later, on eucalyptus plantations in this area".

The need for 170,000 tons/year of charcoal envisaged by Uhart takes into account a possible furnace for iron ore reduction as well as the existing kilns.

VII.2. The Case for Wood as Fuel

The first question suggested to us by Uhart's report and Francis' memorandum is whether wood itself could not be used as fuel in place of charcoal for the cement kilns.

The yield of charcoal on timber is at best 30% to 35% by weight using special retorts, but more usually 25% (in the type of kiln which relies on partial combustion). Although the charcoal has a higher calorific value than the wood from which it is derived, the heating value of the charcoal derived from a given weight of dry wood is only 40% to 50% of that of the wood itself.

A cement kiln requires a temperature of over 1300°C in the clinkering stage at the burner end of the kiln and a temperature of about 800°C for lime burning over 15% of the length of the kiln immediately before the clinkering stage. To meet these requirements, a dry wood of high calorific value is needed. It must be finely divided and introduced continuously into the primary air of the burner. The most practical and economic method appears to be by growing high calorific value wood (such as eucalyptus) on a special plantation adjacent to the cement works, harvesting the wood and chipping it in the green state, drying the chips and storing them, e.g. in silos for feeding the kilns. Some modification to the burners and primary air supply to the kilns would be needed, although these appear to be no greater than the modifications needed for burning charcoal.

The calorific value of dry eucalyptus wood is approximately 4,900 k calories per kg as compared with 7,800 k calories for the charcoal made from it. In fact, the wood fed to the kiln could probably never be entirely dry, but would contain up to 10% moisture. Some extra fuel would be required both to dry the timber and heat the water vapour formed by combustion of the timber in the kiln itself. To leave a margin we therefore allow two tons of dried timber (10% moisture) for total fuel in place of 1 ton of charcoal as estimated by Francis.

Our yearly requirements of dried eucalyptus are shown in the following calculation.

	tonnes/year timber of 10% moisture	Totals at each works
Tororo kiln 1	13,000	39,000
Tororo kiln 2	26,000	
Hima kiln 1	30,000	90,000
Hima kiln 2	60,000	
	129,000 tonnes/year	

Studies made in 1974 by Wood Industries Corporation on the growth of eucalyptus plantations for paper-making show that one hectare of plantation can be expected to produce 300m^3 of timber every 7 years on a continuous basis, providing that the inorganic salts and soil nutrients removed from the soi by the trees are replaced. This amounts to 35 tons of dried timber (10% moisture) per hectare per year. (About twice the yield assumed by Uhart).

Thus 1,114 hectares at Tororo and 2,571 hectares at Hima would be needed. Allowing 15% additional area for roads, firebreaks and chipping machines total plantation areas would be 128.1 hectares or 13 sq. km at Tororo and 2,956 hectares or 30 sq. km at Hima.

As the future of the Tororo factory, where the limestone is running out, is rather uncertain, we consider only the cost of growing eucalyptus near to the Hima site. There appears to be suitable land, not used for other purposes, to the north west of Hima on either side of the Hima river and its tributaries the Kikyo and Nemasusi streams, between altitudes of 3,500 and 4,500 ft. approximately. It is possible that these streams, by providing dams and channels, could be used both for transport of cut logs to the cement works by logging, as well as for irrigation if necessary, although this might restrict logging operations to periods of the year when the flow of water was adequate.

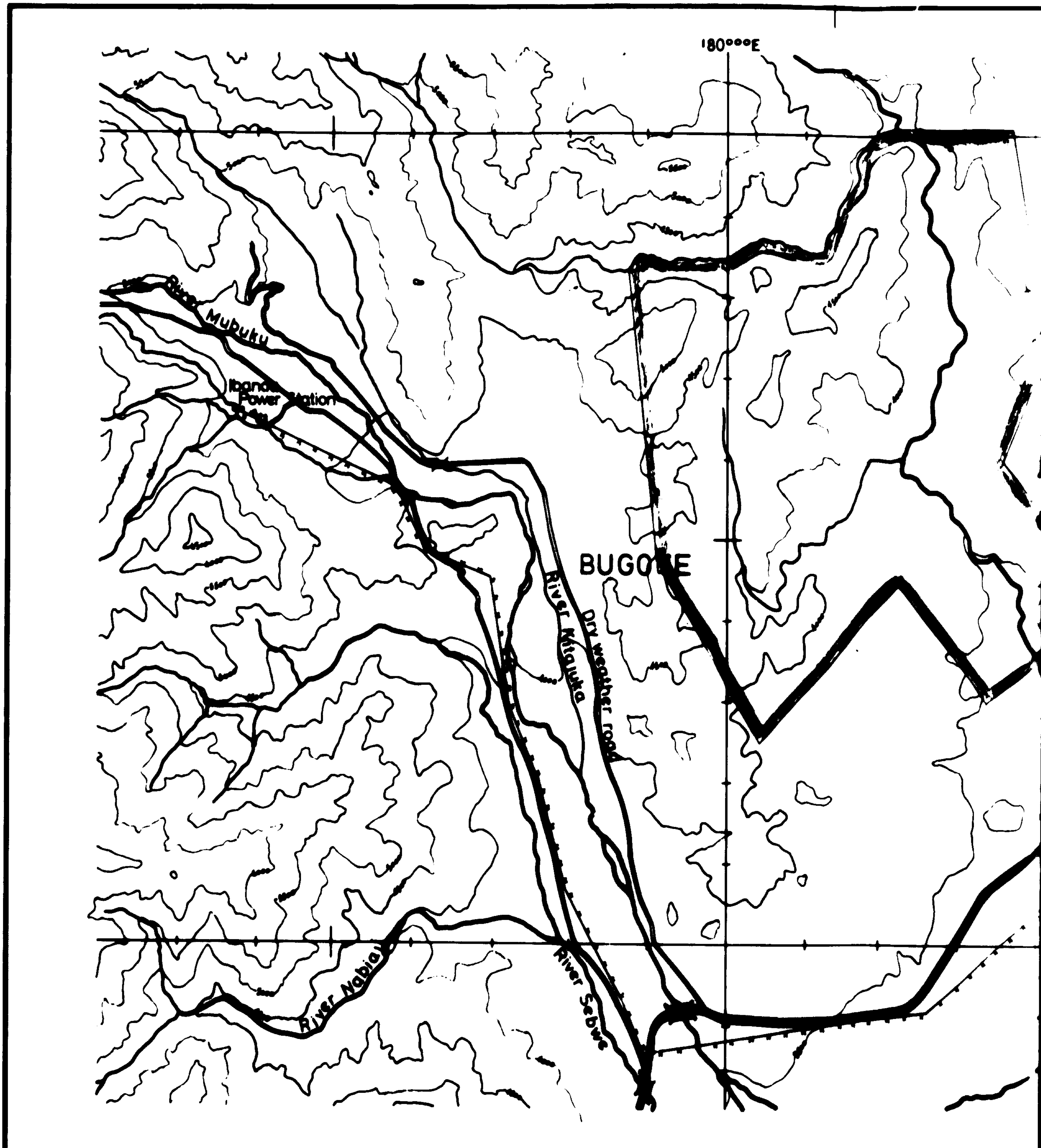
The cost of establishing a eucalyptus plantation for cropping on a seven year rotation was estimated in 1974 by Wood Industries Corporation to be 1,555/- per hectare, made up as follows.

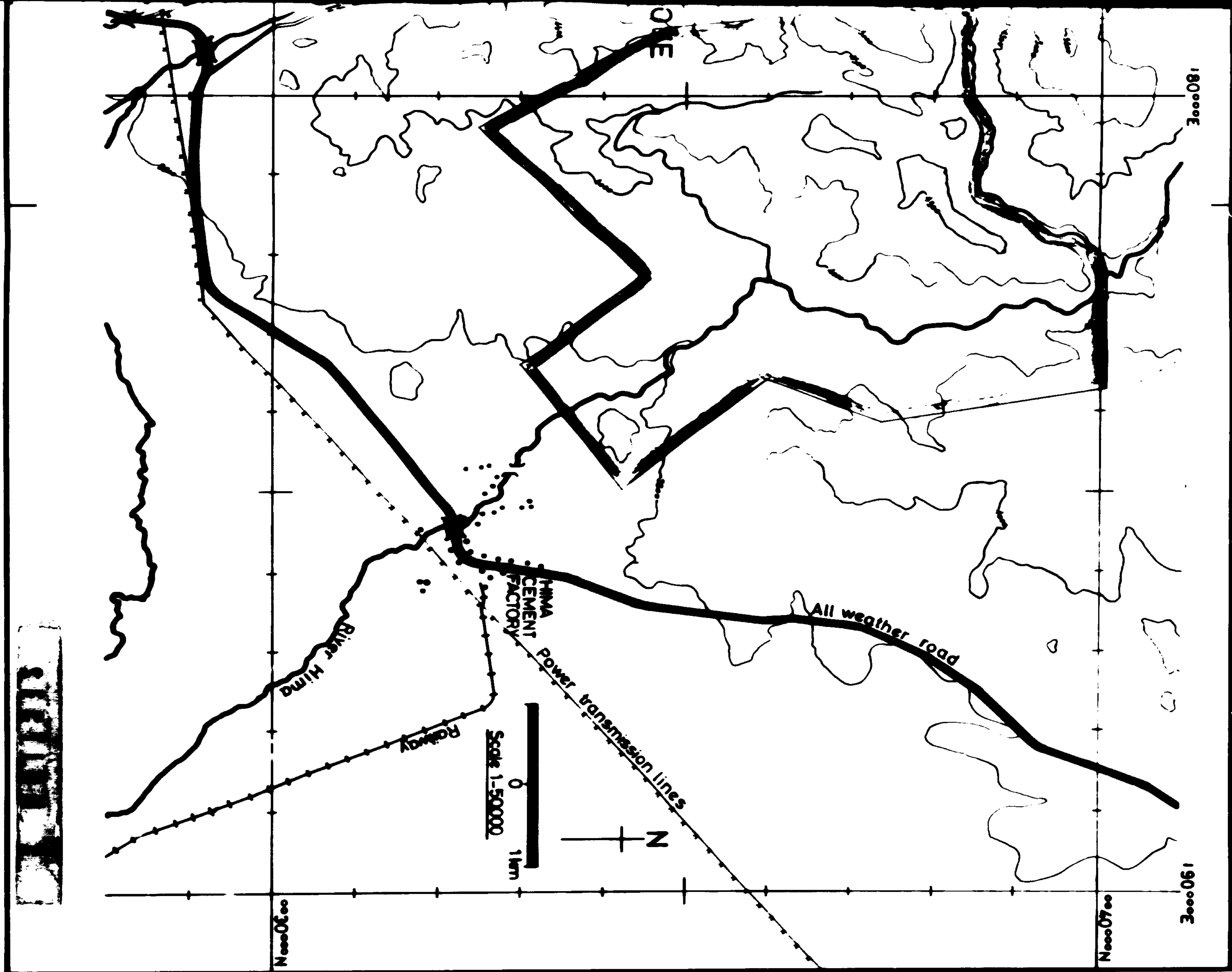
1,260/- per hectare for establishment

25/- per hectare for fire protection

270/- per hectare for planting

These costs would accumulate over the first 7 years at 12% compound interest rate.


River Mubuku
Ibanda Power Station
Dry weather road
River Nabiala
River Sebwe



MAP 5.

HIMA CEMENT WORKS.
SUGGESTED EUCALYPTUS FUEL WOOD PLANTATION.
(26km AREA)

Taking the area planted each year as 367 hectares, the cumulative costs for the first seven years are given in Table E8.VII.

Table E8.VIII

Cost of Establishing Eucalyptus Plantation at Hima

Year	Accumulated Cost and Interest	New Cost in year	Total Capital Required Shs.
1	nil	367 x 1555 = 571,000	571,000
2	571,000 x 1.12 = 639,500	571,000	1,210,500
3	1,210,500 x 1.12 = 1,355,000	571,000	1,926,000
4	1,926,000 x 1.12 = 2,157,000	571,000	2,728,000
5	2,728,000 x 1.12 = 3,055,000	571,000	3,626,000
6	3,626,000 x 1.12 = 4,061,000	571,000	4,632,000
7	4,632,000 x 1.12 = 5,188,000	571,000	5,759,000
8	5,759,000 x 1.12 = 6,450,000	571,000	7,021,000

Cutting starts in year 8 when the costs of cutting, replanting, and maintenance and depreciation of vehicles should be 1,000 Shs. per hectare, or 367,000 Shs. per year, to which must be added the interest charges of 12% on the capital of 6,450,000 Shs., i.e. 774,000 Shs. per year.

Thus the annual cost of the timber cut, reckoned at 90,000 tons at 10% moisture content = 367,000 + 774,000 = 1,141,000 Shs, or 12.7/- per tonne of dry wood.

To this must be added the costs of chipping, drying, storage of dry chips at the cement works and modifications to the burners of the kilns, for which an arbitrary estimate of 13.7 Shs. per tonne has been made, bringing the overall cost of the wood fuel to 26 Shs. per tonne. As 3 tons of dried wood are replacing one ton of fuel oil, the cost of wood per ton of fuel oil displaced is 78 Shs. which is less than 10% of the present price of fuel oil. Thus, even if the estimates given here were to be in considerable error, the margin is so great that the viability of growing fuel wood on plantations adjacent to the fertilizer works at Tororo and Hima cannot be in much doubt. Naturally, however, the schemes need careful planning; many factors must be taken into account, such as soil fertility, species of eucalyptus or other wood grown, replacement of nutrients removed from the ground by the timber and effects on growth of the various atmospheric discharges in the vicinity, including that from the cement works themselves.

The fine dust from many cement works is found to contain high concentrations of soluble potassium salts, sulphate, carbonate and chlorides and is now being developed as a source of potassic fertilizers in Europe. At Hima, there appear to be good prospects of recovering at least as much potash from the fly-ash leaving the kilns as enters in the wood chips used as fuel. This could be returned to fertilize the plantation.

The production and export of wood chips is growing rapidly in Australia; this is illustrated by the figures in Table E8.IX .

Table E8.IX[9]

Australia: Quantities and Values of Wood Chip Exports

Year	Quantities m^3 log equivalent	Value $ Aust
1970	24,750	332,000
1971	378,400	5,038,000
1972	1,036,200	13,809,000
1973	2,741,200	36,446,000
1974	3,116,200	46,428,000

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APPENDIX E9

GLASS BOTTLES AND TABLE WARE

I. SUMMARY

East African Glass Works Ltd is a small glass bottle and tumbler producing factory with one furnace and a capacity of 5,000 tonnes/year. It was started by the Madhvani Group in 1968 and continued to operate until January 1975, when the brickwork of the furnace collapsed. Schemes and proposals for rehabilitation of the factory have been put forward at costs of 15 to 20 million Shs.

The Ugandan market is, however, too small and present manufacturing costs of the glass works, especially fuel costs, are too high for the factory to be run at a profit. We cannot on economic grounds recommend that the plant, be rehabilitated at present. There is a large plant in Kenya which could supply all Uganda's present needs at a very competitive price.

We suggest that it will become reasonable to examine the re-establishment of a glass bottle factory in Uganda when the demand in the country reaches 10,000 tonnes per year. Electrical heating should then be considered in place of oil heating.

II. PREVIOUS EXPERIENCE

II.1 To Time of Furnace Collapse, 1975.

A small glass works, East African Glass Works Ltd., (EAGWL), was built in Kampala by the Madhvani group and in 1968 started production of amber beer bottles, clear bottles for soft drinks and spirits and household tumblers. The plant had one small oil heated tank furnace with no heat recovery, and a rated capacity of 5,000 tons/year of saleable glass. This was the last of four glass factories built in E. Africa by the Madhvani Group; the others were at Mombasa (amber beer bottles), Dar-es-Salaam (tumblers and glass for light bulbs) and Nairobi (tumblers and clear bottles). The main customers for bottles in Uganda were:

Uganda Breweries Ltd., Kampala - half-litre brown beer bottles
Nile Breweries Ltd., Jinja -ditto- -ditto-
Lake Victoria Bottling Co., Kampala - various clear bottles for aerated soft drinks
East African Distilleries Ltd., Kampala - clear bottles for Waragi and other spirits.

The tumblers, apparently all of clear glass, were sold through stores. Up to 1972, production appears to have built up to 70% of capacity. Good glass sand, with a low iron content, suitable for the manufacture of clear and coloured glass was obtained from the shores of Lake Victoria and islands in the lake. Fuel and all other raw materials were imported. The factory had only one glass-melting furnace and it could only make clear and coloured (amber) bottles alternately in blocked out operation. Clear glass would be made for about a year when the furnace was new or newly rebuilt; coloured glass would then be made during a second year when the condition of the brickwork was deteriorating. The furnace would then be shut down for rebuilding after which clear glass would again be made. Clear tumblers could only be made when clear glass was being made. As there appeared to be no market for brown tumblers, it may be assumed that the tumbler-making machinery was idle for the whole period when brown beer bottles were being made.

The practice of shutting down a glass-melting furnace for rebuilding after two or three years' operation is normal and made necessary by the corrosive action of molten glass on the brickwork. It is also normal practice to make coloured glass after clear and not vice-versa, since it would be very difficult to produce clear glass while traces of coloured glass were left in the furnace, and when the refractories were showing significant wear.

II.2 Original Project Data, Costings and Profitability

A detailed project and feasibility report was prepared for the Madhvani Group in 1967[1]. The estimated market in Uganda was 3,100 tons/year of bottles and tumblers in 1969 rising by 10% per annum to 4,100 tons/year in 1972. The production programme of the factory was based on supplying the entire Ugandan market and exporting from 7% to 22% of its products. A second tank furnace was due to be commissioned in 1973-4. Construction had started by 1972.

The total capital cost including buildings, offices, stores, plant and machinery, maintenance workshops and working capital was estimated at £550,000. The cost of all glass plant and machinery, including the furnace, feeders, bottle and tumbler- making machines and lehrs at the start of production in 1966, was estimated at £132,019.

The total manufacturing costs per ton of melted clear glass in 1968 are given in Table E9.I.(p.109). Not all glass melted appears as finished products. A certain amount of scrap is found in bottle-making, but this is recycled to the furnace as cullet.

Several features in the manufacturing cost estimate call for comment.

1. Fuel consumption is much higher than in a large modern glass bottle works where it would be less than half the figures given in Table E9.I(p.109).

2. The use of borax and aluminium hydroxide may be necessary in the production of household tumblers (to give resistance to daily washing in hot water) but neither are normally considered necessary in bottle glass.

3. Labour costs per tonne of glass melted appear high, mainly because of the small scale of production and consequent low labour productivity.

In 1972, the glass company was taken over by the Ugandan Government and first put under the management of Uganda Development Corporation. It was later transferred to Uganda General Merchandise, one of eight trading companies controlled by the Uganda Advisory Board of Trade. Production of glass bottles continued until 1975, without any shut-down for overhaul and for rebuilding the furnace, in spite of the facts that the plant was badly in need of maintenance and that the quality of bottles was very poor. (By 1975, the breakage rate of new bottles in the pasteurization sections of the breweries was said to have reached 25%). Later in 1975, the brickwork of the furnace collapsed entirely and a good deal of secondary damage also occurred. Much of the bottle and tumbler making machinery was badly worn or corroded. Expert attention was needed to determine which parts must be replaced and which could be overhauled. One probable reason for the rapid deterioration was that the temperature measuring instruments in the furnace had not been functioning for some time, so that quite probably the machinery had been operating at temperatures for which it was not designed.

Assistance was sought from the makers of the furnace and machinery, who supplied similar equipment to other glass factories owned by the Madhvani Group in East Africa. This was apparently not forthcoming. It was said that much of the equipment had been supplied on long term credit terms to the Madhvani Group and full payment not made. Madhvani were said to have received little or no compensation for their factory.

Appearances suggest that the glass works have recently been run by personnel with only rudimentary empirical knowledge of the operation of the plant and machinery, and with little scientific or technical training in the problems of glass making. When the factory was forced to close down, most operatives were made redundant leaving a bare handful of senior staff.

III. REHABILITATION SCHEMES

Two rehabilitation schemes have been proposed, one by the UNDP/UNIDO Consultancy Group in 1975[2] and one by Dr. C. Tribuno of Breda Research Institute, Milan, on behalf of two Italian firms, Sasil S.A.S., and Avir S.P.A.[3]

III.1. UNDP/UNIDO Scheme

The UNDP/UNIDO working group made a fairly detailed survey of the glass works and, in the absence of manufacturer's drawings, several drawings of the furnace and other parts of the plant were made. Lists of refractories and of equipment replacements which would have to be bought from abroad were made, including laboratory equipment to check the quality of sand and other raw materials. Apparatus for inspecting the glass products for internal strains and dimensions was not included. The UNDP/UNIDO Consultancy Group estimated that a sum of 5,100,000 Shs. in foreign exchange and 9,754,000 Shs. in local currency would be required to repair and restore the plant and machinery to its original condition. No design changes were included. The total sum estimated was greater than the total capital estimates for the factory including buildings, maintenance workshops and working capital in the 1967 feasibility and project study. It was assumed by the Consultancy Group that both the expertise needed to renovate the factory and the goodwill of the original suppliers of the plant and machinery would be forthcoming. The UNDP/UNIDO report gives an elaborate financial analysis of the operation of the rehabilitated factory which we discuss later.

III.2 Italian Proposal

The Italian proposal is in four stages and goes beyond the mere rehabilitation of the existing factory. It includes new equipment for sand purification and an engineering study for the second glass melting furnace. The proposal includes on the spot inspection of the existing plant and machinery by a team of Italian experts; shipment of defective machines to Italy for overhaul, supply of all refractories, furnace mortar, steel work and instruments needed to rehabilitate the furnace; supervision of all work done in Uganda. The proposal includes practical training of a number of key operational and maintenance personnel for a few weeks on a running plant in Italy (the language in which instruction is to be given does not appear to be specified.) It also includes supervision of re-commissioning the plant. The proposal is made as an offer, which, after excluding those items over and above those needed to rehabilitate the plant and bring it into successful operation again, brings the cost to between $2,000,000 and $2,400,000, or approximately 19 million Shs. at current rates of exchange. Although the cost is higher than the UNIDO/UNDP estimate, it constitutes a reasonably firm offer, and includes definite though limited arrangements for training personnel and supervising re-commissioning.

IV. VIABILITY OF REHABILITATED GLASS WORKS

IV.1 Market for Glass Bottles in Uganda

Most glass bottles used in Uganda (for beer and soft drinks) are returnable. The number of bottles needed by these industries depends on the number of bottles filled annually and on the loss and breakage rate. Breakage, in turn, depends on the quality of the bottles but, given freedom of choice, the bottler will buy only good quality bottles with a low breakage rate (5% or less per filling so as to minimise his losses both of bottles and wasted beverages. Special circumstances, such as a shortage of bottle openers, may increase the percentage of bottles lost per trip, but it seems unwise to count on this in estimating bottle requirements.

Our estimates of bottle needs by the three main users in Uganda in 1976 are given in Table E9.II. (p.110). The estimates are based on visits to the establishments and discussions with the staffs. The figures are, if anything, on the high side, and if present trends continue they are likely to fall further.

The mineral water bottles are dearer than beer bottles. Special moulds are required, printing costs are high and a better quality (clear) of glass is required.

The total market in Uganda for bottles and tumblers which could be made at this factory appears to be 3,000 tons/year at most, in 1976. The import cost would be about 8 million Shs.

IV.2 Trade in Bottles and Glass Table Ware in East African Community

Exports of bottles from Kenya and Uganda in 1973 and 1974 are shown in Table E9.III. (p.111). Kenya had considerable exports: over 10,000 tonnes in 1973 and over 6,000 in 1974 at average prices of 1,060 Shs. per tonne in 1973 and 1,545 Shs.per tonne in 1974. These figures suggest a factory of reasonable size in Kenya (over 20,000 tonnes per year) and low production costs. In these years, Uganda was only able to export small quantities of glass to Rwanda and, with higher production and transport costs, has little chance of competing with Kenya in the export of bottles to other countries.

The exports of glass table ware from Kenya and Tanzania in 1973 and 1974 are shown in Table E9.IV.(p.112). The quantities are very low and so are the prices.

IV.3. Assessment by UNIDO/UNDP Consultancy Group

The UNIDO/UNDP Consultancy Group report considered a number of models for the operation of the glass works and estimated the annual loss (or profit) on each of them. The costs are for the most part based on East African Glass Works' production plan for 1975 and are lower than would apply today.

The cost of raw materials, fuel and other services per tonne of clear glass bottles and tumblers is given as 1,863 Shs.(compared with rather less than 400 Shs.in the 1967 estimates). Other variable costs amount to 623 Shs.giving a total variable cost of 2, 486 Shs.per tonne of clear glass products. The sales revenue per tonne of clear glass bottles (1.28 Shs. per bottle averaging 410 grams) is 3,120 Shs, leaving only 634 Shs.to cover all fixed costs (including capital charges on the rehabilitation costs) and profit. The variable costs on the production of amber bottles were somewhat lower, but the selling price is also lower: i.e. 84 cents on a beer bottle averaging 410 grammes. giving a sales revenue of 2,210 Shs.per tonne. The sales revenue per tonne of clear tumblers (84 cents per tumbler weighing 200 grams) was undoubtedly higher. Revenue from small containers (medicine bottles) would have been higher still at 61 cents per container of 99.5 grams. But Uganda would have to become a nation of hypochondriacs to use up the 30 million bottles a year needed to provide a profitable basis for the company's operations.

It is therefore hardly surprising that the UNIDO/UNDP report concluded that when beer bottles were the predominant product, the company would operate at a loss, although the loss might be reduced by increasing the output of the factory (beyond 350 tonnes/month) or increasing the selling price, or both. The quantity of beer bottles which the company planned to produce in 1975 was only 1,250 tonnes. It is reasonable to assume that this estimate was based on the market demand of the country. The consultancy group were able to show that by operating at 70% of capacity, making clear bottles, tumblers and amber beer bottles, increasing the proportion of tumblers made, and increasing the cost of beer bottles to 1 Shs.each, the company should make a profit of 3.4 million Shs. a year. This would, however, be excluding payment of interest charges on the money borrowed to rehabilitate the factory.

IV.4 Our Assessment

The present small domestic market, and competition from Kenya in export markets make it unlikely that the company will be able to operate profitably. The main obstacles to profitable operations are that:

1. the plant capacity (and the present Ugandan market) are too small. The minimum size of glass bottle factory that should be considered today in Uganda is 10,000 tonnes/year;

2. fuel oil costs in Uganda are very high. An electrically heated furnace would be more economic (See Appendix E8, pp 92-93).

3. fuel consumption per tonne of glass melted is exceptionally high for a continuous furnace; partly because of the small size of the furnace, partly because of lack of a heat exchanger to recover heat from the flue gases;

4. costs of imported chemicals in Uganda are high mainly owing to high transport charges;

5. competition from Kenya will make it virtually impossible to establish a foothold in export markets;

6. no provision has been made for technical collaboration during production with an experienced glass bottle making company.

IV.5 Example of Well Placed African Bottle Factories

As an example, a new glass bottle factory in Africa where conditions are favourable might be noted. This is the Leventis S. Gobain factory at Ughelli in South Nigeria. The salient features are:

1. production capacity of 30,000 tonnes/year;

2. very low cost fuel. This is associated gas from the nearby oil wells which would otherwise be flared; the cost is about 20 Shs per tonne fuel oil equivalent;

3. good quality glass sand close to factory;

4. factory reasonably central for large Nigerian market (about 70 million inhabitants);

5. factory close to port of Warri through which raw materials, such as soda can be imported and surplus production can be exported at minimum transport costs;

6. assured technical cooperation of foreign partner with long experience of glass technology (S. Gobain).

V. RECOMMMENDATIONS

1. In present conditions, we do not yet recommend the rehabilitation of EAGWL. It can only run at a loss unless imports of bottles are subjected to prohibitive tariffs, or banned completely.

2. The Ugandan market is at present too small to justify a bottle factory and prospects of exporting are poor.

3. The position should be re-examined when the market for bottles in Uganda has increased to 10,000 tonnes/year.

4. An electrically heated glass melting furnace should then be considered as an alternative to an oil fired furnace.

5. The prospects of obtaining sufficient sodium carbonate of adequate quality and at a favourable price from the Lake Katwe Salt Project should be taken into account when the feasibility of a glass bottle factory is re-examined.

Table E9.I

Glass Manufacturing Estimate 1968

Shs per Tonne Melted Glass

Raw Materials	price per tonne	Kg/tonne melted glass		Shs per tonne melted glass
Sand	35	750		26.2
Soda Ash	295	285		84
Lime	100	157		15.7
Sodium Nitrate	643	19		12
Aluminium Hydroxide	715	15		11.2
Sodium Sulphate	576	0.9		0.5
Borax	1440	15		21.6
Arsenic	1100	7.5		8.2
Cobalt oxide-Selenium				12
Total Raw Materials				191.4
Utilities	Unit	Unit Cost Shs	Units per tonne glass	Shs per tonne glass
Furnace oil	gallon	0.94	100	94
Diesel oil	gallon	1.63	18	29.4
Power	KVA			53
Water				3
Others				14.5
Total Utilities				193.9
Labour including supervisors and workshops				178.0
Administration and indirect labour				43.5
Office expenses				28
Maintenance Materials				61.0
Total excluding depreciation, capital charges or tax				696

*Note: The project called for a total of 184 full time personnel, including one qualified glass technologist and several trained supervisors for production and maintenance.

Table E9 II

Uganda : Estimate of Glass Bottle Requirements by Main Users in 1976

Type of Bottle	Weight gms	User	Unit Price Shs.	No. required millions	Cost Shs. millions	Wt of glass tonnes
Clear mineral water	420	Lake Victoria Bottling Company	1/50	1.33	2.0	560
Amber 500 ml. beer	400	Nile Breweries Jinja	(1) -/87.5	2.0	1.75	800
ditto	400	Uganda Breweries, Kampala	-/87.5	3.0	2.62	1200
Total					6.37	2560

Average selling price 2490 Shs per tonne.

Note (1) Beer bottles from another source were recently offered at -/70 each, but were not accepted on grounds of quality.

Table E9 III

Exports of Glass Bottles and Containers from Kenya and Uganda

Country of Destination	1973				1974			
	from Kenya		from Uganda		from Kenya		from Uganda	
	Quantity tonnes	Value Shs '000s	Quantity tonnes	Value Shs '000s	Quantity tonnes	Value Shs '000s	Quantity tonnes	Value Shs '000s
Bahrain	61	57	-		-			
Burundi	1,394	1,588	-		970	1,330		
Ethiopia	228	256	-		134	199		
Malawi	429	394	-		352	963		
Mauritus	313	348	-		32	64		
Nigeria	-	-	-		0.1	1		
Reunion	8	11	-		-	-		
Rwanda	117	253	131	220	606	1,019	34	57
Seychelles	19	29	-		3	4		
Somalia	633	817	-		344	756		
South Yemen	56	63	-		231	282		
Sudan	878	963	-		500	678		
Zaire	0.2	0.2	-		-	-		
Zambia	5,185	5,163	-		2,261	3,402		
Other African Countries	135	175	-		302	497		
Other non-African Countries	874	822	-		643	660		
Aircraft & Ships stores			-		20	28		
Total	10,329	10,944	131	220	6,398	9,885	34	57
Average price Shs per Tonne	1,060		1,680		1,545		1,675	

SOURCE : East African Community Trade Statistics.[4]

Table E9 IV

Exports of Glass Table Ware

from Kenya & Tanzania 1973 & 1974

Country of Destination	1973				1974			
	from Kenya		from Tanzania		from Kenya		from Tanzania	
	Quantity tonnes	Value Shs. '000s	Quantity tonnes	Value Shs. '000s	Quantity tonnes	Value Shs. '000s	Quantity tonnes	Value Shs. '000s
Burandi	21	31	1 9	27	8	16		
Zaire	17	28	-		1	2	-	
Zambia	-		-		1	3	-	
Aircraft & Shipstores	1	2	-		1	5	-	
Total	39	61	19	27	10	26	-	

SOURCE : As in E9 III

R E F E R E N C E S

1. "Feasibility and Justification, Project Report on the Establishment of a Glassworks Factory in Uganda". Madhvani Group Report, May, 1967.

2. "Rehabilitation Programme for East African Glass Works Ltd" : UNDP/UNIDO Report, Kampala, 10th. April, 1975.

3. Letter dated 5th. February, 1976, from Professor C. Tribuno, Breda Research Institute, Milan, Italy, to Mr. A.D. Lubowa, General Manager, East African Glass Works Ltd., Kampala, with enclosured offers from Sasil, S.A.S., and Avir S.P.A.

4. Annual Trade Reports of Tanzania, Uganda and Kenya for 1973 and 1974 (Statistical Branch, East African Customs and Excise Department, Mombasa).

5. Private communication from Mr. Andrew David, Technical Director, Leventis West Africa Ltd.

[illegible]

I. SUMMARY

Production in all branches of the Ugandan iron and steel industry has declined from 1971 to 1975, not because of shortage of demand, but from shortage of spares and raw materials caused by foreign exchange problems, and from shortage of managerial and technical staff with the right experience.

It is evident that a considerable injection of capital is necessary to re-equip the industry but this will only be effective if certain other conditions are met :

1. adequate raw material supplies, especially when imported, must be assured to enable the factories in the industry to operate at economic levels;

2. each manufacturing activity should be examined critically to ensure that the planned scale of operations is economic and that the products are of adequate quality. Where these conditions cannot be met, the activity should cease;

3. efforts should be concentrated on increasing production of standard items (e.g. reinforcing bars) for which there is a good demand and which can be made of adequate quality;

4. the industry should be strengthened with experienced technical managers and supporting staff.

Several different sources of indigenous iron ore have been considered as the basis for a smelter in Uganda. Although current opinion favours Kigesi haematite, this is inaccessible and a large investment is required to develop it. Insufficient work appears to have been carried out on the utilization of more conveniently located ores, or of iron oxide which may be produced as a by product of cobalt and sulphuric acid manufacture.

II. UGANDA STEEL CORPORATION

Eight Ugandan companies with different backgrounds, but all engaged in the manufacture and sale of iron and steel products, were brought under the central control of Uganda Steel Corporation in March, 1975. Its main function at present is to centralise control over sales, purchases, finance and personnel matters. As three of these companies have recently changed their names their old and new names and locations are given in Table F10.I (p.115).

The table gives the companies' main products and their estimated requirements of foreign exchange for raw materials, machinery spares and immediate expansion.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 1974, Statist[illegible] Branch, East Afric[illegible]

TABLE E10.III

Sales of Locally Made Steel Ingots and Corrugated Iron Sheets 1971-74

	1971	1972	1973	1974 3 quarters
Steel ingots, tonnes	16,619	17,335	14,548	7,547
Corrugated Iron Sheets, tonnes	14,077	13,293	4,885 (1)	3,098
Shs.'000	34,311	33,663	15,800 (1)	16,367

Note (1) No production shown for 3rd quarter of 1973

SOURCE : Quarterly Economic and Statistical Bulletin, Sept. 1974
Statistics Division, Entebbe.

[illegible]

distance and difficulties [illegible] [illegible]

[illegible] semi-finished and final [illegible] products, and an absence of [illegible] to [illegible] [illegible]

11. Steel [illegible] of East Africa Ltd

[illegible]

[illegible]

[illegible] given [illegible] (p.[illegible]) [illegible]

[illegible] lack of [illegible] to explain the falling production. [illegible] has been [illegible], as well as the quality of roll[illegible] steel [illegible] (from [illegible] of [illegible] Ltd) which [illegible] much [illegible] production. [illegible] has been obtained from Japan at 30% higher [illegible] price, [illegible] better quality [illegible] the [illegible] price paid. [illegible] and spare parts [illegible] also been a problem, although the factory management considered they had suffered less in this respect than other firms.

The [illegible] production line, although, in [illegible] foreign exchange shortage, it would [illegible]

We were told that the average life of a hoe is under one year, but there is no [illegible]. [illegible] the use of [illegible] raw material, [illegible] the use of a low chrome alloy [illegible] manufacturing conditions [illegible] addition of heat treatment with [illegible] hardening at the end of manufacture.

Some of the [illegible] operations [illegible] deal of [illegible] [illegible] press. [illegible]

Table [illegible].IV

Uganda Hoes Limited

Number and Value of Hoes Sold 1965-1975

YEAR	1965		1966		1967		1968		1969		1970	
	Qty	Shs	Qty	Shs	Qty	Shs	Qty	Shs	Qty	Shs	Qty	Shs
January	112,800	610,638	124,632	704,186	84,789	474,820	81,048	438,557	123,792	673,292	118,375	699,210
February	66,600	376,492	69,240	390,933	96,862	545,026	159,144	822,983	187,650	1,050,505	203,625	1,0[illegible]
March	160,594	825,470	104,770	585,595	121,320	682,422	232,008	1,295,605	244,152	1,355,050	117,[illegible]	[illegible]
April	48,523	272,013	132,934	748,67[illegible]	121,320	682,423	153,409	850,595	78,125	433,712	37,500	[illegible]
May	125,078	702,414	144,144	804,487	164,512	867,140	109,464	611,779	169,675	931,255	237,[illegible]	1,2[illegible]
June	90,792	510,324	93,642	561,144	132,0[illegible]	706,117	216,468	1,065,30[illegible]	101,150	542,668	144,000	7[illegible]
July	144,300	641,4[illegible]	185,[illegible]	1,023,704	98,954	535,272	88,963	465,697	106,600	571,865	13[illegible]	[illegible]
August	122,424	677,169	162,408	924,633	74,190	417,280	100,125	515,403	67,500	[illegible]	95,[illegible]	513,520
September	112,320	630,578	79,048	4,441,355	209,760	1,099,512	132,072	694,634	175,475	906,503	150,000	812,552
October	[illegible]6,712	489,937	44,400	257,364	212,568	1,073,261	120,600	614,286	60,636	661,422	30,750	167,[illegible]
November	104,040	5[illegible]	116,470	674,97[illegible]	90,720	471,495	100,968	559,185	21,960	253,409	103,875	559,377
December	138,432	777,154	78,720	449,80[illegible]	97,440	529,232	75,440	422,097	58,250	229,605	40,000	265,450
Total	1,282,668	7,100,453	2,057,283	11,557,390	1,504,533	8,084.001	1,569,756	8,359,125	1,394,395	8,101,164	1,444,375	7,595,726
Average selling price per hoe (Shs)	5/50		5.60		5/35		5/[illegible]0		5/80		5/25	

YEAR	1971		1972		1973		1974		1975	
	Qty	Shs	Qty	Shs	Qty	Shs	Qty	Shs	Qty	Shs
January	112,750	608,[illegible]	109,000	638,026	64,700	361,553	51,800	310,141	15,671	131,760
February	136,000	732,1[illegible]	77,425	456,906	112,500	651,441	42,825	252,674	27,809	420,176
March	167,0[illegible]	1,028,0[illegible]	167,675	940,9[illegible]	130,775	722,254	27,975	255,60[illegible]	124,212	2,131,762
April	128,[illegible]	724,[illegible]	132,750	810,238	73,[illegible]	391,076	143,[illegible]	1,284,12[illegible]	60,[illegible]	994,683
May	129,375	737,[illegible]	127,775	794,[illegible]	124,450	701,5[illegible]	10[illegible],775	[illegible]	143,7[illegible]	2,3[illegible],219
June	112,000	6[illegible]	157,175	1,14[illegible]	94,[illegible]	5[illegible],143	121,[illegible]	1,072,972	[illegible]	[illegible]
July	153,750	874,103	55,350	499,6[illegible]	123,125	733,668	119,600	1,032,322	20,37[illegible]	335,351
August	183,275	1,048,201	172,500	1,057,5[illegible]	149,125	890,564	156,775	1,390,074	84,726	1,390,832
September	109,425	634,560	105,025	659,349	122,825	731,200	109,025	966,320	76,150	99,129
October	124,050	7[illegible],533	110,575	676,451	100,200	601,624	96,100	839,118	46,444	747,553
November	75,050	440,124	120,375	779,407	107,900	650,490	95,775	854,207	115,766	1,447,644
December	30,275	180,002	72 525	458,461	[illegible].600	233,920	35,650	450,441	3,825	57,932
Total	1,461,750	8,349,858	1,439,150	8,449,92[illegible]	1 243,300	7,230,187	1,104,975	9,641,594	783,555	11,986,276
Average selling price per hoe (Shs)	5/70		5/85		5/30		5/70		15/30	

Actual price :

	1974	1975
Lango Hoes	10 Shs.	10 Shs.
1½lbs. 3513c	6 Shs.	8 Shs.
2½lbs. 3513c	8 Shs.	14 Shs.
3lbs. 3513c	9 Shs.	16/50 Shs.

SOURCE : Uganda Hoes Ltd.

N.B. Uganda Hoes Limited was formerly called The Chillington Tool Company (East Africa) Ltd.

Purchases, Exports, Prod...

[illegible] - Steel	(i) Ton		
	Shs.	[illegible]	
	Fuel and Power - Shs.	[illegible]	[illegible]
	Consumable Tools - Shs.	[illegible]	
Machinery Tools - some items purchased [illegible]			
[illegible] Purchases:			
	(a) E.A.C. Nil		
	(b) [illegible]	[illegible]	
	Capital [illegible]		
[illegible] - Kenya: Quantity, cartons of 25 [illegible]		[illegible]	[illegible]
Shs.		[illegible]	[illegible]
[illegible] OF PRODUCTION - Cartons		[illegible]	[illegible]
Shs.		5,[illegible]	[illegible]
Trading Profit Shs.		[illegible]	
[illegible] (Margin Profit)		[illegible]	
CAPITAL STRUCTURE	Fixed Capital-Shs.	[illegible]	[illegible]
	Working Capital Shs.	[illegible]	[illegible]

[illegible] : [illegible] Ltd.

III.[illegible]

[illegible] but [illegible], but for [illegible] development there are several [illegible] obstacles to overcome:

1. [illegible] quantities of [illegible]. [illegible] vary from under 1 million [illegible] to [illegible] 30 million tonnes;

2. remoteness of the ore from markets and lack of transport facilities;

3. need to develop fuel/[illegible] for smelting;

4. lack of capital.

Remoteness of the ore from markets and lack of transport mean that medium or small scale [illegible] (except as a local craft industry). A minimum extraction rate of at least 100,000 tons per [illegible]. The essential first step is [illegible] a detailed survey of the deposits for quantity, quality, potential mining methods and extraction cost.

III. [illegible]

[illegible]

III.4. [illegible] at Jinja

Deposits [illegible] have been reported[4] at Jinja, but no work [illegible] to have [illegible] to establish [illegible]. In view of the [illegible] for [illegible], it is recommended that a preliminary survey be made of their size and quality.

III.5. Pyrite Dump from Kilembe Mine at Kasese

A [illegible] from the mill [illegible] of Kilembe [illegible]. It now amounts to [illegible] tons of pyrite [illegible] [illegible] [illegible] for the production [illegible] and [illegible], the latter for fertilizer manufacture at [illegible]. [illegible] [illegible] [illegible] [illegible]. It would [illegible] [illegible] [illegible], [illegible] deposits, such as [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] ... virtual coll[illegible] of the non-ferrous metal mining industry.

Table [illegible]

Quantity and Value of [illegible] Concentrates [illegible]

Commodity	Quantity	Units	Value £
Copper ([illegible])	35,777	tons	9,776,665
Tin concentrates	9,518	tons	2,179,890
Tungsten [illegible]	2,115.1	tons	1,[illegible]4,063
Gold ([illegible])	140,822	troy ounces	987,479
Beryl[illegible]	1,117.[illegible]	tons	133,697
[illegible] ore	153.2	tons	110,274
[illegible] concentrates	736.8	tons	53,869
Bismuth [illegible]	48.1	tons	23,330
[illegible] ([illegible])	597	tons	5,[illegible]49
TOTAL			14,731,377

[illegible] * [illegible] started in 1927, [illegible] official records [illegible] in [illegible] year. [illegible] gold had been won and exported.

[illegible]

[illegible] have been [illegible].

1. [illegible]
2. [illegible] at depth
3. [illegible]

11.3 Tungsten

Uganda [illegible] deposits of low grade tungsten ores, mainly in [illegible] in the [illegible] of [illegible] There are [illegible] smaller higher grade hypothe[illegible] veins in [illegible] and in county [illegible] ([illegible] province). [illegible] occurs [illegible], [illegible]. These veins are thin [illegible], [illegible] than a few hundred feet long, and [illegible] which [illegible].

The [illegible] south [illegible] with [illegible]. They [illegible] in width between one and three [illegible], [illegible] and [illegible] to over [illegible] feet [illegible]. They contain [illegible] to the [illegible] of [illegible], [illegible] in quartz veins. One such vein has been [illegible] by manual methods.

[illegible]	110,274	43.1	23,330	536.8	[illegible]

[illegible]

[illegible] below the [illegible] [illegible], although [illegible] [illegible] winning [illegible] which [illegible]. The [illegible] [illegible], [illegible] 1 and [illegible] in [illegible] [illegible] on the [illegible] only small [illegible] [illegible] were found below the platform; [illegible], was worked [illegible] depth [illegible] feet before it [illegible] abandoned in 19[illegible], but [illegible] depth or grade.

Most of the [illegible] was thought to be [illegible] in origin. [illegible] well [illegible] were the result of natural concentration by [illegible].

11.4.2 [illegible]

The only [illegible] location at [illegible] was discovered in 19[illegible] and first worked in 19[illegible] by [illegible]. Gravels were up to 4 feet thick, generally [illegible]. The gold was thought to have been [illegible] of the [illegible] immediately to the north.

[illegible]

[illegible] the gold [illegible] below the oxidation zone.

11.?.7 West Nile

Only traces of alluvial gold were found, despite hopes that the Kilo Moto field in Zaire might extend into Uganda.

11.?. Beryllium

Beryl, the main beryllium ore is an alumino-silicate containing only 3.5 [illegible] of beryllium. It occurs in [illegible] (white [illegible] semi-translucent) which are fairly well spread but not easily distinguished from quartz and felspar.

The metal beryllium has been in use since the 1920s as an alloying [illegible]

[illegible]

[illegible]

[illegible] which [illegible] found in [illegible] throughout the [illegible] It contains [illegible] impurities which can be [illegible] by [illegible] content. Microlite, [illegible] associated with beryl and columbite [illegible] radio activity. Small quantities of [illegible] (in the [illegible] goldfield) and of [illegible] (at [illegible] Hill, [illegible]) were found about 1950. After a [illegible], the quantities were found to be insufficient to justify exploitation.

Potentially the most important niobium mineral is pyrochlore, which occurs in large quantities but at low concentration in the Sukulu carbonatite, where it is associated with apatite, magnetite, zircon and baryte[illegible]. There were plans to concentrate the pyrochlore to a saleable product in 1960, but they do not appear to have been realised, probably owing to the fall in the world price of niobium. Only phosphate is now recovered from the apatite for fertiliser production at Tororo).

Pyrochlore was also found at Mounts [illegible] and Toror in Karamoja.

[illegible]

11.15. L[illegible]

Lit[illegible] minerals occur in [illegible], A[illegible] and [illegible], but only in [illegible] were the quantities worth exploiting. The mineral [illegible] occurred in [illegible] on the Mbale estate. Small quantities were mined and exported from 1949 to 1954.

11.16. Other Metal Ores

[illegible] are found in [illegible] quantities in the [illegible] copper [illegible], and the eight [illegible], only a few are likely to be of possible commercial interest. These are chromium, thorium and possibly rare earth metals of the yttrium group.

Impure chromite with a chrome-iron ratio of less than 2.5 to 1 is found in a belt about 4 miles long north of Moroto mountain in Karamoja province. This could be of commercial interest, if a world shortage of chromite were to develop, but at present the high cost of transport from this remote area is against it.

Several thorium minerals occur in Uganda. The most interesting is monazite, which is found at Kalapata and in the nearby valley of the Kalere river in northern Karamoja. The deposits found were not large enough to be exploited.

Yttrium is found in small quantities as euxenite in a deposit at Nsaseke, Toro, and as a phosphate, [illegible] near [illegible] in Karamoja. The [illegible] chromite, thorium and yttrium [illegible] that further investigation might be justified in [illegible] any of the minerals seemed imminent.

[illegible]

Exports of Metal Ores and Concentrates [illegible]

Year	Tin Concentrate		Tungsten Ores		Beryllium Ore		[illegible]	[illegible]	[illegible]	[illegible]
	Tonnes	Shs ('000s)	Tonnes	Shs ('000s)	Tonnes	Shs ('000s)	[illegible]	[illegible]	[illegible]	[illegible]
1971	176	2,998	222	1,603	221	639	[illegible]	[illegible]	[illegible]	
1972	109	1,820	284	4,733	65	145	-	-	-	-
1973	66	994	178	3,273	[illegible]	131	-	-	-	
1974	243	4,612	176	3,991	-	-	-	-	-	

[illegible]

[illegible]

[illegible] Minerals won, and Value; 1970 and 1971

		Tin Ore	Wolfram (Tungsten ore)	Gold	Beryl	Columbite Tantalite	Bismuth
Labour (Daily Working average)							
Europeans	1970	nil	4	nil	1	nil	nil
	1971	nil	4	nil	1	nil	nil
Asians	1970	4	7	nil	9	nil	1
	1971	6	6	nil	6	nil	nil
Africans	1970	[illegible]	1,367	35	560	nil	124
	1971	[illegible]	1,324	12	314	nil	102
Minerals won	1970	182.3	234.7	93 grams	367.2	2.7	12.2
tonnes	1971	188.3	210.0	67 grams	220.5	4.4	13.6
Value	1970	3,359	6,501	1	11,117	33	592
Shs. ('000)	1971	3,334	4,881	0.5	640	53	196

[illegible]

[illegible]

[illegible]

III.2 [illegible]

[illegible] in 1971 and their productions are listed in Table III.V.

Table III.V

Principal Wolfram Producers 1971

Producer	Location	Tonnes produced
Bjordal Mines Ltd	near Kisoro S.W. Kigezi	66.88
Kirwa Wolfram Mines Ltd.	near Kisoro S.W. Kigezi	29.55
O. [illegible] (tributor)		16.30
Mutolere White Fathers		14.73
Mining Enterprises (U) Ltd		12.11
C. [illegible] (Mrs)		6.49
E.J. [illegible]		5.18
N. [illegible]		5.12
Others		53.66
TOTAL		210.02

[illegible]

[illegible]

[illegible]

[illegible]	Location	Tons produced
[illegible]	[illegible]	10.[illegible]
[illegible]	[illegible]	66.
[illegible]	[illegible]	18.1[illegible]
[illegible]	[illegible]	[illegible]
[illegible] Ltd	[illegible]	10.0[illegible]
[illegible]		[illegible]
T O T A L		220.5[illegible]

Beryl mining suffered severely from the slump in the market in 1971 and by the end of the year all mines except Kataka appeared to have ceased production.

III.4 Bismuth

This metal also was affected by the slump in the market and by the end of 1971 only two mines in the [illegible] area were operating.

Tantalum-Niobium remained a by-product of beryl mining.

[illegible]

[illegible] were receiving much [illegible] in the [illegible] way.

Whatever the truth in these rumours, Itama Mines purchases of cassiterite from local miners have fallen from about 240 tonnes/year in 1973 to 50 tonnes per year currently. Purchases of Wolfram have fallen even more sharply from 120 tonnes/year in 1973 to a bare 12 tonnes/year now. Itama Mines now has an overdraft of 3 million Shs. and requires a minimum of 10 million Shs. in working capital in order to operate effectively.

One additional reason given for Itama's present difficulties concerns their method of trading. We were informed that they purchase ores from the miners at 80% of the current LME metal prices, which only leaves a 20% allowance for shipment and smelting. They are not able to sell until the ore reaches its (European) destination, when they receive a price based on the then current LME price. Itama therefore did well during 1973 and early 1974, when most metal prices were rising, but suffered in the second half of 1974 and throughout 1975, when prices were falling.

We suggested that they could hedge this risk by selling forward on the future markets.

	[illegible]	[illegible]	[illegible]	
Year	1973	1974	1975	1976
[illegible] (1)	[illegible]	120	[illegible]	[illegible]
[illegible] (2)	[illegible]	51.16 [illegible]	(50)	[illegible]
[illegible]	1,1??	120	120	[illegible]
	U.Sh. ('000)	U.Sh. ('000)	U.Sh. ('000)	U.Sh. ('000)
[illegible]	2,8??	6,140	4,1??	4,57?
Realization Cost (3)	[illegible]	700	606	667
[illegible]	2,4??	5,440	3,552	3,907
Mine production & maintenance (4)	[illegible]	1,411	1,5??	1,70?
[illegible]	1,205	4,029	2,0??	2,199
[illegible]	23	-	-	-
[illegible] rebate	1,228	4,029	2,0??	2,1??
Development and written off [illegible]	17	17	17	17
Net trading profit	1,211	4,012	1,983	2,182
Admin, Staff & Finance (5)	571	672	739	813
Profit before Depreciation	640	3,340	1,244	1,369
Depreciation (6)	141	141	141	141
Profit for year	499	3,199	1,103	1,228
adjustment for sale of assets	* 3	-	-	-
Profit before Management Fee	502	3,199	1,103	1,228
Management Fee	48	283	-	-
Profit after Management Fee	454	2,916	1,103	1,228
Tax and Royalty	183	1,094	414	461
Profit after Tax	271	1,822	689	767

NOTES:

(1) Production taken at 120 tons per year to exhaust reserves in 5 years.

(2) Wolfram price basis £30/MTU 1975 increasing at 10% per annum.
*ratio sale price.

(3) Realization Cost = (cost 1974 x ratio sale price) + 10%.

(4) Mine production and maintenance cost increased at 10% per annum.

(5) Admin: increased at 10% per annum.

(6) Depreciation taken as constant.

[illegible]

IV.2 [illegible]

[illegible]

[illegible]		30
[illegible]		[illegible]
[illegible]	([illegible])	40

[illegible] (68 [illegible]). [illegible] profit and loss accounts for 1974, 1975 and 1976 are given in Table [illegible].

The ore reserves for the mine are given in Table III.VIII

Table III.VIII

Bjorndal Mines Ltd. Ore Reserves

ORE RESERVES	Tons '000	Grade Kgs/ton	Recoverable Ferberite Min 65% WO_3 Tons
Proved by drilling 1972	1,200	0.80	960
Won 1972/73	250		200
Balance I.I.74	950		760
Won 1974	150		120
Balance I.I.75	800		640

The company has the reputation of being profitable and well managed. The ore reserves quoted in Table III.VIII are probably quite conservative. We were told by at least one [illegible] individual with recent close contacts with Bjorndal Mines that the true reserves are very much larger, that the mine is capable of an output several times higher than at present, and of utilising a greatly expanded labour force. It was even [illegible] that the mine can produce and

[illegible]

IV.4 Revival of Gold Mining

The subject [illegible] of rumours and [illegible] denials. It would [illegible] mining in Uganda at any [illegible] of [illegible] locations II.4.1 to II.4.6 [illegible] discussed earlier. One principal [illegible] was that a foreign prospecting team had found a new commercial gold field near Fort Portal in 1975 and are now engaged in more detailed evaluation. This [illegible] fairly likely.

V DISCUSSION

It is difficult to make proposals on the basis of the scanty information that we have about the present position. According to official information, the only [illegible] in [illegible] ores are now being worked are tungsten and tin. Only the former is being mined in an organised way, but well informed [illegible] suggest that there is considerably more production which is [illegible] reported unofficially.

The two official organisations concerned, [illegible] Mines Ltd. and the Geological Survey and [illegible] Department, are [illegible] badly in need of assistance with finance, technical and managerial [illegible] and equipment.

[illegible]

[illegible]

[illegible]

[illegible] tin, [illegible]

[illegible] is in the production of tinplate for can coating. The tin can, made from mild steel, has a coating of tin .0005 inches [illegible]

tinplate	44%
solder	23%
white metal and pewter	7%
chemicals	7%
bronze	6%
tinning	4%
others	9%

Consumption of tin prior to 1974, was only rising moderately, partly because efforts had been put into [illegible] technical savings. However, it is thought that [illegible] limits are now being approached and that in the long term, consumption may increase at a slightly higher level than hitherto experienced.

[illegible]

[illegible] price [illegible] end of 1976.

VII. PRICES OF ORES [illegible]

International prices of cobalt, wolfram [illegible] beryl between 1971 and 1976 [illegible] in Tables [illegible] respectively (pp.148-150). The price of cobaltite between 1973 and 1976 is charted in Figure LIII.V (p.150).

[illegible]

1. [illegible] ([illegible]). ([illegible]).

2. [illegible], [illegible].

Country	1971	1972	1973	1974	1975
Australia	10	12	10	10	9
Bolivia	30	32	28	29	28
Indonesia	20	22	22	25	25
Malaysia	75	77	72	65	65
Nigeria	7	7	6	5	5
Thailand	22	22	21	20	19
Other countries	23	23	26	23	23
Sino-Soviet bloc	36	35	36	37	37
Total World	223	231	221	217	211

[illegible]	1971	1972	1973	1974	1975 est
[illegible]	37	38	34	28	27
Africa	11	10	10	9	9
[illegible]	[illegible]	17	18	[illegible]	[illegible]
Asia	120	127	[illegible]	121	[illegible]
Australasia	7	7	7	7	7
Sino-Soviet bloc	51	36	37	38	[illegible]
Total World	245	235	228	222	214

Table EII.XI

World Consumption of Tin 1971-1975

'000 tonnes

Region/Country	1971	1972	1973	1974	1975 est.
Europe	68	69	73	71	70
Africa	3	4	4	4	3
America (ex.USA)	12	12	13	12	12
Asia	39	43	50	42	36
Australasia	5	4	5	5	4
USA	56	57	61	54	48
Sino-Soviet bloc	45	46	48	50	44
Total World	228	235	254	238	217

Source : Review of Non-Ferrous Metals 1975

Figure. E11.I

Average London Weekly Prices of Tin

1971–1976 Mar.

£ / Ton

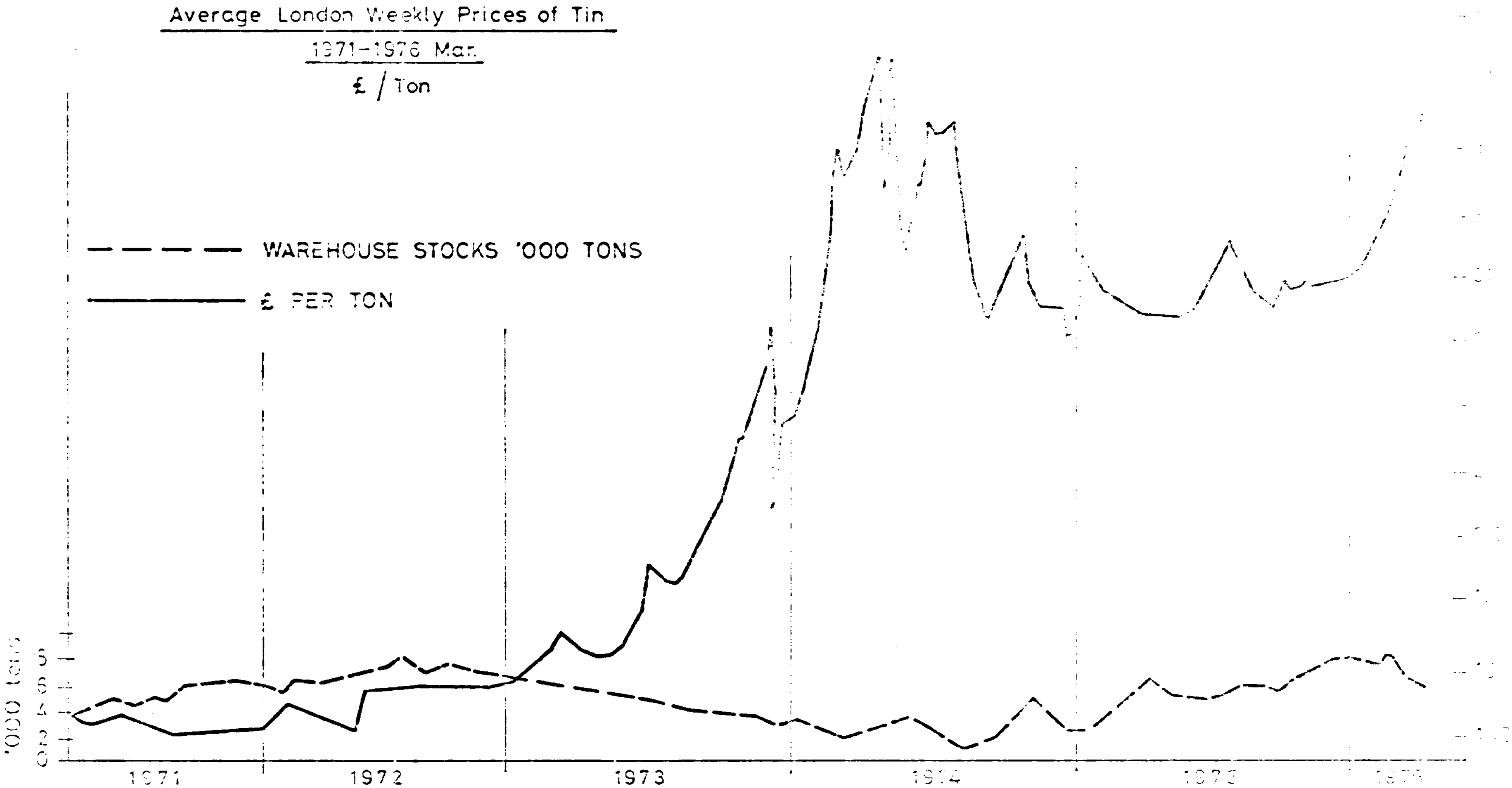
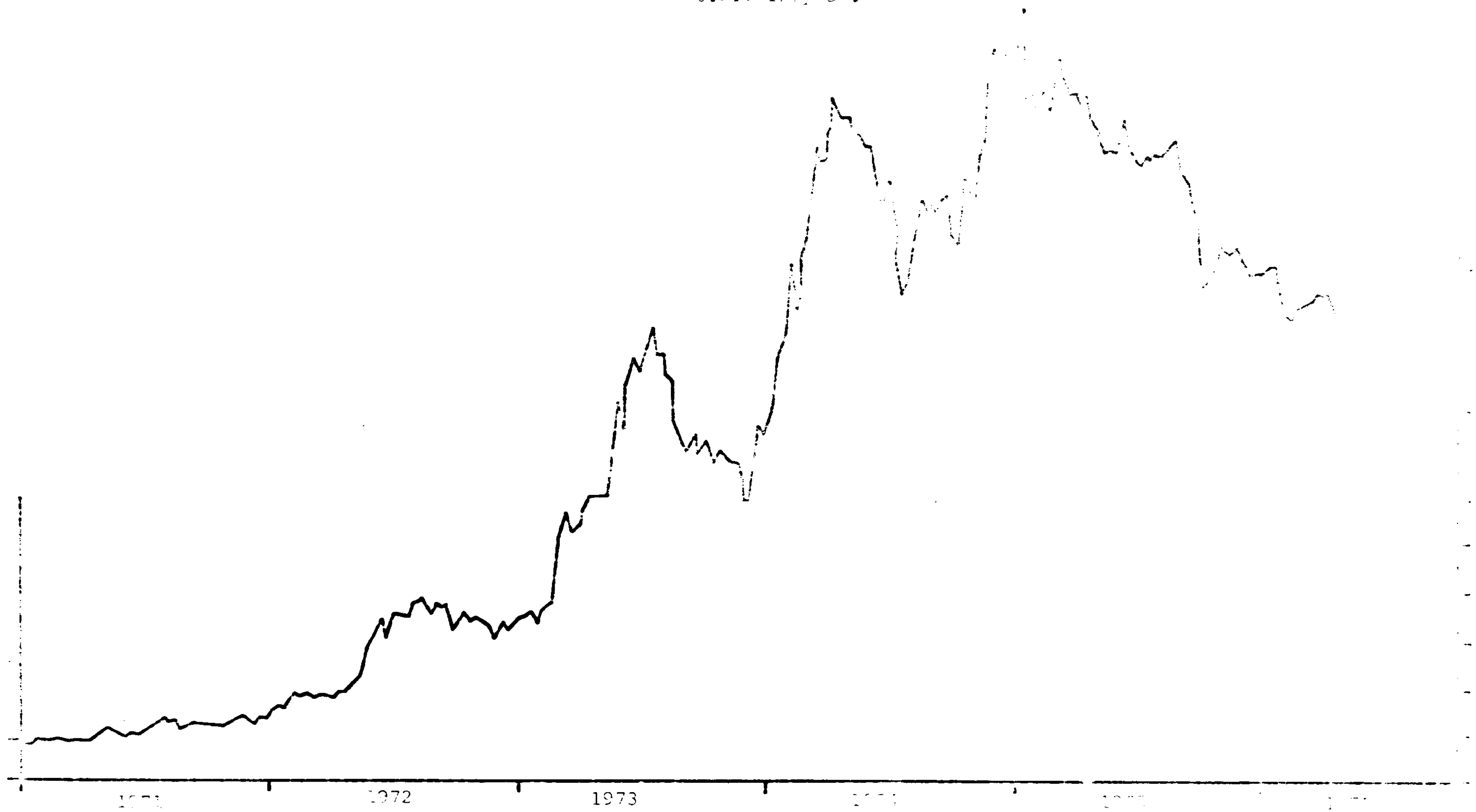


Figure III.II

Price of Gold [illegible]

U.S.$ Troy Oz.



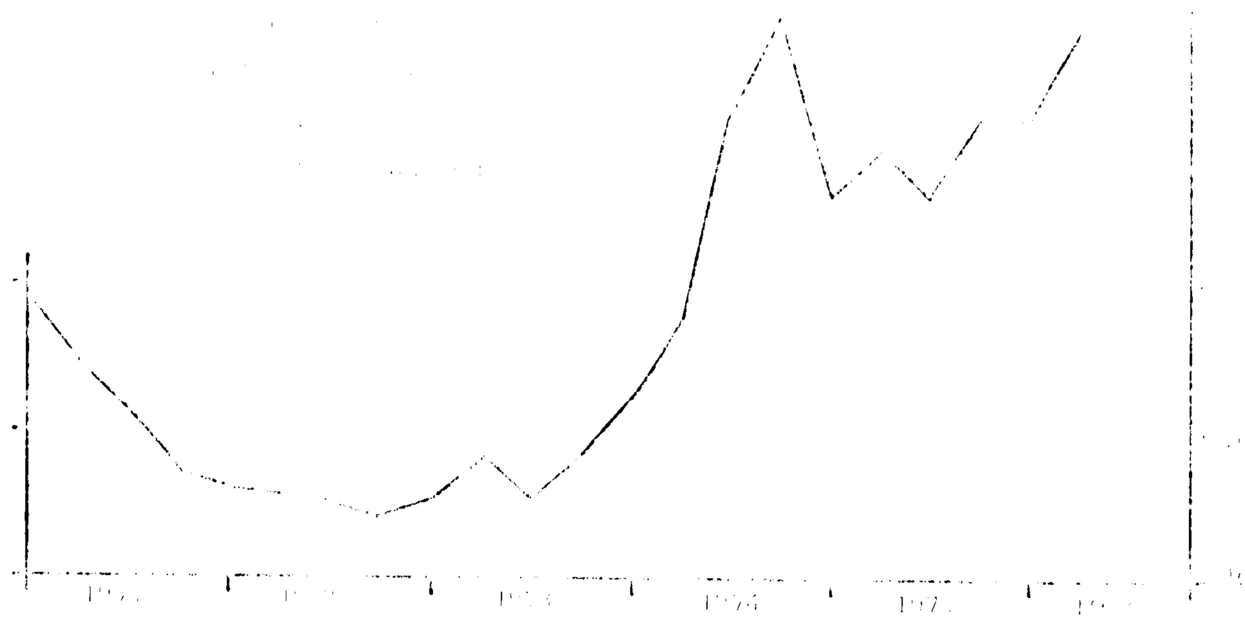


Figure Ell.IV

[illegible]

U.S.$/20 lb[illegible]

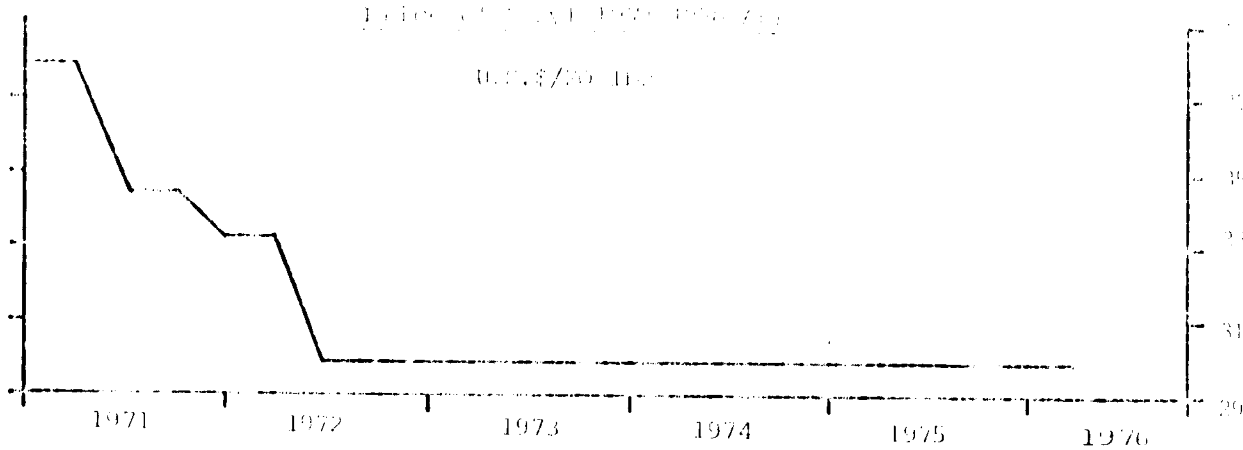
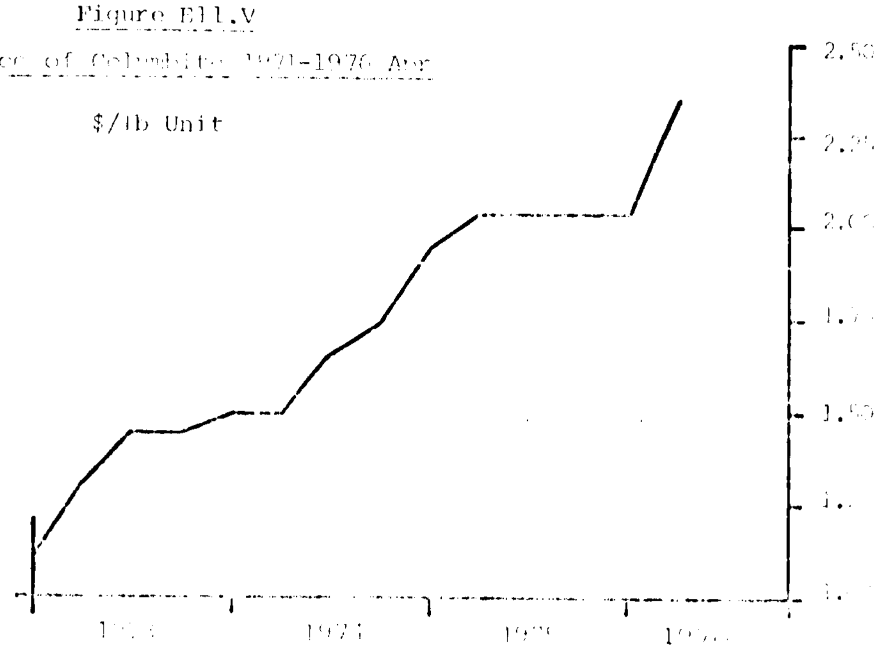


Figure Ell.V

Price of [illegible] 1971-1976 A[illegible]

$/lb Unit



C-34

79.11.30