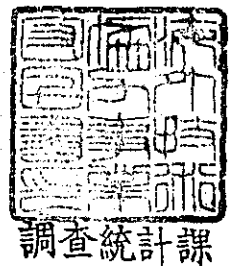
REPORT ON INVESTIGATIONS FOR MEDIUM AND SMALL SCALE INDUSTRIES DEVELOPMENT PROJECT SUDAN

MARCH 1964

OVERSEAS TECHNICAL COOPERATION AGENCY OF JAPAN



FOREWORD

The Report is hereby presented on the results of the basic investigations on the Medium and Small Scale Industries Development Project in Sudan by the Japanese Survey Team which was despatched by the Overseas Technical Co-operation Agency of Japan (OTCA) in response to the request made by the Government of Sudan.

The OTCA which was established on July 1, 1962, serves as an executing agency of the Japanese Government in conducting Japan's government-level technical cooperation to Asia, Near and Middle East, Africa and Latin America. Its principal activities are acceptance of overseas trainees, assignment of technical experts aborad, establishment of overseas technical cooperation centres, and performance of surveys for development projects.

The Survey Team, comprising six experts specialized in different industries, arrived at Khartoum on January 12, 1964. Investigations were then conducted for a period of about two weeks. The Team completed its mission and left Khartoum on February 4, 1964.

Being fully aware of the significance of the Project, I should be pleased if this Report should serve in some measure for the materialization of the Project, contributing in the ultimate to the establishment on a commercial basis of the five industries investigated.

I avail myself of this opportunity to express on behalf of the Team my deepest gratitude to His Excellency the Minister for Commerce and Industry, officials of the competent Government authorities, Governors and Commanding Officers of Provinces of Dafur, Kordofan and Bahr El Ghazaal, for their unlimited and invaluable assistance and cooperation without which the Survey could not have been a successful one.

S. Shibusawa

March 1964

Shinichi Shibusawa,
Director General,
Overseas Technical
Cooperation Agency of
Japan, Tokyo.

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I. INTRODUCTION

1. OBJECT OF INVESTIGATION

The present investigations were carried out in compliance with the request of the Government of Sudan on the development of medium and small scale industries inclusive of the ceramic, wood working, fibre, plastic and glass industry, with the ultimate objective of developing the Sudanese economy and promoting the economic as well as technical cooperation between Sudan and Japan.

Prior to the despatch of the Survey Team, arrangements were made in Sudan in March 1963 between the Japanese Survey Team for Pulp and Synthetic Fibres and Mr. Mansour, Under-Secretary for Commercial and Industrial Supply, who expressed the hope for Japan's technical cooperation. Further arrangements were made in May 1963 through the Japanese Embassy in Sudan with regard to the selection of the industries to be investigated, and later in August 1963 the official request from the Government of Sudan reached the Japanese Government.

The Survey Team, organized by the Overseas Technical Cooperation Agency of Japan, aimed at reviewing the feasibility of developing industries selected, drawing up plans and measures for the desired development, and making recommendations regarding the introduction of affiliated industries.

Today, Sudan is rapidly reforming herself from the primary products producing country into a modern industrialized country. Industries are planned to be established utilizing raw materials that have hitherto been exported; production within Sudan is also contemplated for such import items that are relatively easy to manufacture.

It is expected, however, that in the course of the desired development, difficulties such as competition with imported commodities, shortage of techniques and funds, market limitations and so forth will be encountered. It is therefore hoped that Japan's technical cooperation at this important stage would contribute to the economic development of Sudan and serve at once as the basis for the joint ventures that may take place in the future.

2. FORMATION OF THE SURVEY TEAM

The Survey Team consisted of the following members.

Name	Assignment	Present Post
Mr. Hitoaki Yamaguchi	Leader	Technical official, Technical Cooperation Section, Economic Cooperation Division, Trade Bureeau, Ministry of International Trade and Industry.

Name	Assignment	Present Post
Mr. Fukumatsu Kato	Wood working industry	Technical official, Planning Section, Industrial Arts Institute, Ministry of International Trade and Industry.
Mr. Sukezo Kawamura	Ceramic industry	Technical official, Seto Branch of Nagoya Research Institute of Technology, Agency of Industrial Science and Technology, Ministry of International Trade and Industry.
Mr. Tsuneo Uetsuki	Glass industry	Technical official, Glass Laboratory, Section 4, Osaka Research Institute of Technology, Agency of Industrial Science and Technology, Ministry of International Trade and Industry.
Mr. Minoru Yoshino	Fibre industry	Secretary, Research and Statistics Division, Minister's Secretariat, Ministry of International Trade and Industry.
Mr. Tetsuo Furugori	Plastic industry	Staff of Research Section, Sumitomo Bakelite Co., Ltd.

3. ITINERARY OF THE SURVEY TEAM

Date	Description
Jan. 9, 1964	(Departure from Haneda International Airport)
Jan. 10	(Arrival at Cairo Airport)
Jan. 11	Courtesy call paid to the Japanese Embassy in Cairo.
Jan. 12	(Departure from Cairo, arrival at Khartoum)
	All members paid courtesy call to the Japanese Embassy in Khartoum, explanation given on the situation in Sudan.
Jan. 13	Courtesy call paid to the Ministry of Commercial and Industrial Supply.
	Courtesy call paid to H.E. the Minister for Commerce and Industry at the President's official residence.
	Observed technical training at Khartoum prison.
Jan. 14	Interview with the Director of the Bureau of Cooperative Unions, Ministry of Commercial and Industrial Supply.
	Investigation of Omdurman district (Weaving & sewing factories investigated)

Date	Description
Jan. 15, 1964	Courtesy call paid to the Bureau of Forest Resources, Ministry of Agriculture and Forestry.
	Investigation of Omdurman district (afternoon).
Jan. 16	Inspection tour of the Nile at the invitation of the Japanese Embassy.
Jan. 17	Investigation of a match factory, live-stock market, construction site of apartment houses for workers.
Jan. 18	(Western region investigation group comprising Mr. Yamaguchi, Mr. Kato, Mr. Yoshino, Mr. Kawamura, left for El Obeid - El Fasher districts)
	Mr. Furugori and Mr. Uetsuki remain in Khartoum to continue with their assignments.
Jan. 27	(Western region investigation group returns to Khartoum)
Jan. 28	Observation of Khartoum College of Technology.
Jan. 29	(Southern region investigation group comprising Mr. Yamaguchi, Mr. Kato, Mr. Yoshino, Mr. Uetsuki, left for Wau district)
	Mr. Furugori and Mr. Kawamura remain in Khartoum to continue with their assignments
Feb. 2	(Southern region investigation group returns to Khartoum)
Feb. 3	Final coordination of the results of investigation. Mr. Yamaguchi interviewed with Mr. Hojari, Ass't Under-Secretary, and explained on the progress of the investigations.
Feb. 4	(Survey Team left Khartoum)

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II. REPORT ON INVESTIGATIONS

1. CERAMIC INDUSTRY

2. WOOD WORKING INDUSTRY

3. FIBRE INDUSTRY

4. PLASTIC INDUSTRY

5. GLASS INDUSTRY

III. CONCLUSION

1. CERAMIC INDUSTRY

1-1 PRESENT STATUS OF CERAMIC INDUSTRY OF SUDAN

Throughout the country of Sudan, nothing of facilities can deserve the name of factory for porcelain ware and other ceramic materials. However, the local manufacture of pottery and construction red brick may be called in a sense porcelain or earthenware products of this country. Those called pottery factory or brick factory merely mean the places in the fields or deserts, where the native people gather to work. Neither factory equipments nor advanced techniques have been introduced to their working at all.

The general conditions for ceramic materials in Sudan was as such, but in the technical school in El Obeid and the technical institute in Khartoum, the pottery section produced stoneware coffee cups, pots and ornament stuffs, using some glazing materials. They used the plaster molds and were even equipped with the potter's wheels, foot-driven and electromotive as well.

The manufacture of water jars to meet the local demand was conducted in this way: the material is cut out of the sandy layer containing clay. With a proper amount of water added to this soil, the kneaded clay is made in quantities in one time, out of which the pottery working is done by hand. The native women customarily take care of the handicraft.

In the forming work, the potter's wheel is not used, but the only manual working is in practice stacking up the kneaded clay into the shape of jars.

In this manner, the forming would be carried out comparatively easily in areas where stoneware clay of strong plasticity is available. On the other hand, in the places where the so-called black sand of little plasticity has to be used as the material soil, the cow waste is mixed in the pâte so as to increase the forming convenience as well as to strengthen the durability of the produced jars. Under such uncomfortable conditions, the work is practically continued.

1-2 CONSTRUCTION RED BRICK

1-2-1 Manufacturing Method

The houses in Sudan are for the most part built of the red brick. The demand for the red brick, therefore, would amount to a large quantity as the nation's total. The manufacturing methods were observed almost same through the districts of El-Fasher, El Obeid and the suburbs of Khartoum.

The manufacturing process in general is as follows:

Digging-out of clay -- Adding water at once and kneading (very softly) -- Placing the kneaded clay into the mold frame -- Taking out onto the ground -- Natural drying -- Firing.

As for the firing, they had no permanent kiln built, but carry out in a very peculiar manner. The dried bricks are piled up in the shape of square kiln, and covered by muddy soil all over. The wood debris are thrown into every tunnel opened in the lower parts of the stack. When the fuel woods catch fire enough, all the openings of the tunnels are closed. In about 24 hours, the charged fuel is burnt out.

1-2-2 Quality of Product

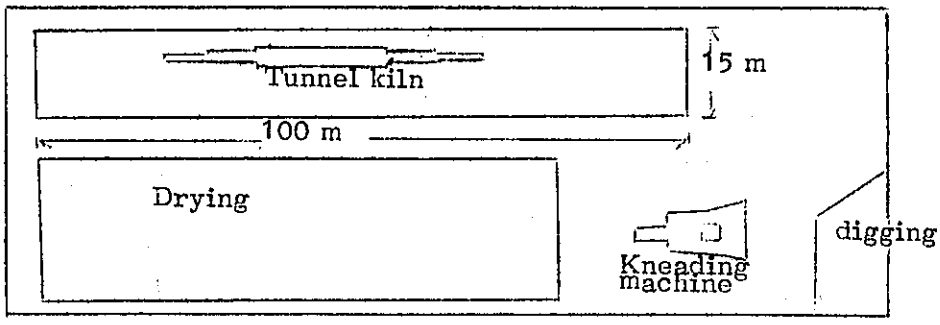
Notable about the produced red bricks are that, besides not being clean on the surface, they are not regular and even in shape, and that the firing solidification is not enough to bear the adequate mechanical strength. Their products would never be up to the standard of Japanese construction materials. As judged from their processing method, the inferior quality might be resulted from the large moisture content of the body brick, no pressure applied in forming, the poor handling when taken out of the mold, and the inferior quality of raw material itself.

The following measures are suggested to improve such poor conditions:

(a) The material soil should be screened through sieves so that the little lumps chiefly consisting of miscellaneous organic materials and iron might be taken out.

(b) The moisture content should be decreased to make the more hardened material soil. The forming should be performed by means of beating. In this way, however, the production speed will be lowered so that the cost charges may become considerably high.

(c) The feasibility should be studied for establishing a factory near El Obeid in which modern processing should be adopted by using the tunnel kiln.



The investment capital and the estimate of costs for a new factory given in (c) above are outlined below.

In this plan, the production scale is proposed to be 500,000 pcs. per month. Judging from the market conditions and the consumption trend in Sudan, there would be no fear of saleability for 1,000,000 pcs. a month, but the firing by the tunnel kiln is an epoch-making attempt in this country, so the smaller production will be suitable to start with.

(1) Equipment

a) Shaping Section		
Vacuum Kneading Machine	1 set	£2,200
b) Firing Section		
Tunnel Kiln	1 unit	£12,000
c) Other Tools		
Transfer Car	10 sets	£100
		£14,300

(2) Construction Cost

a) The layout of the proposed factory is as shown in the above drawing.

b) Estimate of Construction Cost

Building Area (m^3)	Unit Price (£/m^3)	Amount
1,500	10	£15,000

(3) Indirect Cost

a) Depreciation

Equipments	£14,300 x 0.12 = £1,716
Building	£15,000 x 0.045 = £675
Vehicles	£240 x 0.53 = £129

b) Repairing and Maintenance Cost

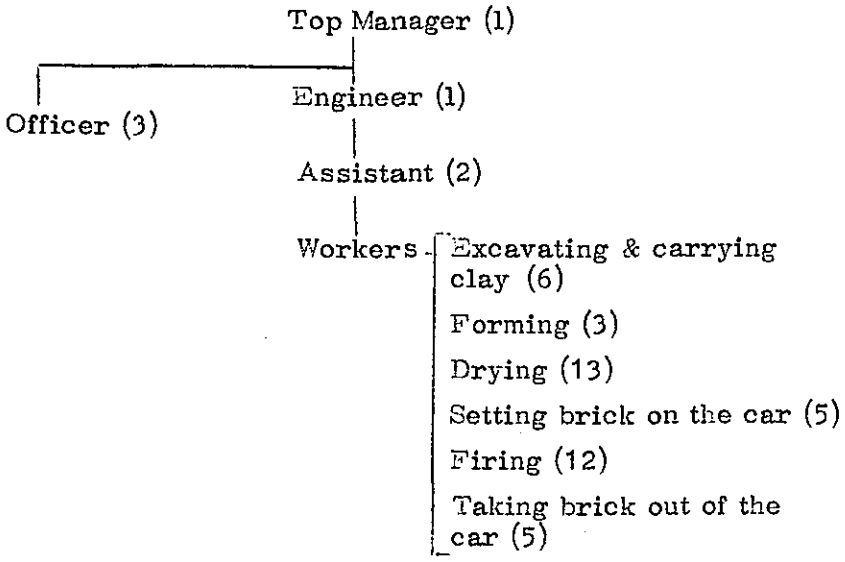
Annual Repairing/Maintenance Cost	£2,500
General Cost	£2,500
Total Annual Indirect Cost:	£7,520

(4) Material Cost

a) Clay Material	Nil
b) Fuel (crude oil) - Annual charged cost	£7,000
c) Electric Power Consumption - Annual chargec cost	£400
Total Annual Material Cost:	£7,400

(5) Labour Cost

a) The employees corresponding to the proposed production scale are as follows.



b) Pay and Wage

Top manager	£300 x 1	£300
Engineer	£200 x 1	£200
Assistant	£25 x 2	£50
Officer	£25 x 3	£75
Worker 1st class	£25 x 6	£150
Worker 2nd class	£10 x 38	£380
	Total:	£1,155

(6) Total Cost

Annual Material Cost	£7,400
" Pay and Wage	£13,860
" Indirect Cost	£7,520
Total:	£28,780

(7) Annual Output

@ 6.0 MS/brick:

500,000 pcs. x 12 months x 6.0 MS = £36,000

(8) Annual Profit and Profit Rate

Annual Profit: Annual Output - Total Cost = £7,220

Profit Rate: Annual Profit/Annual Output x 100 =20.0%

(9) Study on Selling Price of Brick

The selling price of 6.0 MS per brick may sound a little high compared to that in practice in Sudan. However, the

quality of the new products will be superior and the breakage will be reduced to almost nothing. In the light of this, the actual selling price will be set at much lower level.

1-3 DISTRIBUTION CONDITION OF PORCELAIN WARE AND OTHER CERAMIC MATERIALS

1-3-1 The porcelain ware products and other ceramic materials of Sudan are only confined to the construction red bricks and the jars to stock cold water. All these stuffs are made of the inferior material soil which turns out red coloured in the firing process. No utilization of the kaoline clay, feldspar and quartz at all is known to the people. However, the past geological survey reveals the existing dolomite, lime-stone, talc, quartz and feldspar in this country. In addition, the survey carried out this time has proved the yield of kaoline clay of excellent quality. The main materials are distributed as follows:

1-3-2 Six kinds of sandy material soil which are produced near Dardeib of Kassala Province and called "kaoline clay" by the Sudanese Geological Survey Institute, were tested in Japan, and turned out to be the feldspathic or siliceous sand caused from the weathering of granite. These materials are referred to as "Saba" in Japan, containing a plenty of iron, titanium, mica and other miscellaneous impurities, not suitable for the industrial utilization.

The ash-coloured soil being produced in quantities near Omdurman used to be applied for the construction wall material in this district. The soil was brought back to Japan and tested. The results proved it to be kaoline clay of good quality. The kaoline is one of the most superior materials for ceramic manufactures as well as feldspar and quartz, and when the modernized facilities are equipped for the manufacture, it should be fully utilized as an important material.

1-3-3 At the pegmatite dyke in Mt. El Razoun located west to Abu-Hamed, the feldspar can be quarried in quantities. In general, Sudan is rich in the pegmatite dykes all over the country. South to El Obeid, the existence of feldspar was recognized, and further observed is that the people excavated the surface sandy soil to take the sheet mica. A plenty of feldspar will be safely expected anywhere in Sudan.

1-3-4 As does the feldspar, quartz is richly found in the pegmatite dykes. In fact, at Tam-Hamin of Red Sea Hills, quartz is quarried, and

the best quality of the produce is reportedly evaluated to consist of 99.5% of SiO_2.

1-3-5 There cannot be expected the produce of the best plastic clay which can be equal to the Kibushi or Gairome clay of Japan, but the Sudanese secondary kaoline, being comparatively plastic, could be utilized for industrial purposes.

In the estimate of the production cost, however, it was assumed that the ball clay of Japan would be imported to be used.

1-4 TEST RESULTS OF MATERIALS FOR PORCELAIN WARE AND OTHER CERAMIC MATERIALS

1-4-1 Sample 25745 - B

(a) Plenty of biotite is contained, and it is observed that the test piece resulted from the weathering of granite. Biotite was attempted to be separated, but to no success. The weathering has been made to a large degree.

(b) The result of the diffraction according to the X-ray powder method is shown in the appendix. Much of feldspar and quartz are contained, and a bit of haloisite and hydro-haloisite are observed. As a result of the additional firing test as SK9 (1,280°C), the test material is concluded after all to belong to feldspathic-sands.

(c) The feldspathio-sands (referred to as "Saba" in Japan) is applicable to the manufacture of tiles, but the complete extraction of black mica would be a problem to be further settled.

1-4-2 The other six kinds of the test materials are found to be of feldspathic- or siliceous-sands. In any case, the iron, titanium or other impurities, or black mica are largely contained. No utilization for the industrial ceramic material is therefore feasible.

1-4-3 So-Called White-Clay Produced in Omdurman

(a) Chemical components (according to chelatometry)

Component :	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2	K_2O	Na_2O	Ig.loss
Percentage:	69.89	17.91	1.55	0.30	0.24	0.14	0.44	0.44	7.62

Total: 98.43

(b) Fire resistence: SK 32

(c) Diffraction by X-ray powder examination, shown in appendix, indicates that the material consists of kaoline containing substantial silica content.

(d) Kaoline material of excellent quality may be obtained if washed with water.

1-4-4 Feldspar produced in Abu Hamad

(a) Chemical components

Component :	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2
Percentage:	66.56	16.65	0.30	0.25	0.16	tr

K_2O	Na_2O	Ig. loss	Total
11.00	2.75	0.87	98.54

(b) Diffraction by X-ray powder examination shown in appendix indicates that the material consists chiefly of microcline.

(c) Microscopic photo is shown in appendix. The double crystalization of oligoclase is observed. As a result of the overall testings, the material is concluded to be of microcline perthite.

1-5 MARKET SITUATIONS

The Sudanese import of ceramic materials amounts to 300 million yen as of 1963. The following are the actual market prices.

Item	Size	Q'ty	Price (in Yen)	Mfg. country
Porcelain ware				
Coffee set	Smaller than common size (16" dia.)	1 set	2,750	France
"	"	"	2,950	Germany
"	"	"	2,950	Japan
Cake plate	7"	1 pce.	80	Poland
Soup dish	10"	"	150	Poland
Coffee set	Common size	1 set	7,100	-
Coffee cup & saucer	Small size	"	100	-
Salad bowl	10"	1 pce.	300	Poland
Ironstone ware				
Coffee set	Small size	1 set	2,000	England
Salad bowl	14"	1 pce.	700	France
"	10"	"	400	France
Oval dish	10" x 8"	"	300	England
Ornaments	Miniature	"	200 - 300	-

Generally speaking, the quality and design could be rated to be middle and lower class. Compared to the market prices in Japan, the porcelain wares are sold at a little higher prices, and the ironstone wares are priced much higher. Especially notable is that the ironstone wares are occupying an overwhelming market share over the porcelain wares. The main exporting countries to Sudan are England, Germany, France, Poland, Japan and Czechoslovakia. England, Germany and France put on the market the heat-resisting tablewares such as pyroceram or earthenware.

In the city of Khartoum, there are several shops specializing in the tablewares, mostly the earthenwares. In the country towns, however, the enamelled wares are only sold instead of porcelain wares. Further, in the districts like the western part of Sudan where the living standard is extremely low and the nomadic people move around, no ceramic manufactures will be used at all. Under the present circumstances of Sudan as a whole, the porcelains and earthenwares would not be able to compete with the enamelled wares, chiefly due to the inconveniences of transportation. On the other hand, the market which is importing the ceramics for 300 million yen a year, is considered suitable for a new factory of medium size to start with. What is more expective for the industry, the consumption and demand for the ceramic wares will arise constantly in the city life. There can be the brighter prospect over the future expansion of the ceramics market.

1-6 A DRAFT PLAN ON PRODUCTION

1-6-1 Ironstone Wares

The Sudanese ceramic industry is just at its beginning stage and has no traditional background for the manufacturing technology. Taken into consideration the results of the actual survey, the ironstone wares would be more suitable for the market than the porcelain wares.

1-6-2 Annual Output

Under the conditions that the manufacture of the porcelain and earthenwares should make quite a new start, the production scale should be decided with full consideration taken into for the following two points, a) As a number of unexperienced labourers will engage in the work, the production should be confined to the scale enough to be easily controlled and supervised by a comparatively small number of engineers for the administration and technical instructions, and b) the output should not exceed the local demand. The local demand could be anticipated with the available statistic figure. However, the problem a) above will have to be settled by experience. Based on these considerations, besides

being referenced to the existing plants, the production scale in project for the purpose of exporting manufactures will be recommended as follows.

(a) The most decisive factor in making up the production scale is the tunnel kiln which is assumed as follows.

Glost Tunnel Kiln -

Full length:	50 m
Effective area:	700 mm x 1,200 mm

(b) Based on the firing capacity of the tunnel chamber as described above, all the manufacturing equipments will be set up.

(c) With an 8-hour work a day (25 working days a month), the facilities is capable of producing 450,000 pieces of hard earthenwares for a month.

1-7 EQUIPMENTS AND MANUFACTURING PROCESS

1-7-1 All the necessary equipments are given below in the order of processing.

1. Elutriation & clay preparing shop
2. Clay forming shop
3. Drying conveyor
4. Biscuit firing tunnel kiln
5. Glost firing tunnel kiln
6. Electric decoration kiln
7. Glaze making shop
8. Saggar making shop
9. Laboratory shop
10. Mold making shop
11. Gypsum firing shop

Further details of the nomenclatures and number of machines and equipments are as follows.

(a) Material Preparatory section

1.	Jaw crusher	1 set
2.	Edge runner	1 set
3.	Bucket conveyor	1 set
4.	Portable platform scale	1 set
5.	Elevator	1 set
6.	Ball mill	3 sets
7.	Agitator	3 sets
8.	Rotary sieve	2 sets
9.	Magnetic separator	2 sets

10.	Diaphram pump	2 sets
11.	Filter press	2 sets
12.	De airing auger machine	1 set
13.	Pipe and fitting	1 set

Total estimate cost: £18,500.00

(b) Forming section

1.	Semi automatic jigger	6 sets
2.	Machine jigger	16 sets
3.	Automatic dryer	1 unit
4.	Finishing jigger	6 sets
5.	Shelf transfer car	5 sets
6.	Hand jigger	20 sets
7.	Press for casting slip	2 sets
8.	Agitator for casting slip	1 set
9.	Duct for drying furnace	3 sets
10.	Blower for drying furnace	3 sets
11.	Saggar pin forming machine	1 set

Total estimate cost: £13,300.00

(c) Biscuit firing section

Biscuit firing tunnel kiln 1 unit

Estimate cost: £20,500.00

(d) Glost firing section

Glost firing tunnel kiln 1 unit

Estimate cost: £18,200.00

(e) Decorating section

Electric decoration kiln 4 sets

Estimate cost: £3,600.00

(f) Glaze making section

1.	Ball mill	1 set
2.	Rotary sieve	1 set
3.	Magnetic separator	1 set
4.	Glaze agitator	1 set

Total estimate cost: £3,100.00

(g) Saggar making section

1.	Edge runner	1 set
2.	Bucket conveyor	1 set
3.	Pug machine	1 set

4.	Friction press	1 set
5.	Steel press for friction press	10 sets
	Total estimate cost:	£3,500.00

(h) Mold making section

1.	Pot mill	1 set
2.	Table jigger	1 set
	Total estimate cost:	£300.00

(i) Laboratory section

1.	Pot mill	1 set
2.	Auto-crave	1 set
3.	Test kiln	1 set
4.	Agitator machine	1 set
	Total estimate cost:	£1,000.00

(j) Other tools

1.	Mold case	1 unit
2.	Drying conveyor	1 set
	Total estimate cost:	£1,600.00
	GRAND TOTAL:	£83,600.00

Flow sheet and factory layout are given in appendix.

1-7-2 Preparation Example of Ironstone Ware

The ironstone ware is often called the feldspar ware. Being white, it is the hardest and best quality of all the earthenwares. The characteristics of the manufacturing process different from that of the porcelain ware lies in the firing temperatures. The biscuit firing of the body is carried out at SK 6 through 8 (1,200°C - 1,250°C) and the glost firing at SK1a through 3a (1,100°C - 1,140°C). The following shows the preparation which was used as the standard in calculating the material cost in production.

Body - Biscuit firing at SK6a - 7

Kaolin	42%
Silica	34
Feldspar	12
Ball clay	12

Glaze - Glost firing at SK2a

Frit	48%
Silica	10
Feldspar	25
Lime-stone	6

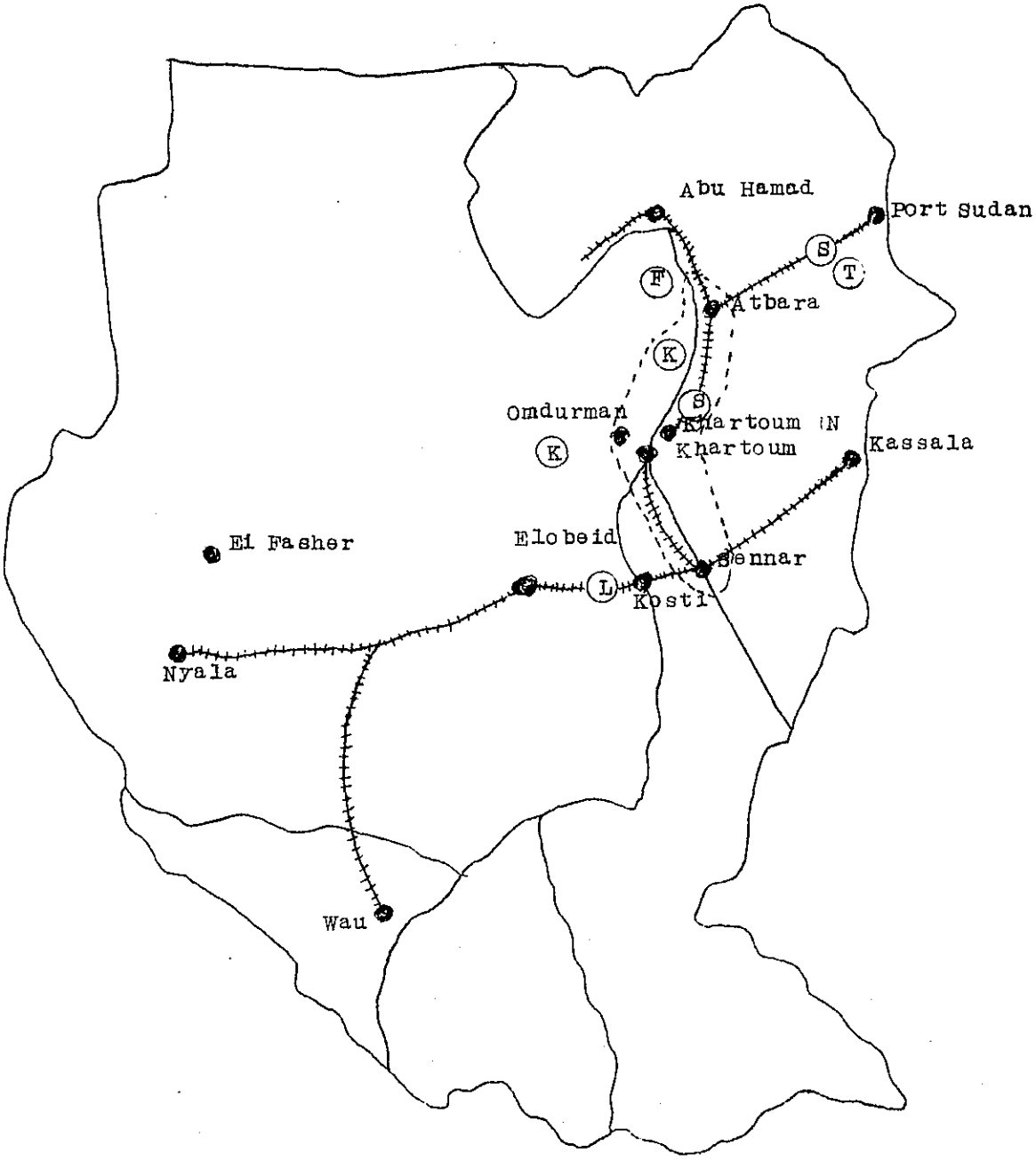
Kaoline	6
Zinc-white	5

1-8 SUITABLE SITE FOR FACTORY CONSTRUCTION

Gnerally speaking, apart from the northern part of Khartoum in the east Sudan, El Obeid and its surrounding areas would probably be a promising land for the future industrial development. The remaining areas might be left far behind the industrialization due to such unfavourable conditions as the shortage in electric power and water supply and the traffic inconveniences.

Due to the unfavourable geographical features in addition to the vastness of land, Sudan is rather underdeveloped in regard to the transportation roads. This will affect the nation's economical and industrial close contacts among the interested parties. What is worse, the country is far behind the development of industrial electric power resources. Such being the conditions involved, the districts suitable for the industrial site would be limited to only those neighbouring several towns located north or south to Khartoum, though Sudan is vast in its territory. In Khartoum, there is now under construction the light industrial zone for the first time in Sudan, where in operation are the modern factories for spinning, BATA's shoemaking, match, and enamelled ware, and so forth.

The distribution conditions of ceramic materials, locations of main cities and towns, traffic map and electric power supply conditions are shown in the next page..



Legend
- S : Silica
- T : Talc
- F : Feldspar
- K : Kaoline
- L : Lime stone
- ++++ : Railways

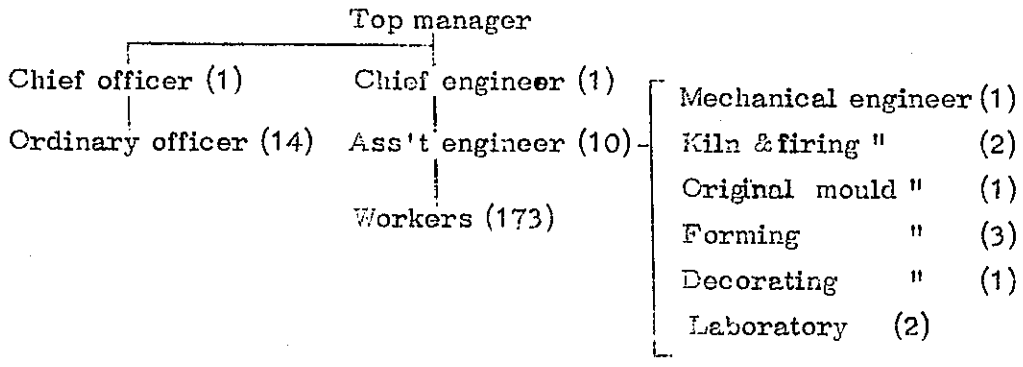
Remarks : The area enclosed by dotted line is abundant in electric power supply for industrial use

1-9 MATERIAL COST

	Item	Annual Consumption (ton)	Unit cost per ton delivered at Khartoum (£)	Amount(£)	Remarks
BODY	Kaoline	480	4.0	1,920	
	Silica	456	4.5	2,052	
	Feldspar	120	4.0	480	
	Ball clay	144	20.0	2,880	Imported
GLAZE	Frit	120	36.0	4,320	Imported
	Silica	24	4.5	108	
	Feldspar	55.2	4.0	220.8	
	Lime-stone	14.4	4.0	64.8	
	Kaoline	14.4	4.0	57.6	
	Zinc white	11	16.0	176.0	Imported
SAGGAR	Kaoline	150	4.0	600	
	Shamotto	90	7.0	630	
	Ball clay (low grade)	60	10.0	600	Imported
SUBSIDIARY MATERIAL	Gypsum	50	6.9	345	Imported
	Crude oil	364,000 gal.		15,000	Imported
	Water	1,200,000 gal.		240	
	Electricity	420,000 KWH	12.0 MS/KWH	5,040	
			GRAND TOTAL:	£34,734	

1-10 LABOUR COST

1-10-1 The composition of employees corresponding to the proposed production scale is as follows.



1-10-2 Labour Cost

Top manager, Chief engineer:	£300 x 2 x 12 (months)	= £7,200
Chief officer:	£100 x 1 x 12	= £1,200
Assistant engineer:	£35 x 10 x 12	= £4,200
Workers, 1st class:	£25 x 35 x 12	= £10,500
Workers, 2nd class:	£10 x 138 x 12	= £16,560
	Total:	£39,660

1-11 CONSTRUCTION COST

Item	Area (m^3)	Unit cost (£)	Amount (£)
Main factory	72 x 60 = 4,320	20	86,400
Decorating factory	24 x 18 = 432	20	8,640
Material warehouse	20 x 5 = 100	5	500
Product warehouse	24 x 6 = 144	8	1,152
Saggar factory	18 x 12 = 216	5	1,080
Office building	18 x 10 = 180	20	3,600
		Total:	£98,372

1-12 INDIRECT COST

The annual total amount of indirect costs including depreciation amount, maintenance and repair cost and other miscellaneous expenses is estimated to be approximately £40,000.

1-13 ANNUAL TOTAL COST

(Material cost) (Pay and wage) (Indirect cost) (Total sum)

£35,000 + £40,000 + £40,000 = £115,000

1-14 ANNUAL TOTAL OUTPUT

The monthly output of 450,000 pieces makes 5,400,000 pieces for one year, and the average selling price would be presumedly set at 30 P.T. per piece.

Annual total amount: 5.4 million pieces x 30 P.T. = £162,000

1-15 ANNUAL PROFIT AND PROFIT RATE

(Annual total output) - (Annual total cost) = Profit

£162,000 - £115,000 = £47,000

(Profit) ÷ (Annual total output) x 100 = Profit rate

£47,000 ÷ £162,000 x 100 = 29.0%

1-16 CONCLUSION

A conspicuous fact about the ceramic industry in Sudan is that the construction bricks are largely demanded and manufactured in many different districts of the country. It is to be noted, however, that the quality of the bricks are rather inferior and needful of improvement in the manufacturing method.

Though there exist latent conditions that make it foreseeable that the production of porcelains and earthenwares will be undertaken in Sudan, it cannot be definitely be said that there will be a sharp increase of demand in the near future.

It is therefore recommended that the establishment of small scale factories be materialized as a part of the country's light industries development project.

Khartoum Technical Institute, which embodies Pottery Section, is urged to make further improvement in the ceramic techniques to be provided as the basis of the desired development of the ceramic industry in Sudan.

For the development of the ceramic industry in the broad sense of the word, the magnesite deposits available in large quantities in Sudan deserve due attention. It may be advisable to study the possibility of exporting it in magnesia clinker.

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2. WOOD WORKING INDUSTRY

2-1 PRESENT STATUS OF WOOD WORKING INDUSTRY

2-1-1 Forest Resources

Sudan is located in the north eastern part of the African continent, with the desert covering the greater part and the mountaineous regions occupying a small portion of the country. The total area is 2,595,905 km^2. While Northern Sudan is mostly the desert, the climate of the southern part of the country is subtropical. Forest resources are therefore found concentrated in Zalingei district along the foot of Mt. Jeb el Marra in Dafur Province in the west, in Wau district of Bahr El Ghazaal Province south to the upper stream of the White Nile as well as in Equatoria Province. The southern part of the country, where subtropical forest zone is discovered, is best fit for trees to grow. Forest resources are also found in areas south to the Provinces of Kordofan, Upper Nile as well as of Blue Nile. (See the distribution map of forest resources in appendix) Main species of the trees of Zalingei district which are mostly broad-leaved trees of hard lignin are:

a) Acaciya Arabica
b) Tamarinpus Indica
c) Acaciya Singal
d) Acaciya Labita
e) Khaya Senegalensis
f) Dapical
g) Cordia Abyssinica

With its exceptionally fine quality and grain, Cordia Abyssinica is best fit for manufacturing furnitures. Dapical is one of the rare trees of soft lignin produced in this district.

Trees in the southern part of Bahr El Ghazaal Province grow fast and are available in many species. Major species available in this district are as follows:

a) Anogeissus Schimperi
b) Terminalia Spina
c) Khaya Senegalensis
d) Prosopis Africana
e) Afzelia Africana
f) Lsoberlinia Doka
g) Melia Azadirachta

Among these trees, Khaya Senegalensis is conspicuous as it is used for manufacturing furnitures of superior quality. Lsoberlinia Doka, now used for railway sleepers only, can also be utilized for making furnitures. Afzelia Africana, yellowish brown in duremen merging outwardly into white, could be used for building houses with its excellent anti-corrosive property and specific gravity of 0.52 - 0.66.

As regards the afforestation in Sudan, Wau district has been afforested since 1956 with Tectona Grandis, Dilling district in Kordofan Province with Khaya Senegalensis and Tectona Grandis, and the green belt along the Nile in Khartoum district with acerose trees. In Nyala district of Dafur Province and El Obeid district of Kordofan Province, one finds huge Tabaldi trees of the diameter ranging from 7 - 10 m. As this tree has soft lignin, people hollow it out to preserve water in it, and its bark is utilized for manufacturing ropes.

Although the distribution map (see appendix) does not indicate in exact figures the forest resources concentrated in Zalingei district and in the southern part of the country upstream of the White Nile, it may be said that a number of western districts and Wau district are likely to provide sufficient wood materials for the promotion of the lumber industry. Proper utilization of Khaya Senegalensis is recommendable for the production of high class furnitures.

It was noted that in Sudan broad-leaved trees of hard lignin are planted in larger quantities than acerose trees of soft lignin. Since virtually all the furniture factories in Khartoum import timbers of soft lignin from northern Europe, it is urged that more acerose trees be planted within the Nile basin.

2-1-2 Wood Working Technique

(a) Khartoum district

(1) Furniture factory

Furniture factories in Khartoum procure, in one case, the main timber material from Wau district and import supplementary materials such as soft lignin timbers, plywood, paint, metal fittings, etc. from Sweden, Netherlands; and in another case, they import all the necessary materials from abroad. These factories in Khartoum manufacture a wide range of furnitures including desks, chairs, wardrobes, book-sholves, dressing tables, beds, tables, etc. which are supplied to governmental offices and middle- and higher-class families.

In the case of A. Zuccato & Co. which served as a subject of the investigation, their 83 workers manufacture excellent furnitures of wall-flash structure employing wood working machines and tools. Khaya Senegalensis, their main timber material, is obtained from Wau district and also from Juba district where the company possesses timber seasoning facilities, whereas their supplementary materials are all imported from abroad. They also import wood working machines from the U.K. and West Germany. Tools like carpenter's kit and shaving tools are imported from West Germany. Their factory is equipped with cross cut circular machines, hand planers, automatic planers, universal circular sawing machines, spindle shapers and presses. From Khaya Senegalensis, the best material obtainable in Sudan, they manufacture wardrobes, doors, beds, tables and chairs, and these furnitures are supplied to the Khartoum Industrial Bank and other concerns. Though their techniques have been found to be needful of further improvement, the company may well be regarded as one of the best Sudanese furniture makers. Equipped with fine tools and capable of turning out quality products, they can in fact be considered as a company worthy of representing Sudanese furniture makers.

Eisa Factory, another furniture factory that served as a subject of the investigation, employs 80 workers and manufactures wardrobes, tables, doors, wooden chairs, metal chairs, dressing tables, etc. All the timber materials for their products, including plywood, are imported from Sweden and the Netherlands, and their machines and tools are West German made. Machines and tools available at this factory are cross cut circular sawing machines, band sawing machines, hand planers, automatic planers, presses, shaving tools, and other supplementary tools. The factory adopts an integrated and continuous manufacturing method covering trimming work, wood working and processing, painting, upholstering, etc. The factory was found quite characteristic in that it has separate divisions for metal chairs as well as for looking glasses which are manufactured by their own method from the material imported from West Germany. It was noticed that the vinyl cord used for the metal chairs was Sudanese made.

The factory is divided into many divisions, e.g., wood working and processing division, upholstery division, looking glass division and metal products division. It was also noticed that the proprietor himself takes the lead in the designing and processing of materials.

(2) Wood working factory of Khartoum Forest Department

Equipped with steam-operated timber seasoning facilities, this factory engages in the drying of major timber materials. The materials are dried to contain as little as 8% of moisture content after processed and are used for experimental manufacture of such furnitures as wardrobes, tables, desks, chairs, etc. While the main timber material for these products is Khaya Senegalensis of the south, all the other supplementary materials are imported from abroad. The factory, equipped with such machines and tools as saw milling band sawing machines, wood working band sawing machines, cross cut circular sawing machines, hand planers, automatic planers, universal circular sawing machines, hollow chisel mortisers, spindle shapers, etc. also engages in the wood working by flat tennon structure. In view of the fact that the factory is regarded as an institution to provide technical guidance and assistance, further improvements are desired to be made in designing, shaving techniques, binding agent, grinding, polishing and painting.

(3) Working techniques of Khartoum Omdurman Market

The technique found in Khartoum Omdurman Market is mainly for engraving on ebonies and ivories. The engraving being performed by hand, the technique is entirely free from the use of any machines. This apparently outmoded technique cannot be recommended not only from the viewpoint of efficiency and saving of the material but also because it is not capable of producing sharp sections that could readily be created by means of edged tools. Products manufactured by this technique are therefore inevitably inferior in quality. Since the materials are precious and costly, it is urgently recommended that the use of modern machines and tools be introduced.

(4) Working technique of Khartoum Prison Workshop

The prison workshop in Khartoum district is equipped with wood working machines, universal circular sawing machines, hand planers, automatic planers, and engages in the manufacture of wardrobes, tables, desks, chairs, etc. Since the prison is considered as an institution to provide the basic training, it is desired that proper and correct technical training will be conducted. Furnitures manufactured at this prison workshop are of European style, but are not found to be accurately structured. It is therefore recommended that guidance be given for the proper and correct application of high accuracy tools and carpenter's kit.

(5) Lumber Industry Course at Khartoum College of Technology

Training factory: The training factory established within the campus of the college is completely equipped with excellent wood working machines and tools imported from the U.K. and West Germany, and is providing training on wood working techniques based on an entirely mechanized manufacturing process utilizing imported soft lignin timbers. The training factory furnishes education and training for draftsmanship, structure, wood working and painting. Lectures are given on the quality, lignin as well as seasoning of timbers. At the expense of the Government, about 1,000 students have already completed the course and are employed by governmental offices. The college provides two-year and four-year courses. Graduates from the two-year course, about 400 in number, are employed by private enterprises or serving as instructors at secondary schools. The college does not set the entrance examination, but the admission is granted only to those applicatns who have been considered qualified and promising. Training facilities at this college have been found satisfactory.

It is hoped that further endeavours will be made by the college in fostering its education and training as well as facilities whereby the service of a larger number of technicians will be made available.

(b) Nyala district

(1) Furniture factories investigated

Factory A which served as a subject of the investigation: Though small in scale with only 6 employees, this factory manufactures excellent furnitures. Their products, beds, for instance, are of wall-flash structure and finished with modern techniques. The factory utilizes Cordia Abyssinica, a speciality of this part of the country, as their main timber material, and imports plywood from Sweden, machines and tools from West Germany. Work covered by this factory is wood working and processing and painting. For a small scale enterprise, the factory was found to be quite promising, but would need further technical improvement particularly in the field of painting, colouring, grinding and polishing finish. Technical guidance is therefore hoped to be provided in these fields.

(2) Working technique provided by the Lumber Industry Course of the School of Technology

The school aims at educating and training those who are to serve as middle-class technicians. To provide them with the basic education on the wood working techniques, the school is equipped with universal wood working machines and machine tools imported from West Germany. It was felt that further improvements should be made in the basic technical education and mechanical facilities with the stress placed on the training for the applicationof shaving machines.

(3) Nyala Branch of the Forest Department

Explanation was given by the Branch on the distribution of trees in the western part of Sudan with particular reference to Zalingei district. The Branch is providing guidance for the experimental manufacture of chairs from Cordia Abyssinica.

(c) El Fasher district

(1) Working technique of El Fasher Prison Workshop

Furnitures are made chiefly from Cordia Abyssinica at this prison workshop where sawing is performed manually with gang sawing machine since no modern sawing facilities are yet installed. Tables are manufactured by West German made carpenter's kit (for working on the Gambil and Ebony materials) as well as by hand spinning lathe (for working on the legs of the tables). The legs of the tables are inlaid

with ivory. At this prison workshop are manufactured desks, chairs, tables, etc. with such other work as painting and metal fitting concurrently performed. It was felt that the the mechanization of facilities will be necessary.

(d) Wau district

(1) Forest Department Workshop

In Wau district where furniture timbers are produced in largest quantity, the furniture industry is considerably developed by notably utilizing Khaya Senegalensis. The Workshop is urged to undertake the experimental furniture production utilizing Lsoberlinia Doka which, despite its suitableness for furnitures, is currently used only for railway sleepers. Also, effective utilization of Khaya Senegalensis, an internationally known superb furniture timber, should be promoted by introducing new techniques and designs. The workshop manufactures wardrobes, floor boards, shelves, desks for office and school children, and chairs. It is hoped that the lumber industry in this district will be further developed under the leadership of the Workshop. With regard to the bamboo produced in this district, it was noted that the Workshop is not making full use of it presumably because of its thickness. Wau district differs from other districts as its humidity is quite higher, which leads to the imperative necessity of installing complete seasoning facilities. Wood working and shaving work in this district is conducted by means of engine lathes and was found to be superior to that of other districts.

(2) Furniture factories investigated (2 factories served as subject of the investigation)

Factory A: With West German made carpenter's kit but without any mechanical facilities, 3 workers of this factory manufacture chairs, shelves, etc. from Khaya Senegalensis.

Factory B: This factory employs 4 workers and manufactures tables from Khaya Senegalensis with circular sawing machines and planers.

Both factories are of extremely small scale and require technical improvement.

(3) Wau Prison Workshop

Equipped with universal wood working machines, this workshop manufactures tables, chairs, desks, book-shelves, etc. mainly from Khaya Senegalensis. It was noticed that the back of the chairs manufactured at this workshop is upholstered with sisal hemp material. Though continuous manufacturing process including painting and finishing work is adopted by this workshop, the shaving work is performed by hand spinning lathes. The buffalo horn working may be regarded as an outstanding feature of this workshop. The horn products are excellent as local handicraft articles and may as well be considered objects of industrial art.

(e) Tonj district

Investigations were conducted on the Sawmill and the Prison Workshop located in Tonj district 63 km south of Wau district.

(1) Sawmill

This sawmill belongs to the Forest Department Workshop and its 150 workers engage in sawing up of Lsoberlinia Doka trees for railway sleepers, the sawing machines being operated by steam power as in the case of other districts. The indoor seasoning facilities of the sawmill were found satisfactory. It was noted that the circular sawing machines are the main component of its mechanical facilities.

(2) Prison Workshop

This workshop manufactures mainly chairs from timbers of hard lignin. It was noted that the shaving work is rather poor, calling for the improvement of tools. The seat and back of the chairs are upholstered with the sisal hemp net. Rotary shaving work is performed by hand spinning lathes, resulting in the uneven surface finish. Improvement of basic technique was felt necessary for the wood engraving at this workshop. Though much cannot be expected due to its being a prison workshop, necessary steps should be taken towards the gradual but steady technical improvement.

2-2 STUDY OF PRESENT STATUS OF WOOD WORKING INDUSTRY AND COUNTER-PLANS

2-2-1 Forest Resources: Exploitation and Utilization

Save for the southern region, Sudan is a dry country with low humidity and high temperature. The country can be divided into three major areas, namely, Northern Desert Area, Central Part comprising Thorn Savanna and Savanna Woodland Areas, and Southern Woodland Area. Forest resources are found concentrated in the southern part of the country, i.e., in BahrEl Ghazaal Province upstream of the White Nile and in Equatoria Province. Timbers of hard lignin available in these areas, of which Khaya Senegalensis is most representative, are expected to be exploited and utilized as timbers of African origin. It is reported that the present cutting volume in Wau district amounts only to 1.8 million cubic feet which is about one fifth of the total permissible cut.

The furniture industry to be developed in Sudan is expected to be the largest demand source for timbers which will be made available by exploiting the country's rich forest resources. It is therefore suggested, in the first place, to establish in Wau district factories to manufacture various furnitures including knock-down chairs and tables which will be transported by rail to Khartoum where the assembly work is to be done. Furnitures thus manufactured and transported to Khartoum may not only be sold in the capital city and other parts of the country but also could be exported to such adjacent countries as U.A.R., Ethiopia, Kenya, etc. It is recommended, in the second place, to modernize the felling method in the western and southern part of the country in order to elevate the felling efficiency. This could be realized by introducing the use of small-sized cutting machines which operate with portable engine chain saw. Thirdly, in order that different timbers in the south will be further exploited, it is suggested that the full-scale industry be established whereby the production of synthetic fibre-boards, particle boards and hard boards will be materialized. Lastly, establishment of plywood factories and floor boards factories is recommended for the same purpose of further exploiting timbers in the south. It may be added that the floor board industry which is to utilize timbers of hard lignin is quite promising.

Utilization of Cordia Abyssinica of Zalingei district for manufacturing furnitures deserves serious consideration. Saw-cutting and other tests have revealed that this material is quite suitable for furnitures.

The western part of the country is, as stated already, backward

in its felling method. It will therefore be necessary to introduce the use of portable engine saws for the modernization of felling method and elevation of efficiency.

It is noteworthy that despite the fact that the Sudanese forest resources provide many different species of trees for timbers, steps are yet to be taken for their effective utilization. It follows therefore that efforts should be directed to obtaining the accurate figures of the accumulated forest resources which would serve as the basis of the future development of the lumber industry. Investigations for this purpose will therefore be a matter of utmost importance.

With regard to afforestation, further efforts are urged to be made in planting Tectona Grandis in Wau district and Khaya Senegalensis in the central part of the country. Highest priority should be given, however, to the planting along the Nile in Khartoum district of soft woods that would be utilized as important timbers for promoting the lumber industry in the future.

Since it is evident that the lumber industry will greatly contribute to the development of medium and small scale industries of Sudan, effective utilization of timbers of hard lignin should be materialized especially in the southern part of the country.

2-2-2 Review of the Present Technical Level and Counter-Plans

The present technical level of the Sudanese lumber industry is low in general, and particularly so with regard to the rotary shaving technique which still remains as it was 300 years ago. Technical improvement is therefore desired in every part of the country where the lumber industry exists. Rotary shaving technique of prison workshops is the lowest of all and its improvement should be given high priority.

Regarding the two furniture factories investigated in Khartoum, it was revealed that their techniques are generally equivallent to those of the Japanese furniture factories of medium scale. Attention is drawn to the fact that of the two factories investigated, one imports all its materials from abroad whereas the other utilizes Khaya Senegalensis. It was found necessary for both factories to introduce modern techniques in such field of their manufacturing process as designing, shaving, binding, assembling and painting.

Furniture factories in the western, southern and central part of the country are usually equipped with insufficient facilities and their techniques are rather low with a few exceptional cases; guidance should

therefore be given to these factories in the future.

The technical level of the prison workshops in different districts is, as already mentioned, very low particularly in the rotary shaving work and this may, in a way, be attributable to the quality of the workers. However, modernization of facilities of prison workshops should not be neglected. Though difficulties may be encountered in elevating the technical level of prison workshops, stress should be placed at all times on the basic education and training of the workers. This is recommendable because of the enthusiam expressed by the authorities concerned and by the workers themselves.

Workshops belonging to the Forest Department are, in most cases, equipped with machines and tools imported from the U.K. or West Germany. Further efforts are urged to be made for technical improvement, better selection of component materials and for the structural improvement of their products. Under the existing conditions, these workshops are serving as the only institutions capable of providing direct and on-the-spot guidance in the oountry. It is therefore urged that modernization be immediately effected in their facilities and designing in parallel with the technical improvement which is desirously to start with the elevation of the basic shaving techniques. It is also recommended that the use of foot-driven and electro-motive spinning lathes be introduced in Khartoum Omdurman, Dilling as well as in the western and southern part of the country. Cutters and knives for rotary shaving work should be replaced by those of better and sharper quality.

As to the engraving of ebonies and ivories in Khartoum Omdurman, it is to be regretted that their products show no exquisiteness or minuteness that could be created by edged tools. Since these products are regarded as objects of industrial art and are made from costly materials, efforts should be exercised towards the introduction of the improved techniques and the use of better shaving cutters and knives. It may be added here that the utilization of ultra-hardened cutters and knives of alloy metal should also be introduced for the technical modernization, elevation of efficiency and for the advanced working of hard lignin timbers.

Modernization of both techniques and designing is urged to be effected by the furniture factories in Khartoum and by the Forest Department workshops so that such modernization will lead to the further exploitation of the locally available timbers and to the development of the

lumber industry at large.

Generally speaking, the wood working technique in Sudan is equivallent to the medium level of the Japanese technique, with the notoable exception of the rotary shaving technique which is noted to be extremely backward. It is clearly evidenced that there is a wide gap between the highest and the lowest levels of the Sudanese wood working techniques. In view of the desired development of the medium and small scale industries in Sudan, it is hoped that remedies be found as soon as possible to fill the existing technical gap.

2-2-3 Training of Technicians and Related Plans

The training of technicians is provided by the lumber industry course of the College of Technology in Khartoum. The college is equipped with British and West German made wood working facilities. The course covers the education and training relative to the lumber industry at large. Lectures on timber materials are given only on the imported materials. It is recommended that materials of Sudanese origin be added to the subject of such lectures. The college is responsible for cultivating, training, and sending out to the world men of talent whose service is greatly required as the driving force for the development of the Sudanese lumber industry. It is therefore desired that thorough and exhaustive education and training be given on such basic techniques as seasoning, shaving, grinding and polishing, binding, painting, etc. It is further desired that the college will positively play the important role of actively utilizing the timbers of hard lignin produced within the country.

The lumber industry course of the Technological School in Nyala, Dafur Province, is charged with the education and training of the middle class technicians who would serve as the backbone in the development of the lumber industry. From this viewpoint, facilities of the School cannot be regarded satisfactory; and for the purpose of elevating its standards of the fundamental education and training, it is recommended to install sufficient machines and tools for shaving, grinding, polishing, painting, etc.

For the purpose of providing the training on mechanization to the Sudanese engineers whose service is required for the exploitation of timbers in Zalingei district, it is suggested that top class wood working technicians be despatched from Japan to Sudan under a technical cooperation agreement between the two countries.

2-2-4 Conclusion

In completing this present status of the wood working industry in Sudan, it is suggested, in order that the proposed plans be smoothly put in practice, that the Government of Sudan will take without the least delay necessary initiative and actions in supporting the establishment of a body corporate whereby the construction of a sawmill in Wau district, technical training in Nyala district, and guidance for designing and techniques, may be materialized.

2-3 PROJECT FOR ESTABLISHING A FURNITURE FACTORY IN WAU DISTRICT

2-3-1 Purpose

The project aims at the exploitation of the timbers available in Sudan in relation to the development of the lumber industry of the country. The proposed furniture factory will engage in the production of knock-down chairs and tables of medium and higher quality from timbers of hard lignin available in Bahr El Ghazaal Province. The furnitures will be transported by rail to Khartoum where they are to be assembled and put on the domestic market, to be provided to the middle- and higher-class families.

2-3-2 Establishment Site: Wau district, Bahr El Ghazaal Province

2-3-3 Factory Area: 2,000 tsubo (approx. 6,600 square meters)

2-3-4 Factory Building: 500 tsubo (approx. 1,650 square meters), steel framed, slate-roofed and concrete-floored one-storied building.

@¥45,000 per tsubo.....¥22,500,000

2-3-5 Factory Facilities (Value in Thousand Yen, F.O.B. Yokohama)

..... 47,000

	Item	Q'ty	Unit price	Amount
1)	Power: Steam engine	1 unit, miscellaneous expenses inclusive.	-	8,000
2)	Timber seasoning chamber, internal system, capacity 400 CFT	3 chambers	2,000	6,000
3)	Band sawing machine, 30"	2 pcs.	700	1,400

	Item	Q'ty	Unit price	Amount
4)	Circular sawing machine, 16"	2 pcs.	400	800
5)	Rip sawing machine, 16"	1 pce.	1,200	1,200
6)	Hand planer, 12", automatic feed	2 pcs.	300	600
7)	Automatic planer, 24"	1 pce.	750	750
8)	Super surfacer, 24"	1 "	700	700
9)	Circular sawing machine 16"	3 pcs.	150	450
10)	Spindle shaper	1 pce.	450	450
11)	High speed router	2 pcs.	300	600
12)	Horizontal boring machine	2 "	900	1,800
13)	Copying machine with attachment	2 "	3,500	7,000
14)	Compression press	1 pce.	2,500	2,500
15)	Automatic lathe	1 pce.	800	800
16)	Table boring machine	2 pcs.	150	300
17)	Belt sander	1 unit	500	500
18)	Curved surface polishing device	1 "	800	800
19)	Assembling machine	1 "	800	800
20)	Spreader	1 "	450	450
21)	Knife grinder	1 "	2,000	2,000
22)	Painting facilities	1 "	2,500	2,500
23)	Portable tools	1 "	300	300
24)	Dust removing device	1 "	2,500	2,500
25)	Upholstery facilities	1 "	2,500	2,500
26)	Spare cutters & knives	1 "	800	800
27)	Miscellaneous expenses for factory facilities	-	-	500

2-3-6 Goal of Production: Arm chairs & tables - 1,000 sets... 30,000

2-3-7 Workers: 100 workers

2-3-8 Machines & Tools

1. Foot-driven spinning lathe, steel, 1 set..... 80
2. Wood working lathe with gasoline engine, 2 m.L... 150
3. Ultra-hardened chip circular saw blade of alloy metal, 80 pcs. 20

2-4 DATA RELATIVE TO THE COMPARATIVE SAW-CUTTING TEST CONDUCTED ON MATERIALS OF SUDANESE AND JAPANESE ORIGIN

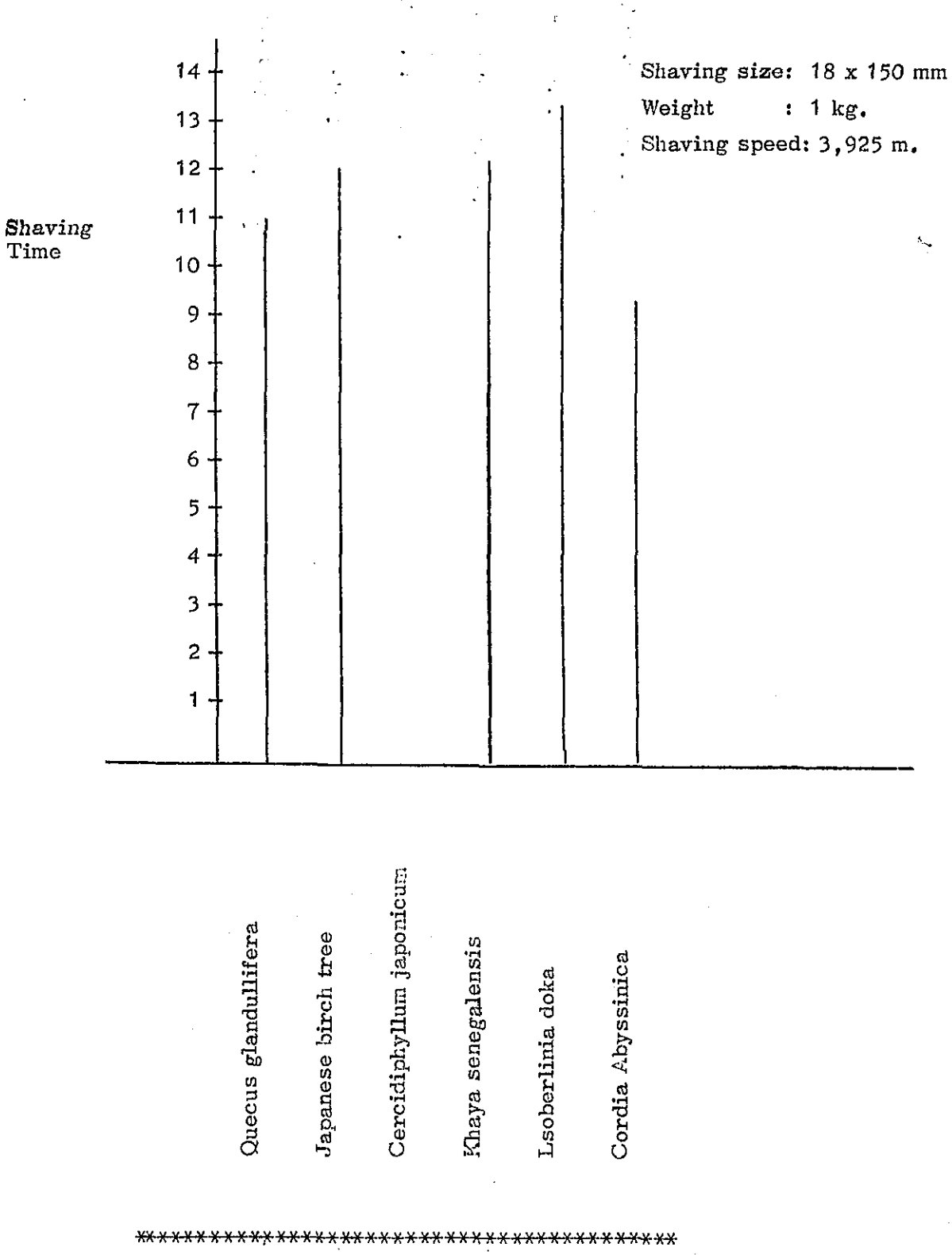
1. Tester: Saw-cutting testing machine, diagram system, principal axis - 5,000 rpm.
2. Test pieces: a. Quecus glandullifera
   b. Japanese birch tree
   c. Cercidiphyllum japonicum
   d. Khaya senegalensis
   e. Lsoberlinia doka
   f. Cordia abyssinica
3. Shaving size: 18 mm x 150 mm
4. Weight: 1 kg.
5. R.P.M.: 5,000 r.p.m.
6. Saw blade diameter: 250 mm
7. Type of teeth: Ultra-hardened chip blade
8. Shaving: Conducted perpendicularly to the running direction of fibre.
9. Sawing width: 2.5 mm
10. Moisture content of test pieces: 10 - 13%
11. Test method: Fixed weight method was employed, i.e., shaving property of test pieces was determined by the time required for shaving. Ultra-hardened chip circular sawing blade of alloy metal (Japanese made) operating at the shaving speed of 3,925 m was used. Precise filing was conducted on the teeth of the circular sawing machine which was applied for repeated shaving tests. Average time required for repeated shaving tests was recorded.

Comments on the results of the test:

The limited quantity of the test pieces brought back from Sudan was not sufficient to conduct the test satisfactorily though they were utilized to the fullest extent. Comparison was made between the Sudanese and Japanese materials with regard to the shaving property. The test lead to the conclusion that -

1. Cordia abyssinica is easily shaved.
2. Khaya senegalensis is equivallent to the Japanese birch tree in its shaving property.
3. Substantial time was required for shaving Lsoberlinia doka due to its lignin being hard and resinous.

Cordia abyssinica and Khaya senegalensis are easily shaved and found to be best fit for furnitures. Lsoberlinia doka could also be utilized for furnitures if proper method is employed in the shaving process.


Shaving size: 18 x 150 mm
Weight : 1 kg.
Shaving speed: 3,925 m.
Shaving Time
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Quecus glandullifera
Japanese birch tree
Cercidiphyllum japonicum
Khaya senegalensis
Lsoberlinia doka
Cordia Abyssinica

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3. FIBRE INDUSTRY (Animal hair & sisal hemp)

Results of the investigations conducted on the fibre industry in Sudan are given hereunder by regional groups investigated, materials as well as by products.

3-1 WESTERN DISTRICTS (Khartoum, El Fasher, Nyala and El Obeid)

3-1-1 Material used: Animal hair (camel - sheep - goat hair)

(a) Carpet

Carpets manufactured from hand carded camel hair at prisons in Khartoum and other districts are excellently woven and designed. However, the carding method employed at these prisons being rather outdated, the following process is recommended for the mass production of woolen yarn for carpets:

Scour the collected raw wool in the solution of soap and caustic soda (5 - 10% solution against 1 kg of raw wool). Soak it in the sulphuric acid and remove the vegetal impurities by carbonizing them at a high temperature. Impurities thus removed, the raw wool is then to be carded by foot-driven carding machines such as have been found to be used at the El Obeid Prison. Yarns of even thickness for carpets can be produced easily when the worker gets accustomed to this process.

With regard to the designs of the carpets, it is suggested that, in addition to the conventional geometrical patterns, new and modern designs be introduced to give softer touch and impression to the finished carpets. Weaving was noticed to be confined to plain weaving, but it should be performed by a variety of methods employed for Indian and Chinese carpets which have piles and rings. Combined employment of both the Indian and Chinese methods would make it possible to produce carpets better fit for export.

The striped carpets observed in the rest houses and street stalls were found more or less primitive in their manufacturing method. In order to improve their qualities, it is recommended that:

1) Yarns of even thickness be produced by means of foot-driven carding machines from the raw wool, i.e., sheep or goat hair, or the mixture of both.

2) Wooden handlooms (See photos in appendix) be used to weave carpets of even thickness with the desired width (Choice of handlooms should be made according to the desired width of the finished products).

Carpets thus manufactured will be of better finish and at once have the uniformity in size, density and quality. It is also recommended to produce two kinds of carpets, one for outdoor use to be spread directly on the sand, and the other for indoor use which naturally should be better in quality. In order to extend the demand for these carpets, it will be necessary to cut down the selling price and to reform the production system by converting the present home industry into small scale enterprises to be organized by the home industry. The proposed small scale enterprises will assume the form of either cooperative union supported and invested by each participating home industry, or of small factories to be similarly set up in each district with the productive capacity meeting the availability of raw wools.

(b) Press Felt

The utilization of the cow hair was noticed to be entirely neglected at present. It is therefore proposed that a factory be established in Khartoum to process the cow hair into press felt which will be provided for such diversified purposes as saddlecloth, oiling and greasing of railway coaches, sound-heat absorption for buildings, , and for polishing jewels, glass, metals and marble. The factory is proposed to have the productive capacity that would meet the estimated minimum demand. The material for the press felt does not necessarily have to be the cow hair only. It can be either the mixture of the cow hair and sheep and goat waste hair, or the cow hair mixed with a small percentage of other animal hairs (See Supplement #1).

(c) Blanket

It is presumed that the demand for blankets in Sudan is considerably large specially in winter due to its continental climate. Construction of a blanket factory with a minimum productive capacity that meets the local availability of the raw wool is therefore recommendable. Should the demand increase in the future, the factory proposed above may be expanded in scale, otherwise, a new factory to meet the increased demand may as well be established. The construction plan for the proposed blanket factory

is given in Supplement #2. Regarding the construction site, the first preference is given to El Fasher district because of its being a distributing centre of the raw wool. Transportation facilities available in Nyala district makes that district commendable as the second choice. Owing to the technical difficulties foreseeable in the construction and operation of the factory, it is advisable that the proposed enterprise be undertaken under a joint venture of Japanese and Sudanese concerns.

3-1-2 Material used: Dom palm and Tabaldi

(a) Dom palm rope and cord

Observation of the manufacturing method of Dom palm ropes and cords at prison workshops in different districts have lead to the conclusion that the use of Japanese-made rope making machines would largely contribute to the elevation of efficiency (See the photo in appendix).

If the utilization of the above rope making machines to be driven by power for mass production is desired, the following preliminary process will be required:

> The leaves of Dom palm should be soaked for a couple of days, then carded and torn by beating with pins driven on a board in several lines. The carded and torn leaves are then to be softened by passing through a pair of grooved rollers 4 or 5 times. The rollers may be either hand-operated or power-driven. During this softening process, care should be taken not to dry the fabrics.

The fabrics can then be processed into ropes or cords by means of the rope making machine.

It should be noted that Dom palm rope or cord, when dried, lose flexibility and elasticity, and is therefore not suitable for goods wagons or timber transportation.

(b) Tabaldi rope

Ropes made of Tabaldi materials are, like those of Dom palm material, weak in flexibility and elasticity. Problems remain to be solved, therefore, in the field of their application. Regarding the preliminary processing of the Tabaldi material into fabrics, the method presently employed would be the only one applicable. It is suggested, however, that more time be spent for the beating process to effectively remove the lignocellu-

lose. Washing with water of the fabrics and subsequent softening by means of the rollers menti oned in (a) above will be useful for the production of ropes of better quality.

3-2 SOUTHERN DISTRICT (Wau and Tonj)

3-2-1 Material used: Sisal hemp and rice straw

(a) Sisal rope

The sisal rope, a speciality of Wau district, is internationally known for its strong fibre and enjoys the world-wide reputation. But its present production is limited to meet the domestic demand only. In view of the expected growth of demand in the future, it is recommended that its quality be improved to the international level. Though at present it is not in large demand in the southern part of the country, the sisal rope will undoubtedly become one of the most important and indispensable commodities for such transportation facilities as boats, railways, vehicles, etc. when the volume of trade through Port Sudan is expanded and the domestic industries in Khartoum district are developed. It may be added that the sisal rope is reportedly being produced by power-driven rope making machines in the three East African countries where the state of self-sufficiency is already achieved. To meet with the expected increase of demand, it is suggedted that a sisal rope factory with the minimum productive capacity be established on the basis of the construction plan proposed in Supplement #3. The use of power-driven rope making machines (See photos in appendix) is recommended in the proposed construction plan. Where electric power is not available, diesel engines can be used to supply the necessary power. Depending upon the purpose of use, utilization of throw-in type rope making machines is acceptable as they are capable of producing ropes of considerable strength (See photos in appendix). In the event the use of the throw-in type machines is not feasible, foot-driven rope making machines will solve the problem to an extent.

In European countries, sisal hemp is processed into baler twines and binder twines which are widely used for binding agricultural crops. These twines are manufactured by the machines and equipment given in Supplement #3. But they can also be manufactured by the aforementioned foot-driven machines.

Mass production of the sisal fibres can be realized by the

increased installation of the existing type breakers.

(b) Sisal mat

The sisal mat is a superior quality hand-knitted product for indoor use. Its production on a larger scale is recommendable since the demand is expected to increase in the future. It may be worth mentioning that the standardization of the sisal mats and production of smaller mats, such as may be used for automobiles, would be effective in extending the market.

(c) Rice straw

During its stay in Sudan, a request was made to the Survey Team by the Department of Agriculture in Wau for a) Japan's technical cooperation in the field of rice straw utilization, rice thrashing and polishing, and b) the supply of catalogues of machines and equipment for such purposes. The requested catalogues are attached as appendix.

As regards the rice straw utilization in Japan, it is hoped that the information given below will be of some use to the Department. In Japan, rice straw is -

1) processed into 2 ply ropes by means of the wooden rope making machines as shown in the photo in appendix, and used for the purpose of binding.
2) Utilized as litter for livestock.
3) Chopped into pieces and mixed with the fodder for livestock.
4) Utilized as the raw material for corrugated cardboard.
5) Burnt to ashes and used as potassic manure.
6) Woven into mats by means of the machines shown in the photo in appendix.
7) Woven and made into bags to contain fertilizers.

3-3 CONCLUSION

Cotton, the main export product of Sudan, is cultivated in Gejila district and many other districts. However, the fibre industry of this country is yet to be developed. There were found a limited number of spinning, textile and knitting factories now in operation.

Ropes, carpets and mats are produced mainly at prison workshops, while other products excepting yars are manufactured by small enterprises. The production method was generally noted to be quite low save for a few textile and knitting factories and larger scale spinning factories.

In order that the fibre industry of this country will be developed into a modern and mechanized industry, it is suggested that the following measures be taken -

1) Establishment of research laboratories for the improvement of basic techniques, and of a technical centre for the fibre industry.
2) Extension of market in relation to the development and promotion of other industries.
3) Training of technicians by fostering the technical education on the fibre industry. (It appeared that no efforts are being made at present for providing technical guidance for the fibre industry)

Sudan's national rehabilitation programme provides good grounds for expecting that her people's living standards will be elevated and the demand for fibre products, inclusive of clothes for daily use as well as industrial purposes, will accordingly increase in the near future. It is therefore urged that the Government will draw up a basic policy for the development of the fibre industry along with the general development plan for the country. The Government is also urged to draw up short- and long-term supply-demand programmes by the source of demand (i.e., export-import, industrial demand, and demand for clothes), whereby the demand prospect will be made clear and the fibre industry at large will be steadily developed.

SUPPLEMENT #1

PRODUCTION METHOD OF COW'S FELT

1. Flow Chart

   Bale breaking -- Washing -- Mixing -- Carding -- Pressing -- Stocking -- Finishing.

2. Purpose of Use: Sound and heat absorption for buildings, steam pipe covers, chair cushion, carpet underlay, and for rolling stock and oil supplying.

Explanation of Manufacturing Method:

1) Starting and scouring process

   Perform bale breaking of the material (which consists of cow's hair, or hairs of sheep - goat - other animals). Wash the material with the washing machine to remove suet and impurities (solution containing appropriate percentage of soap and caustic soda against each 1 kg of the material is used for washing). Then, soak the material in sulphuric acid to remove vegetal impurities by carbonizing them at a high temperature. This process removes vegetal and other impurities from the material. If low class hairs are used, sorting should be done before washing.

2) Mixing process (not required if the material consists only of cow's hair)

   Add a specified percentage of vegetable oil to the material if the material is the mixture of cow's hair and other animal hairs, or if the flexibility of the felt is desired to be weakened or strengthened.

3) Carding process

   Card the cow's hair into thin rup. Shoddy or opening card is generally used for this purpose. In case of the wool rug, utilize the rug grinding machine or rug picking machine to remove impurities and process it into the rup. The rup thus produced is then to be piled up to the thickness as may be required by the stocking percentage to be caused by the pressing or stocking process.

4) Pressing process

   Harder machines are employed at this stage which is the most important of the felt manufacturing process. Place the rup of the specified thickness on the lower plate of the machine. Supply sufficient steam and moisture to the rup and heat it. Then give rapid reciprocating as well as left and right rotating motion with pressure placed on them by the upper plate, so that several sheets of rups will be processed into a sheet of rup and the hairs will be interwined. Continue this motion for 4 - 5 minutes.

Rups thus manufactured can be offered as finished products for certain uses after they have been dried.

5) Stocking process

The pressing process does not make the hairs of the felt sufficiently interwined, which allows the swelling of the felt. The pressed felt is therefore to be hardened by the continuous beating motion of the stocking machine which has 2 - 4 hammers. During this beating motion, soap water should be sprinkled on the felt. Further, the surface of the felt should be equally beaten by the hammers. Then wash the soap water off and dry.

6) Finishing process

Cut the stocked felt into the desired size according to the purpose of use.

SUPPLEMENT #2

CONSTRUCTION PLAN OF A BLANKET FACTORY

The factory proposed in this plan is designed to have the same scale as that of a Japanese blanket factory equipped with ten sets of weaving machines and capable of producing comparatively high class blankets. It is to be noted that "dyeing" and "raising - finishing process" can be omitted if the material is mainly the wools of Sudanese cross-bred sheep and the products are meant for the domestic market only.

1) Specification of the products

Size	:	60" x 80"
Weight	:	Approx. 3.0 lbs.
Pattern	:	Plain

2) Productive capacity

Weaving capacity	:	18 pcs a day per machine
Annual output	:	18 pcs x 10 sets x 25 days x 12 months = 54,000 pcs.

The minimum scale of the spinning facilities for the raw materials to be processed by 10 sets of weaving machines is as follows.

1 set of card

1 set of mule

Supplementary machines for processes which precede or follow the spinning section

The spinning capacity of the above machines will be as follows, provided that the daily working hour is 8 hours.

In case of wool : 350 lbs.

In case of wool (50%) mixed with cotton or rayon staple : 500 lbs.

In order to attain the maximum productivity while keeping the balance between the weaving and spinning capacities, it is recommended that the operation of weaving and spinning facilities will be set as follows.

Weaving : 24 hrs. operation, 3 shift system

Spinning : 12/20 hrs. operation, 1½ or 2½ shift system

In case raising-finishing process is required, one set of raising machine will suffice to meet with the above-mentioned production capacities which are tabulated below.

Section		Productive capacity per 8 working hours
Spinning	All wool	350 lbs.
	50% wool	500 lbs.
Weaving		180 pcs.
Raising-finishing		300 pcs.

It should be noted that the capacities tabulated above will not be trebled but reduced to an extent even if the three shift system is adopted. Supposing that the productive capacity per eight hours is "C", the capacities by two and three shift system would be 1.9 C and 2.8 C respectively.

Explanation given so far will make it clear why 24 hour operation is required for the weaving section.

Given hereunder are capacities of each section in two different cases; in case a), it is assumed that 100% wool is used as material, whereas in case b), 50% wool plus cotton or rayon staple is assumed to be used as material.

a.) 100% wool

Spinning capacity	350 lbs x 2.8 = 980 lbs (3 shift system)
Volume of muled yarn	980 lbs x 90% = 882 lbs (")
Volume of finished blanket	882 lbs ÷ 3.0 lbs = 294 pcs (1½ shift system)

b) 50% wool plus 50% rayon staple

Spinning capacity	500 lbs x 2.8 = 1,400 lbs (3 shift system)
Volume of muled yarn	1,400 lbs x 90% = 1,260 lbs (")
Volume of finished blanket	1,260 lbs ÷ 3.0 lbs = 420 pcs ($2\frac{1}{2}$ shift system)

Note: Loss in muling process - 10%

3) Materials required. (in lbs.)

Material	Section		day	month	year	remarks
100% Wool	Warp	Wool	980	24,500	294,000	local purchase
	Woof	Cotton or rayon staple	150	3,750	45,000	local purchase or import
50% wool mixed with cotton or rayon staple	Warp	Wool	700	17,500	210,000	local purchase
		Cotton or rayon staple	700	17,500	210,000	local purchase or import
	Woof	Cotton or rayon staple 30/2	220	5,500	66,000	local purchase or import

4) Machines and Personnel (No. of personnel based on 8 working hours)

Section & machines	Q'ty	Unit price (in US$)	Total price, CIF Sudan, in US$	Personnel E	M	F
Spinning Section						
Super cleaner	1 set	1,861.17	1,861.17		1	2
Mixing machine	"	2,440.35	2,440.35		4	2
Pneumatic transport equipment	"	1,564.26	1,564.26			
Card, 60" width	"	22,206.45	22,206.45		1	
490 spindle mule	"	13,874.89	13,874.89		1	10
Hank reeling machine	3 sets	205.85	617.55			4
Sub-total:			42,564.67	2	7	18

Note: E - engineer
M - worker, male
F - worker, female

4) Machines and Personnel - Cont'd -

Section & machines	Q'ty	Unit price (in US$)	Total price, CIF Sudan, in US$	Personnel E	M	F
Dyeing section						
Dyeing machine, type 100	1 set	3,757.55	3,757.55			
High speed carrier for the above	"	968.30	968.30			
Centrifugal separator	"	900.92	900.92			
Subtotal:			5,626.77	1	3	
Weaving section						
Bobbin winder	1 set	1,026.61	1,026.61)	1		4
Sectional warper	"	1,623.88	1,623.88		1	2
IC type loom for 75" width	10 sets	845.92	8,459.20)	1		10
Weft spooling machine	5 sets	267.46	1,337.30		1	3
Subtotal:			12,446.99	2	2	19
Finishing section						
75" German type raising machine	1 set	5,271.33	5,271.33		1	
75" British type raising machine	1 set	4,170.81	4,170.81		1	
Tentering machine	1 set	1,741.53	1,741.53		2	2
Hand operating sewing machine	4 sets	16.53	66.12			
Sewing machine, model 108	4 sets	151.80	607.20)		2	6
Label sewing machine	2 sets	101.80	203.60			
Hem cutting machine	1 set	394.45	394.45		1	1
Hem folding machine	1 set	112.80	112.80			1
Name folding machine	1 set	23.90	23.90			1
Subtotal:			12,591.74	2	7	11
Power section						
Boiler, 180 kg/cm^2	1 unit	4,765.06	4,765.06)		2	
Electric power generator, 166 KVA	1 unit	13,442.52	13,442.52			
Subtotal:			18,207.58		2	
Accessories	1 set		1,265.00			
Spare parts	1 set		9,250.00	(packing)	2	5
GRAND TOTAL:			101,952.75	7	23	53

If the raising machine is not used, there will be some changes in the finishing and power section as given below.

Finishing section	: Raising machine, stenter, and hand sewing machine not required
Power section	: Boiler not required; 100 KVA of capacity of power generator would be sufficient

Price and number of personnel will accordingly change as follows.

		E	M	F
Finishing section:	US$ 1,341.95		3	9
Power section :	US$11,432.52		1	
(GRAND TOTAL:)	(US$83,297.90)	(5)	(18)	(51)

5) Building

Floor space (factory, warehouse and office):

About 1,500 m^2, @$28.00 per m^2 - US$42,000

Expenses for electric wiring work:

@$14.00 per m^2 - US$21,000

6) Total Plant Cost

Cost of the plant with raising process: US$164,952.75

Cost of the plant w/o raising process : US$146,927.90

Remarks: 1) Mixing of 50% cotton or rayon staple with the wool will strengthen the yarn and prevent the breaking during the muling process.

2) Wools can be cleaned in warm soapsuds or caustic soda solution. To remove dust and other foreign matters, use cleaners.

SUPPLEMENT #3

MFG. METHOD OF SISAL ROPE AND CARDAGE

Three manufacturing processes of sisal ropes are as given below.

a. Sisam hemp -- breaker card -- spreader -- draw frame -- finisher -- spinner -- strander -- closer -- examination.

b. (For Baler Twine and Binder Twine)
Sisal hemp -- spreader -- finisher -- spinner.

c. For the simplest 2 ply twine, use Hand Feed Type Twine Making Machine (also known as Straw Rope Machine) and 2 ply Twine Packing Machine (see photo in appendix).

Explanation

A. Bale Breaking and Mixing

Sisal hemp of each grade is mixed according to the use of the finished products.

B. Hackling

a. Breaker card

Sisal hemp is carded while 7 - 15% spindle or machine oil is dropped on it at the hopper. This oiling ensures smooth working of the hackling pin, makes the surface of the fibre oily and prevents the entangling of the fibre, and at the same time provides flexibility, antiseptic and spinning property required for drafting the fibre into sliver.

b. Spreader

Several or several tens of the sliver forwarded from the breaker card is again carded and drafted into even sliver.

c. Draw frame

4 - 6 slivers forwarded from the spreader are gathered and carded to give uniformity to the fibre.

d. Finisher card

Several slivers forwarded from the draw frame are gathered, given uniformity, and polished with the leather belt.

C. Spinning

2 - 4 slivers forwarded from the finisher card are carded by the spinner machine, drafted into the specified rate, given the left twist, and made into single yarn and wound on the bobbin.

D. Forming (Strander)

Three forms of the specified size are generally required for making a rope. Strander serves the purpose of making these forms by gathering several threads forwarded from the spinner machine and by giving them the right twist.

E. Closing

Three forms forwarded by the strander above are given the left twist. The rope can be made either softer or harder by adjusting the number of pitches within a fixed length.

F. Layer

The layer is used to manufacture cords of fine gauge by twisting 2 - 4 single yarns forwarded from the spinner machine.

G. Examination

Perform the breaking test to confirm that the strength of the finished rope or cord meets the specified standards.

Plant Specification

Daily capacity. 3,000 lbs (1,370 kg) Finishing section - 11 hours
Spinning section - 24 hours

Ropes of 3 - 8 mm dia. (580 lbs)
13 mm dia. (740 lbs)
18 mm dia. (1,680 lbs)

			(HP)	
1.	Breaker, or	1 set	10 x 1p	1 set
2.	Apron-head spreader	1 set	5 x 6p	1 set
3.	Spinner	5 sets	3 x 4p	10 sets
4.	8 mm strander	2 sets	1 x 4p	2 sets
5.	8 mm closer	1 set	2 x 4p	1 set
6.	12 mm strander	2 sets	2 x 4p	2 sets
7.	12 mm closer	1 set	3 x 4p	1 set
8.	18 mm strander	1 set	3 x 4p	1 set
9.	18 mm closer	1 set	5 x 4p	1 set

Floor space required:

Factory	400 yds^2
Factory office	72 "
Tool room	65 "
Raw material room	27 - 45 "
Packing room	27 - 45 "

SUPPLEMENT #4

FACILITIES FOR GUNNY BAG MFG.

Annual output: 300 million bags or 7.8 million lbs. (each bag weighs 2.5 lbs.)
Daily output : 26,000 lbs. by 8 working hours a day.

Machine		No. of machine	Unit price	Power required (hp)
Spreader		1	£4,530	10
Breaker card		3.5	£4,100	12.5
Finisher card		3.5	£4,700	7.5
Roving frame	No. 1	3.5	£2,100	3
	No. 2	1.5	£2,900	4.5
	No. 3	5	£2,900	3.5
Spinner				
Warp, 4-3/4", 96 spindle		8 (768 sp)	£4,100	20
Weft, 5½", 80 spindle		5 (400 sp)	£4,100	20
Spool winder		1.5	¥2.6 million	5 hp x 2
Cop winder		5	$4,600	2.5
Warping machine		1	¥3 million	7
Loom (44")		96	¥4.53 million	1
Cloth inspection machine		7	¥150 thousand	1
Conditioning machine		1	¥200 thousand	5
Calendering machine		1	¥9.6 million	30
Cutting machine		1	¥1.5 million	3
Sewing machine		8	¥80 thousand	1
Packing machine		1	¥5 million	25

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4. PLASTIC INDUSTRY

4-1 PRESENT STATUS OF PLASTIC INDUSTRY

4-1-1 Supply and Demand Relations of Plastic Products

The heat-plastic resin such as resin-vinyl chloride, polyethylene and polystyrene comes up in the market as the daily use merchandise for the most part, and its circulating amount is estimated at about 2,000 tons a year. Against the current demand, the Sudanese self-sustenance is presumed to reach 70% nominally and less than 50% in substance.

4-1-2 Processing Industry

The investigation was carried out on six companies, only two of which might as well be called specialists in plastic processing. Moreover, even these two concerns were doing business on the minimum enterprising scale. Besides these six, there were five establishments preparing for the operation in the processing business.

4-1-3 The Management, Technique and Labour

In so far as the management people came into contact with the survey team, they were all recognized well talented. 15 year experience and incessant self-training must have brought them what their ability was this day. The labourers were generally diligent. Under the present circumstances, a four-year period would be required to be a full-fledged worker. To secure the satisfactory labour, it would be necessary to give the technical education to those unskilled or unemployed in this industry. During the survey, no qualified engineer could be met. A good number of engineers, especially of mechanism, will be required for the foundation of the processing industry.

4-1-4 Technical Level

All are being imported, the materials, metal patterns and processing machines, from abroad. No relative fundamental industry exists in Sudan, and in this sense of the word, the present status would be far from the industrial independence. Not only manufacturing field but testting and experimental facilities should be well equipped so as to grow out of the present status which is dependent upon the exterior conditions.

4-1-5 Circulation Area

Details are unknown. In addition to be unavailability of the

nation's entire demand, there is a narrow bottle-neck in respect to the traffic conveniences. It may be almost safe to say that the economical circulation should be confined to the local small districts.

4-1-6 Prospective Demand

It can be expected that the demand will increase for the everyday general merchandise. The prospect over the packing uses would be bright. Furthermore, the governmental procurements for the plastic products would increase gradually in the near future, though no sufficient investigation was conducted in this respect.

4-1-7 Points of Problem

(a) Whether or not acceptable the control policy under the open economic category

In consideration of the present processing technical level of the plastic industry, it is necessary that the Government should play an instructive role in enhancing it by ruling the guidance policies as well as giving its assistances in order to adjust the balance of supply-demand.

(b) The existing industry affected by the protective policy

The plastic products change with the processing methods and intended uses. A certain control policy on manufacturing should be effected to avoid unnecessary competition.

(c) Nursing of processing techniques

As one of the general technical training carricula, the primary knowledge about the plastic should be taught with the necessary equipment furnished. The training scheme should be complete with the required testing facilities.

(d) Exploitation of demand

It is most desired to exploit the Governmental procurements. On the other hand, it is necessary to make the feasible study to replace the imported plastic products by those home-made possible substitutes, encouraging the domestic manufacturing or processing industry.

4-2 RECOMMENDATION

4-2-1 Requirements for the Competent Authorities

(a) In the Ministry of Commercial and Industrial Supply, there should be a personnel assigned at least to specialize in plastics. Also, a well planned programme should be prepared for the grow-

th of the plastic industry. The assigned personnel is so desired as is not thoroughly acquainted with peculiar branches of techniques but should be capable of having a comprehensive understanding over the whole industry from the administrative viewpoint. The Government should also take into consideration the despatch of its personnel abroad for the advanced techniques, and the invitation of the planning engineers to Sudan as well.

(b) The competent section, known as Industry Section, should keep closer connections with the relative sections or other public institutions, for the Government concerns will play a significant role in nursing the basic techniques in the country and in exploiting the Governmental procurements. Further, it will become necessary to make a comparative study with other kinds of the nation's industries in the light of the overall adjustment on the investment and operation of labour population.

(c) The testing and research institutes for plastics should be completely equipped. It is a matter of course that individual enterprises are prepared for the research activities at their own account and risks. However, the requirement is beyond possibility under the present conditions. The Government, therefore, is requested to provide these equipments, enabling the private enterprises to obtain the necessary data.

(1) Plastic items already in production

Water pipes and plastic coating coil wire are among the standardized items in Sudan. The respective standards are stipulated for them to pass in marketing. A simple example of the testing equipment is as follows:-

Testing equipment for wire cord to be used in electric appliances.

Test	Tester	Estimated price (Home market, in ¥1,000)
Withstand voltage	Testing booster	18
	Testing switchboard	340
	Testing transformer	50
(Subtotal:)		(408)
Insulation resistence	Mirror galvanometer	20
	Shunt	11
	Lamp scale	15
	Standard resistence	12
	Others	32

(subtotal:)		(90)
Spark	Spark tester	80
Tensile test	Tension tester	260
Aging by heat	Aging tester	180
Heat deformation	Heat deformation tester	350
Accessories	Air oven	60
	Others	80
TOTAL:		1,500

Testing facilities for polyethlene water pipe in accordance with Japan Industrial Standard

Test	Tester	Estimated price (home market, in ¥1,000)
Dimension	Slide caliper and micrometer	10
Tensile test	Blanking die for test piece	200
Water pressure	Water pressure tester	150
Resolution	Testing apparatus for quantitative analysis of the lost chroline and consumed potassium permanganate	80
Internal thermo-pressure creep	Internal thermo-pressure creep tester	1,500
Ash	Electric muffle furnace	600
	Chemical balance	150
	Platinum crucible	500
TOTAL:		3,540

In case the processed products are available in the common market, there should have been some tests conducted for the qualification of such merchandised products by the private enterprises or a certain approved testing institute. These calibration testing equipment, if purchased, would reach a considerable amount.

(2) Data for the outdoor or peculiar uses of plastic goods in Sudan

Up to date, the qualification of plastic products has mostly been carried out in countries of high altitude, and few data are available for the use in those of low altitude like Su-

dan, especially almost nothing about the outdoor uses. Consequently, it is necessary to perform the outdoor deterioration test of the plastic products intended to be used for construction materials. The test will need so long a period to be completed that it should set to an early start.

(3) Development study on the versatility suitable for Sudan

The plastic will be indispensable for the development of the desert district. It is because the plastic film coating would perfectly prevent evaporation. Further, the characterristics of the plastic should be made the best of improving the soil. It will be possible to utilize the containers of plastic product in river navigational transportation. Even the hull of a ship will be made of the plastic, and further studies should be made to develop the versatile uses in this field.

(d) Precautions required for approving new enterprises,

Several enterprises for the processing industry are now under preparation. The competent authority should be cautious enough to give its approval to them in respect to the basic fundamental requirements being satisfied, financially or technically.

4-2-2 New Processing Industry to be Established

The existing processing methods are divided into two kinds by the machines employed; one is the injection moulding by small machines, and the other the extrusion moulding. It is of course desirable to adopt the various kinds of processing methods that are widely practised in other countries, but at this time required is to provide the following prepositions.

(a) Prepositions necessary for new processing methods

(1) Not to compete with the existing enterprises

(2) Comparatively small amount of investment required for operation

(3) Not so difficult to acquire the know-how

(4) Minimum demand to be secured when occasioned to start business

(5) Substantial effects on the national economy shall be brought about by the new processing industry. It is to substitute the imported goods, saving the outflow of the foreign currency. Or, it shall make contributions to the elevation of the labour level.

(b) Compression moulding of thermo-setting resin

Scope: It is to acquire the compression moulding technique.

Use of products: Tablewares, military uses and hospital utilities.

Reason and effect: The most basic technique for the processing, but no instance of this method is in practice in Sudan.

Required personnel: One forming worker for one set of machine. One each for finishing, inspection and packing, totaling four.

Other requirement: Refer to Supplement #1.

(c) Surface treatment of sheet or likewise

Scope: It is to acquire the processing technique of plate and sheet-like products.

Use of products: Rulers for educational purpose. Sign boards for governmental use, and industrial utensils for governmental factories.

Reason and effect: The most fundamental technique for the secondary treatment or processing, whereas its practice was not recognized in Sudan. The achievement of flat-surface treatment will be much of help to the acquirement of curved surface treatment. This technique is in reality the foundation for the advanced vacuum forming process which enables the mass production. In addition, the necessary equipments for wood working process can be made use of.

Required personnel: In case of ruler making, one each for cutting, shaving, hole-making and calibration, and two for packing, totaling six.

Others: Calibration, if difficult to do, can be omitted for the time being. Details are given in Supplement #2.

(d) Secondary treatment of film products

(1) Heat-sealing process of polyethylene film

Scope: Perfect sealing of packing bag, and heat-sealing of polyethylene film.

Reason and effect: The manufacture of polyethylene tubes which is described later, includes the automated bag-making process. After the fulfilling of the bag, the pedal control semi-automated sealing machine will be applied.

This process will be basic for all heat-sealing systems.

Required personnel: One worker for one machine.

(2) High frequency welding treatment of vinyl chloride film

Scope: Manufacture of general merchandise.

Use of products: With a view to replacing the imported goods, the production items should be selected to meet the market demand.

Reason and effect: In practice, the high frequency heating is utilized in sealing the vinyl chloride film. In this case only, it is possible to use the high frequency machine. However, in relation to the leather treatment, which will be given later, this process is adopted which is capable of treating thicker films. The operation of the radio-frequency unit, and the design and manufacture of the required sealing unit mould will be rather difficult to be adjusted according to the production purposes. It will be necessary to begin with the simple linear sealing.

Required personnel: One worker for a machine when the cutting is effected at the same time as sealing by the edge attached on the mould. In case of separate cutting being used, an additional cutting worker is needed.

(Supplementary) Vinyl chloride leather treatment

Scope: Manufacture of general merchandise.

Use of products: Same as in the vinyl chloride film.

Reason and effect: In case of high frequency welding process, same as in the vinyl chloride film. In case of sewing treatment, the utilization of the existing industrial facilities and labour population should be taken into account for further development.

Required personnel: One worker each for a machine.

All the relative accounts will be given in Supplement #3.

(e) Production of inflation polyethylene tube and packing bag

Scope: Manufacture of polyethylene packing bag.

Use of products: Packing of various kinds of liquids, powder and solid materials. In packing shoes and textiles, the imported goods are used. The packing method may be applicable for salt, sugar and fruits. The versatile uses are numerous.

Reason and effect: This method covers the most wide range of

uses. There are many other film manufacturing systems such as Calendar Method and T Die Method, but this is the simplest to be equipped, giving the most economical effect.

Required personnel: One worker each for an extruding machine and a bag-making machine. One each for inspection and packing. When two sets are in operation, six persons are needed in total.

Others: As per Supplement #4. At the beginning, no printing on the film will be enterprised.

(f) Reference: Plant in use of the applicable thermo-setting resin

Future possibility - The plastic industry in Sudan will be developed with emphasis placed on the processing industry, and many difficulties will be encountered to produce the material resin. When, however, such enterprises as given below are undertaken in this country, the domestic production of the material resin might be considered.

Main products of resin of thermo-setting resin plant and their applications

(Resin)	(Product)	(Application)
Phenol resin	Adhesive	Plywood of high quality Wood working Hard board
	Coating material	Electric insulation Wood working
Urea resin	Adhesive	Plywood Particle board
	Coating material	Transparant vanish for wooden goods

Remarks; The possible production of melanine resin may be practicable, but its products and applications are omitted in this table.

Production scale: The production scale will largely change with the uses and scales in the application field, resulting in the large difference in the required unit amount of resin. No attempt to estimate the production scale will be taken up in this report.

Derivative products: Since the resin applicative plant is established, it is possible to make the forming materials or

laminated products. These manufactures will involve highly advanced techniques.

(g) Reference: Production facilities of the primary products of thermo-plastic resin

Future possibility: The study should be made for the respective categories of compound products and sheet-like ones. Among the compound products, vinyl chloride has a bright future. The vinyl chloride resin will be imported, and kneaded with the added various blending materials. In this kneading process, rolls and extruding pugmills will be required. As for the sheet-like products, there are two types, one is the extruded and the other laminated. The former requires the betterment of the extruding technique and machinery operation, and the latter will make it necessary to be equipped with the calendar-roll and the multistage laminating press. The extruded type will be preferably chosen as the more suitable for the manufacture of the various kinds of the thermo-plastic sheet products such as vinyl chloride, polyethylene and polysthylene.

Production scale: The minimum production scale is only dependent upon the capacity of the equipped machines. Detailed description is omitted hereto, but the following volume of demand will be secured at least.

Compound	- Extruding pugmill	200 t/month
Sheet	- "T" die type extruding machine	50 t/month

4-2-3 Recommendable Comments for the Existing Enterprises

(a) It is desired for the management to willingly learn and acquire the administration techniques of factories. Most of the existing enterprises have been established for three or four years since their start, and currently the production techniques as well as the business status is considered to be stably established under the present facilities. However, there should be some difficulty on the small-scale production in the near future from the factory administration standpoint. The factory management should be well eligible for the production administration system, taking in the upto-date knowledge.

(b) Expansion plan should be precautiously studied

Many of the enterprises are housed in small space. What is worse, the layout of machinery is mostly unsuitable for the efficient operation. With the view to improving the present defective points, the future expansion plan should be carried out on the basic studies, whether it is related to the quantitative expansion or to the development of new production items.

SUPPLEMENT #1

PRODUCTION OF TABLEWARES WITH COMPRESSION-MOULDING METHOD OF THERMO-SETTING RESIN

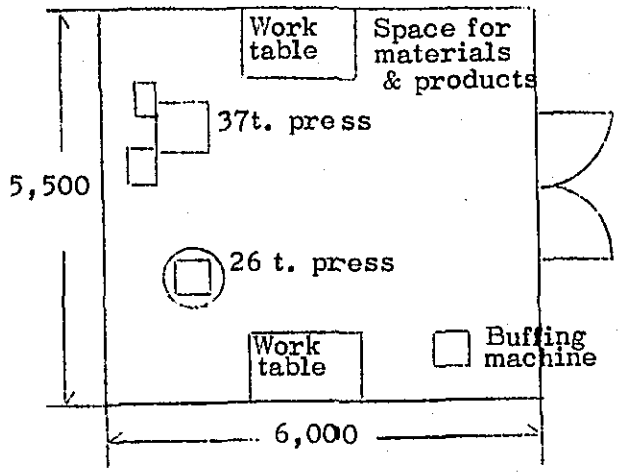
1. Outline of Process
   (1) Weigh the material.
   (2) Put the material into the metal pattern and form it by thermo-compression moulding press, and make mould-gassing if necessary.
   (3) Take the patterns out of the press after a specified interval, and take out the formed material from the pattern.
   (4) Make buffing to finish the product.
   (5) Carry out the inspection, and despatch after packing and tallying.
2. Outline of Equipments

(1) Compression moulding press, 26 t., 37 t.	1 set each
(2) Metal patterns	4 sets
(3) Accessories	1 set

3. Plant Layout

There is not any particular difficulty, but the buff-grinder should be furnished with the dust collecting equipment. An example of the overall layout is as per the following drawing. The necessary floor space is 5.5 m x 6 m.

(Scale: 1/100)



4. Estimation of Equipments and Facilities (in Yen)

Main machines	2 sets	240,000
Metal patterns	2 sets	200,000
Auxiliary facilities		240,000
Building		1,000,000
	Total:	1,680,000

SUPPLEMENT #2

SURFACE WORK OF HARD VINYL CHLORIDE SHEET

A. Production of Rulers

1. Outline of Process

(1) Cut the sheet at a certain dimension with a cutting machine.

(2) Set several tens of the cut material on the jig and plane them.

(3) Make a hole in the middle of the cut material with the drilling machine. (Linear and angular accuracy to be secured)

(3)' Use the rooter-machine is necessary.

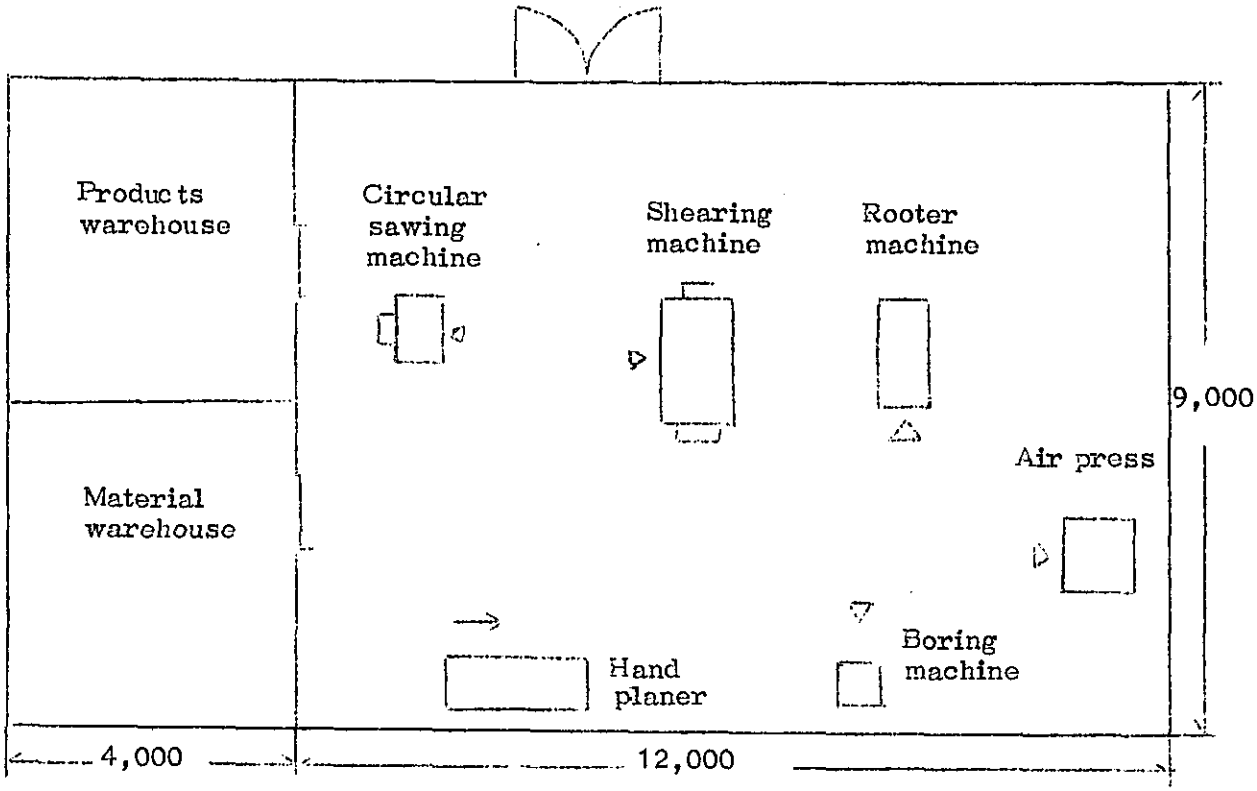
(4) Calibrate the material with the air-press.

2. Outline of Equipments

(1) Cutting machine (foot driven or power-driven shearing machine; circular sawing machine for box-making acceptable)	1 set
(2) Automatic planer	1 set
(3) Rooter-machine & Drilling machine	1 set each
(4) Air-press	1 set
(5) Accessories	
a. Tool polisher	1 set
b. Buffing machine	1 set
c. Air compressor	1 set
d. Jigs	1 set
e. Calibrator & Stamping ribbon	1 set

3. Plant Layout

There are not particular problems except that the dust-collector should be furnished in the cutting and planing process. The floor space is 16 m x 9 m. The drawing given below, scale 1/100, is an example of Plant Layout of the Surface Work Plant of Hard Vinyl Chloride Sheet.



4. Estimation of Equipments and Facilities

The wood working equipments will be made use of for this purpose.

B. Production of Indicators

1. Outline of Process

1-1 The simplest method of putting paints into the stamping points.

(1) Cut the sheet of proper thickness (approx. 5 mm) at a specified dimension, and get the segment plate.

(2) Set the plate on the stamping machine and stamp letters and signs.

(3) Put paints into the stamped concave, and make letters and signs clear.

1-2 The method of setting the cut-off letters on the plate.

(1) Cut the sheet at a specified dimension.

(2) Cut the letters and signs out of the sheet material of the colour different from that of the base plate, using the thread sawing machine.

(3) Set the letters on the plate with adhesive.

1-3 The method of setting the box-type letters on the plate.

(1) Cut the sheet at a fixed dimension.

(2) Cut letters and signs out of the sheet material of the colour different from that of the base plate with the thread sawing machine. Also, cut the side portion of the box-type letters out of the material.

(3) Set up letters and signs into box type.

(4) Set them on the plate with adhesive.

2. Outline of Equipments Covering Above Three Methods

(1) Cutting machine

(2) Drilling machine

(3) Stamping machine

(4) Thread sawing machine

(5) Buffing machine

(6) Tools for treating with adhesive.

3. Plant Layout and Estimation of Equipments

There are no particular problems. The floor space of the building should be enough to accomodate necessary machines. Other particulars are the same as in the case of ruler manufacturing.

C. Production of Containers and Tanks for Industrial Use

The production scale of the containers or tanks in this paragraph is confined to the extent that the plant makes use of the processing facilities for rulers and indicator-plates mentioned above.

1. Outline of Process

(1) Cut the sheet to a specified dimension.

(2) In case of surface working, weld the cut sheets to a certain structure with the hot-jet.

(3) In case of bending work, use the tubular heater.

2. Outline of Equipments

(1) Cutting machine	1 set
(2) Hot-jet machine	3 sets
(3) Tubular heater	1 set

3. Plant Layout - Omitted

4. Estimation of Equipments

Items given below are additional ones to the plant for rulers and indicator-plates.

Hot-jet machine	@¥30,000	3 sets	¥90,000
Tubular heater	@¥21,000	1 set	¥21,000
		Total:	¥111,000

SUPPLEMENT #3

SECONDARY PROCESS OF FILMS

1. Outline of Process

(1) Cut the material sheet.

(2) Heat-seal into a fixed shape.

2. Outline of Equipments

A. For Heat-Sealing Process of Polyethylene Film

(1) Cutting machine	@¥11,000	1 set
(2) Heat-sealer	@¥ 300	3 sets

B. For High-Frequency Welding Process of Vinyl Chloride Film (artificial leather)

(1) High-frequency welder (single head) @¥200,000 1 set

3. Plant Layout and Estimation of Equipments

Omitted since there can be no particular problems.

SUPPLEMENT #4

PRODUCTION OF POLYETHYLENE TUBE BY INFLATION METHOD

1. Outline of Process

(1) Put the material polyethylene into the hopper of the extruding machine.

(2) Prepare the operation of the extruding machine inclusive of warming up of the cylinder and other preparations.

(3) Extrude the tubular film from the circular die.

(4) Pull them up between two squeeze rolls (Pass them through cooling rings).

(5) Check the volume of the compressed air at the time of starting.

(6) The tube swells automatically.

(7) Adjust the drawing speed.

(8) Cut the tube at a certain measurement (for instance 100 m).

(9) Set it on the winder, and despatch after packing.

2. Outline of Equipments

(1) Extruding machine, 40 m/m	1 set	(Another set to be installed later)
(2) Dies	2 sets	
(3) Cooling ring	2 sets	
(4) Tubular film drawing machine	1 set	
(5) Bag making machine	1 set	(Used to seal one end of the tubular film & cut the other end)

(6) Accessories

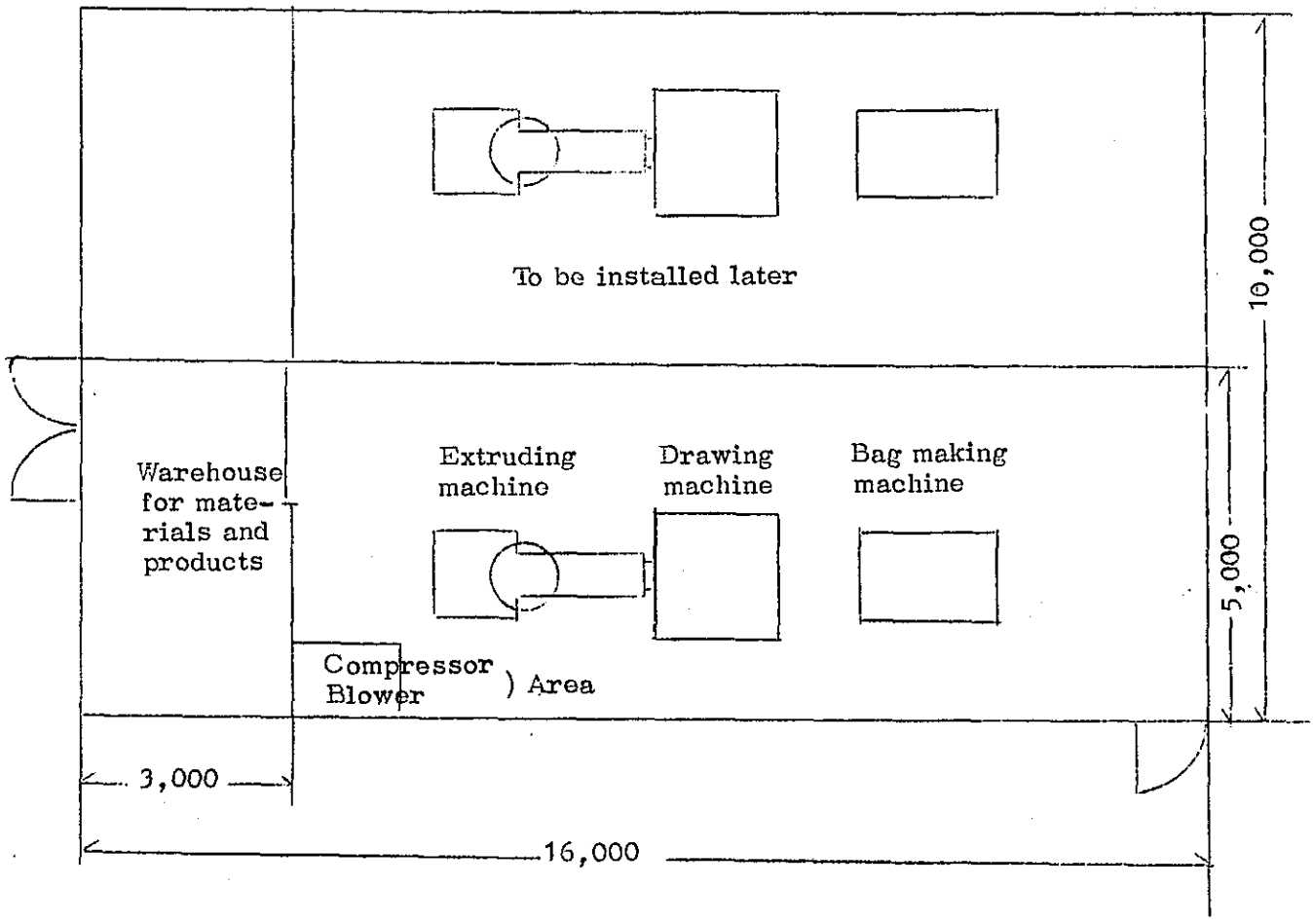
a. Spare parts of the extruding machine	1 set
b. Thickness gauge (for process control and checking)	1 set

3. Plant Layout

(1) The necessary height of the building is 4 - 5 m to accomodate the drawing machine.

(2) The structure of the building should be designed taking into consideration the high temperature in summer. If the bags are to be used for food packing, the building is desirously to have tightly closed doors to keep sanitary conditions. In the layout example given below, 2 sets each of bag-making machines and extruding machines are to be equipped with the total floor space of 10 m x 16 m which offers ample space for storing materials, products and others.

(Scale 1/100)



4. Estimation of Equipments

(1) Main machinery -	Extruding machine Drawing machine Bag making machine	2 sets each	¥3,859,200
(2) Metal patterns	@¥144,000	2 sets	288,000
(3) Accessories	Spare parts & gauges		330,000
(4) Building			5,000,000
		Total:	¥9,477,200

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5. GLASS INDUSTRY

5-1 GENERAL

5-1-1 Consumption

No accurate figure of the glass consumption in Sudan is available. However, judging from the imports record of 1962, an estimated volume of 12,000 - 13,000 tons is considered to be consumed annually. Glass products are consumed mainly in large cities like Khartoum. The present per capita consumption in Sudan where 12 million people live is as small as 1 kg. It is expected, however, that the consumption will rapidly increase in the future.

70 - 80% of the glass products consumed in Sudan are at present imported from abroad, their total value amounting to approximately £S650,000 which constitutes about 0.7% of the country's total import value.

5-1-2 Classification

The glass products consumed in Sudan can be classified as follows: bottles dominantly occupying 50% of the total consumption in terms of weight, followed by pressed glasses of 30%, plate glasses of 20%, plus a small quantity of other glass products. The future increase of demand is not expected to change the above proportion.

5-1-3 Quality

Demand for glass products which has not been popular until recent years arose among wealthy city dwellers who have been familiarized with European-made products. It has been noticed that the products of higher quality are generally preferred and consumed. Consumers have a liking for completely transparent glass products, e.g., they prefer transparent bottles to coloured ones unless they are for specific purposes (such as for beer bottles), and transparent cups if they are not decorated. It has also been noticed that consumers prefer quality products even if they may cost more.

5-2 PRESENT POSITION OF GLASS INDUSTRY

The glass products consumption in Sudan, though small at present, is expected to increase in the near future. If the glass industry in this country is developed to the state of self-sufficiency, it will constitute 1% of the country's total industrial production which earns 16% of the total national income. It is to be stressed that though this percentage is quite small, the establishment of

the glass industry within Sudan will contribute in a great measure to the development of other affiliated industries.

5-3 CONDITIONS FOR ESTABLISHING GLASS INDUSTRY

5-3-1 Consuming Area

The glass industry of Sudan is under a comparatively favourable situation in that the consuming areas are within the country, that the exporting countries of glass products are in the distance, causing high import freight.

5-3-2 Raw Material

Heavy oil, which is not produced in Sudan, costs about 20 -30% higher as compared with other glass producing countries. Since it occupies a considerably large percentage in the cost price of glass products, it is hoped that the heavy oil will be secured at lower prices in the future. It is to be added that the same thing can be said about the electric power required for the production of glasswares. Regarding silica material which accounts for most (70% Wt.) of the chemical components of glass products, the bluish glass is manufactured from the silica with substantial Fe_2O_3 content available within Sudan, whereas transparent glass is manufactured from silica with little Fe_2O_3 content after smashing it into powder. Expenses incurred by this smashing process is one of the factors of the high cost price. Another cause of the high cost price is the high import freight of soda ash, the raw material for Na_2O, which forms about 20% of the glass components. CaO and MgO are fortunately produced within the country.

5-3-3 Engineers and Workers

There are vew few chemical engineers specialized in the glass industry. This shortage of engineers calls for the service of foreign engineers in virtually every field of the glass industry. In addition, workers lack the basic skill required for the manufacturing process, calling for the technical training of several years. As the glass industry demands skilled workers, the low wage prevailing in Sudan cannot be considered as an advantage due to the inefficiency of unskilled workers.

5-3-4 Affiliated Industries

Under the existing conditions, neither the development of soda ash industry nor the production of machinery in the immediate future can be expected. It should be added that there exists no fire-proof materi-

al industry in the country. It is therefore hoped that these industries will be developed along with the future development of the cement industry, iron industry, etc. However, gradual development is being made in some industries related to the consumption of glass products, e.g., beer brewering, juice manufacturing and pharmaceutical industry (which utilizes ampoules), and these industries are anticipated to contribute to the development of the glass industry.

5-4 PRESENT STATUS OF GLASS INDUSTRY

The operation during the past 3 years of the glasswork now existing in Sudan is to be highly assessed in view of the fact that it is not locationally favaoured except for the availability of the market. The glasswork, which suffered accidents as well as a considerably long period of non-operation caused by its management policy and other reasons, is still closed at present. It is to be noted, however, that in the face of such problems as -

(a) Shortage of engineers
(b) Lack of technical training of workers
(c) Insufficient development of affiliated industries
(d) Lack of reputation and confidence on the part of consumers in the home-made products,

steady steps are being taken to cope with each of these problems towards its solution.

The above-mentioned glasswork now suffers the shortage of engineers and capital, and is desirous of concluding with a foreign concern an agreement for the joint venture involving capital investment as well as technical cooperation agreement.

5-5 PROSPECT OF GLASS INDUSTRY

If one considers the existing conditions under which it is placed, one would readily reach the conclusion that the glass industry of Sudan will pursue in the future the policy of attaining the state of self-sufficiency. As regards the plate glass which is already in a considerably large demand, however, the desired state of self-sufficiency will not be achieved for some time to come on account of its minimum economical production. Minimum economical production of such specific products as spectable glass, watch glass and glass beads will also be difficult. It is therefore suggested that the glass industry of Sudan will attain, in the first place, the state of self-sufficiency of products centering upon glass cups, then be developed to the stage when other items can be economically produced.

5-6 SUGGESTIONS AND RECOMMENDATIONS

5-6-1 It is not advisable to have the glass industry undertaken by a number of private enterprises and expect that the competition among them will stimulate the development of the industry. It will be necessary to provide the basis for the sound development of the industry by exerting efforts to be directed to bringing up one single company and fostering it into a stable and integrated glass products company. An advantage of bringing up one company is the availability of 3 - 4 times the present facilities and services: forming devices, fire-proof materials, spare facilities, engineers and workers, ancillary equipment and facilities including molds, mold manufacturing plants, smashing process of raw materials, machine tools and so forth.

5-6-2 The proposed glasswork will have to adopt the production programme to be prepared on the basis of the expected demand. Importance should be attached to the continuous production system as it is an indispensable factor in the glass industry from the viewpoint of both Quality and Cost. Endeavours should be made towards separating the furnace for white ground products from that for the blue ground products, though it may result in the smaller size of the furnaces.

5-6-3 Propagation Activities should be carried out by the management of the glasswork as well as by the Government to encourage consumers to use home-made products. It is recommended that the Government give its guidance to the consumers, in line with the production situation including the availability of raw materials, whereby they should be inclined to purchase, for instance, home-made beer- and juice-bottles.

5-6-4 The Government should take into consideration the education and training of engineers and workers. In this respect, the Government is urged to provide its assistance in establishing the faculty of chemistry in universities, in employing leading engineers specialized in the glass industry for the elevation of the technical level as well as in establishing within the proposed glasswork a laboratory that, in combination with the glasswork, would serve as a training institution to provide technical and engineering guidance and assistance. It may as well be added that during the early period of the development of the Japanese glass industry, the Government-run glassworks played an inestimably important role.

5-6-5 It is advisable that the Government take such measures, in view

of protecting its developing glass industry, as introduction of foreign capital, import restrictions on specific glass products, and other effective measures. It is to be emphasized that no efforts should be spared by the glasswork itself towards attaining the perfect balance between the technique and capital, and further improving each field of the glass industry.

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III. CONCLUSION

It is observed that the gap existing between the fairly developed district in and around Khartoum and the less industrialized provinces in the south and west is being posed as one of the political issues in Sudan. Establishment of industries and increase of employment in these under-developed areas are therefore among the major policies of the Government of Sudan.

Due consideration was paid to such political situation in carrying out the investigations which aimed at studying and determining, by district, the feasibility of developing various industries other than the plastic and glass industries which are referred to at the end of this conclusion. The investigations have lead to the conclusion that in view of the availability of raw materials and transportation facilities in different districts investigated, it would be most advisable to start with those industries which would be developed to meet the limited local demands. Industries suggested to be developed or promoted in different provinces are as given below.

Dafur Province	:	Development of blanket industry to utilize camel - goat - sheep hairs available in El Fasher and vicinity.
		Promotion of wood working industry in Nyala - Zalingei districts to provide furnitures mainly to the local markets.
Kordofan Province	:	Promotion of brick industry in El Obeid district.
Bahl El Ghazaal Province	:	Development of knock-down furniture industry to utilize mahogany as main material and to provide furnitures to Khartoum and vicinity.

Referring to the fairly industrialized district around Khartoum and its further industrial development, investigations revealed that raw materials of relatively fine quality for ceramic manufactures are available in the proximity of Khartoum. Establishment of the ceramic industry in this district

can be anticipated if further investigations prove that these raw materials are suitable for porcelain, earthenwares and sanitary wares. The brick industry in this district is generally under the same condition as that in El Obeid district and should be promoted in much the same way.

With regard to the glass and plastic industries for which there already exist manufacturing factories, suggestions were given in this report on the course of their future development.

In concluding this report, it is earnestly hoped that Japan's technical co-operation for the development of medium and small scale industries would serve the purpose of developing and stabilizing the economy of Sudan and at once prevent eventually the outflow of her foreign currency reserve.

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IV. APPENDICES

Sudan 1	Photo 1 - 3	(Fibre Industry)
Sudan 2	Photo 4 - 11	(Fibre Industry)
Sudan 3	Photo 12 - 15	(Fibre Industry)
Sudan 4	Test Result	(Ceramic Industry)
Sudan 5	"	(")
Sudan 6	"	(")
Sudan 7	"	(")
Sudan 8	Distribution Map of Forest Resources	(Wood Working Industry)
Sudan 9	Catalogue	(Fibre Industry)
Sudan 9'	"	(")
Sudan 10	"	(")
Sudan 10'	"	(")

SUDAN-1 (Fibre Industry)

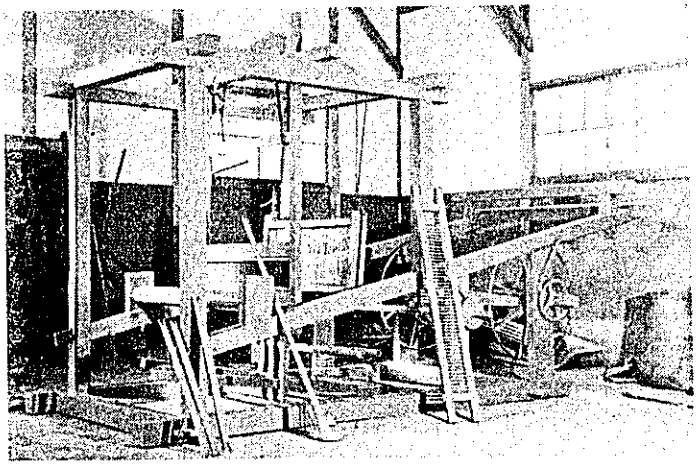


Photo 1

Wooden Handloom
(Horizontal type)

Capacity: 2 m^2/hr

Price: Y135,000

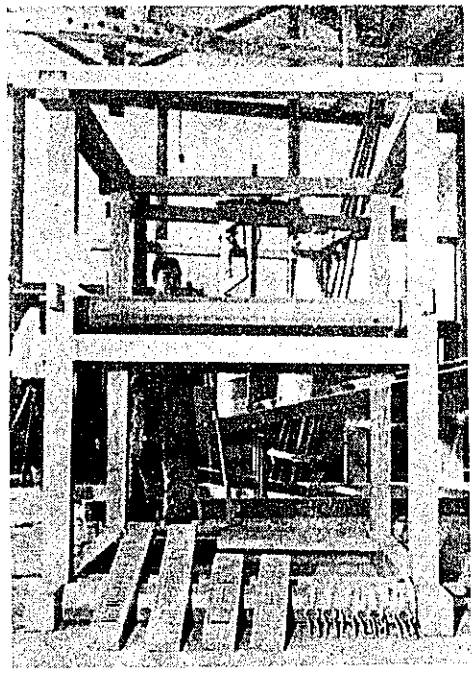
(See Page 37)

Photo 2

Wooden Handloom
(Vertical type)

Capacity: 0.5 m^2/hr

Price: Y79,000



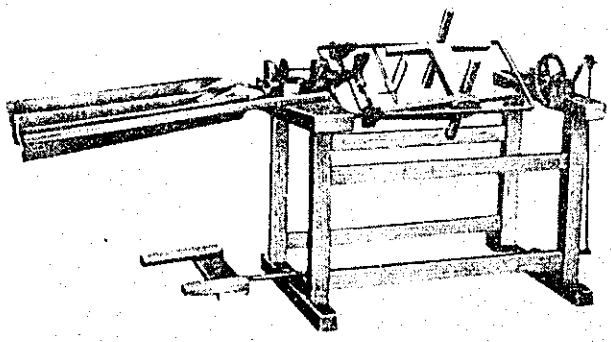


Photo 3

Rope Making Machine

Capacity: 150 m/hr (wooden frame)
(5/32" in diametre - iron frame)

(See Page 38 & 39)

SUDAN-2 (Fibre Industry)

Photo 4 (¥1,450,000)

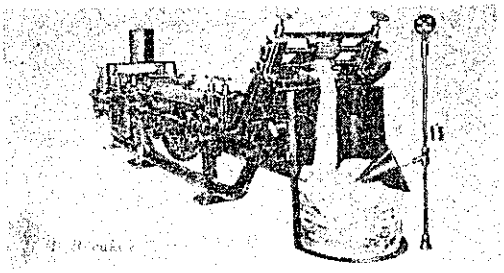


Photo 5 (¥1,000,000)

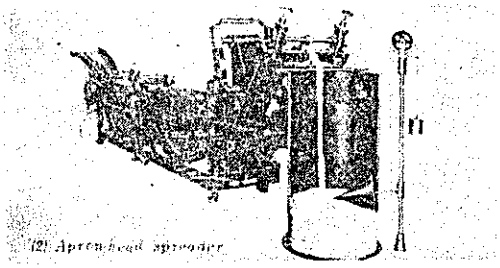


Photo 6 (¥550,000)

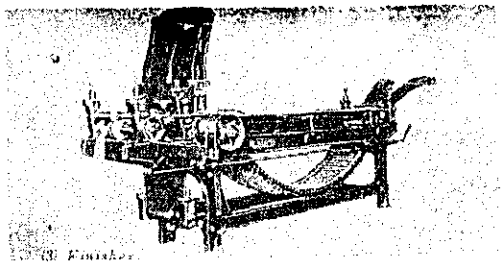
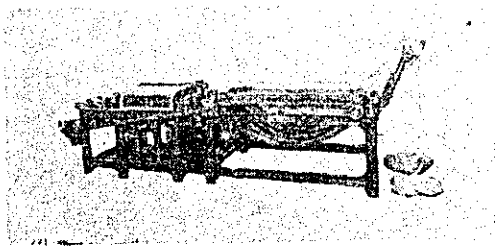
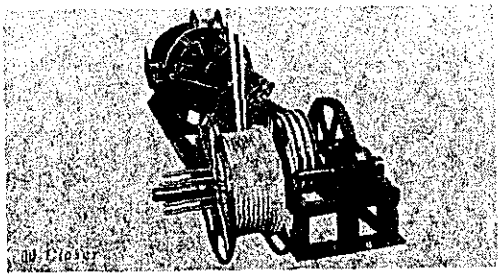


Photo 7 (¥320,000)



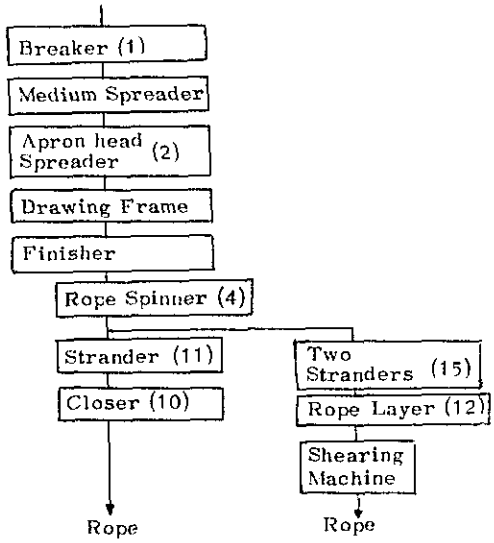
(¥200,000 - 9 mm)
(¥1,600,000 - 36 mm)
(¥2,400,000 - 50 mm)

Photo 8



Manufacturing Process

Raw Material (hemp)



(¥100,000 - 9 mm)
(¥800,000 - 36 mm)
(¥1,200,000 - 50 mm)

Photo 9

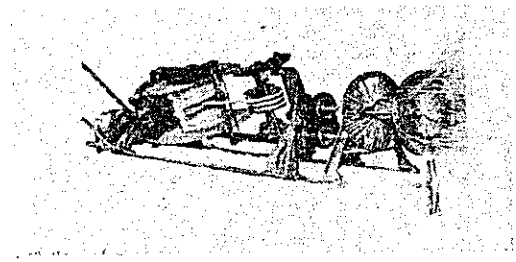


Photo 10 (¥400,00 - ¥650,000)

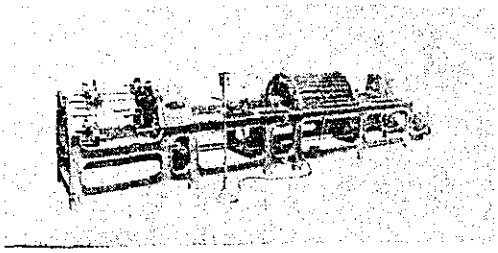
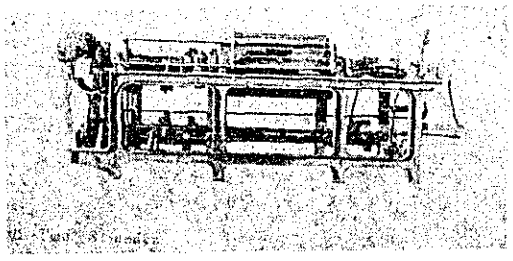


Photo 11 (¥300,000)



SUDAN-3 (Fibre Industry)

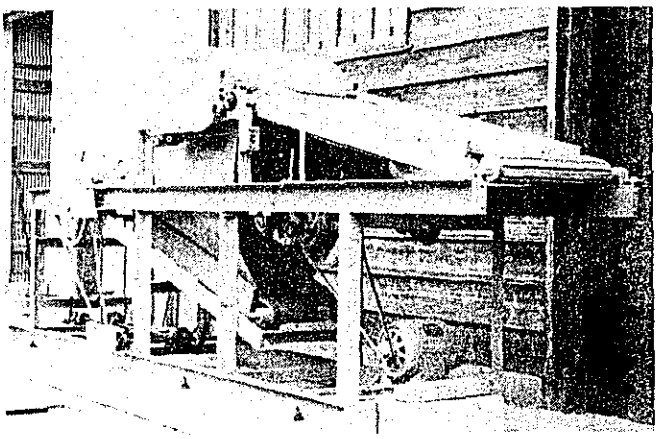


Photo 12
Automatic Throw-in Type
Sliver Manufacturing Machine
Capacity: 15 kg/hr
HP: ½ hp
Price: ¥264,000

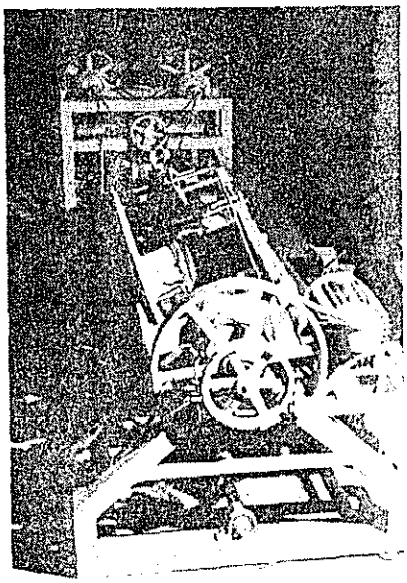


Photo 13
Automatic Rope Making Machine (2 ply)
Capacity: 400 m/hr, 36" dia.
HP: ½ hp
Price: ¥234,000

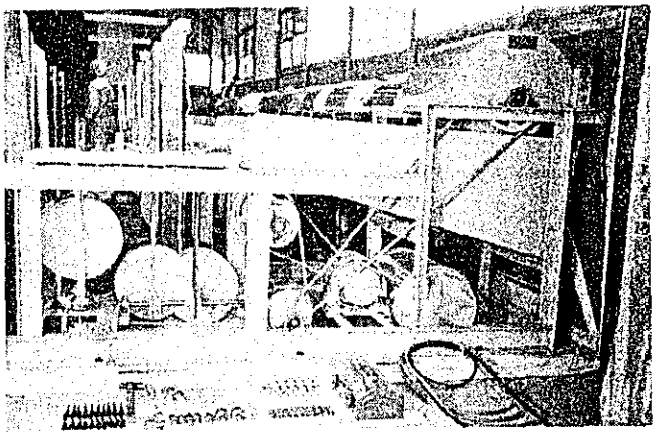


Photo 15
Rope Making Machine

	Wooden frame		Iron frame	
	M	L	M	L
Capacity:	300/hr (½" dia)	200/hr (7/8" dia)	300	200
HP:	2	3	2	3

Price: ¥582,000

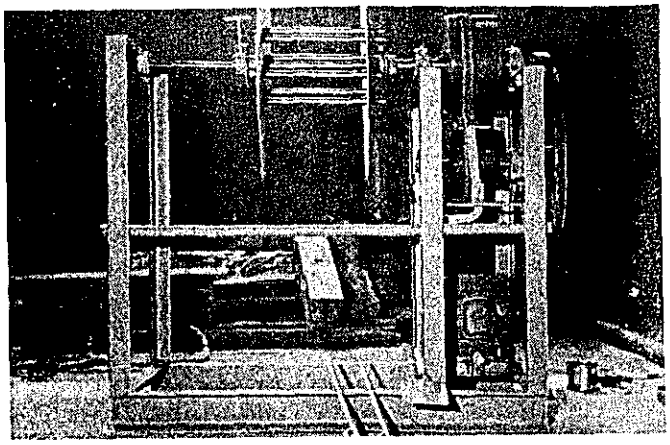
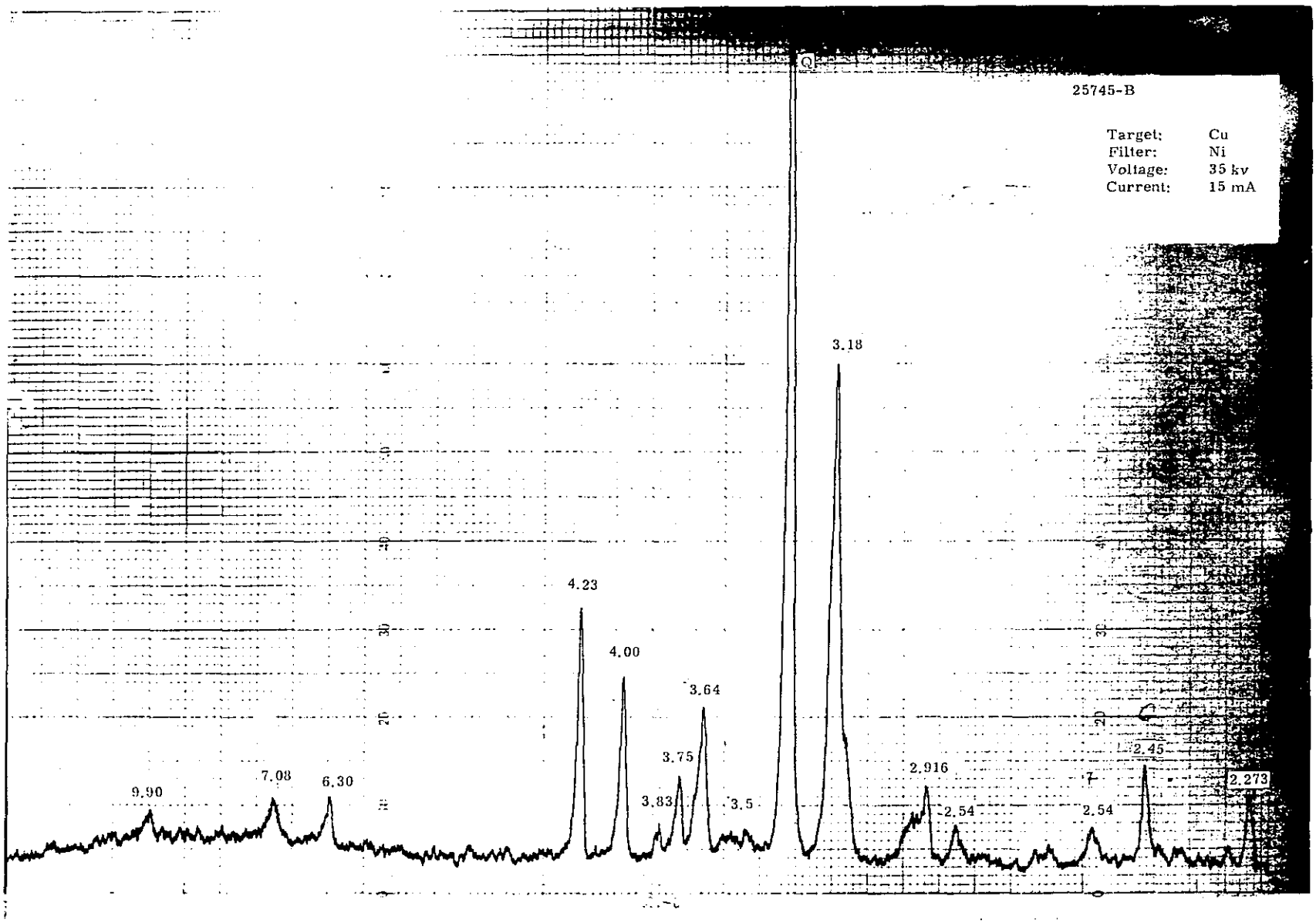


Photo 14
3 Ply Twine and Rope
Packing Machine
HP: ½ hp
Price: ¥58,500

Diffraction in X-Ray Powder Examination
25745 - B

(See Page 9)

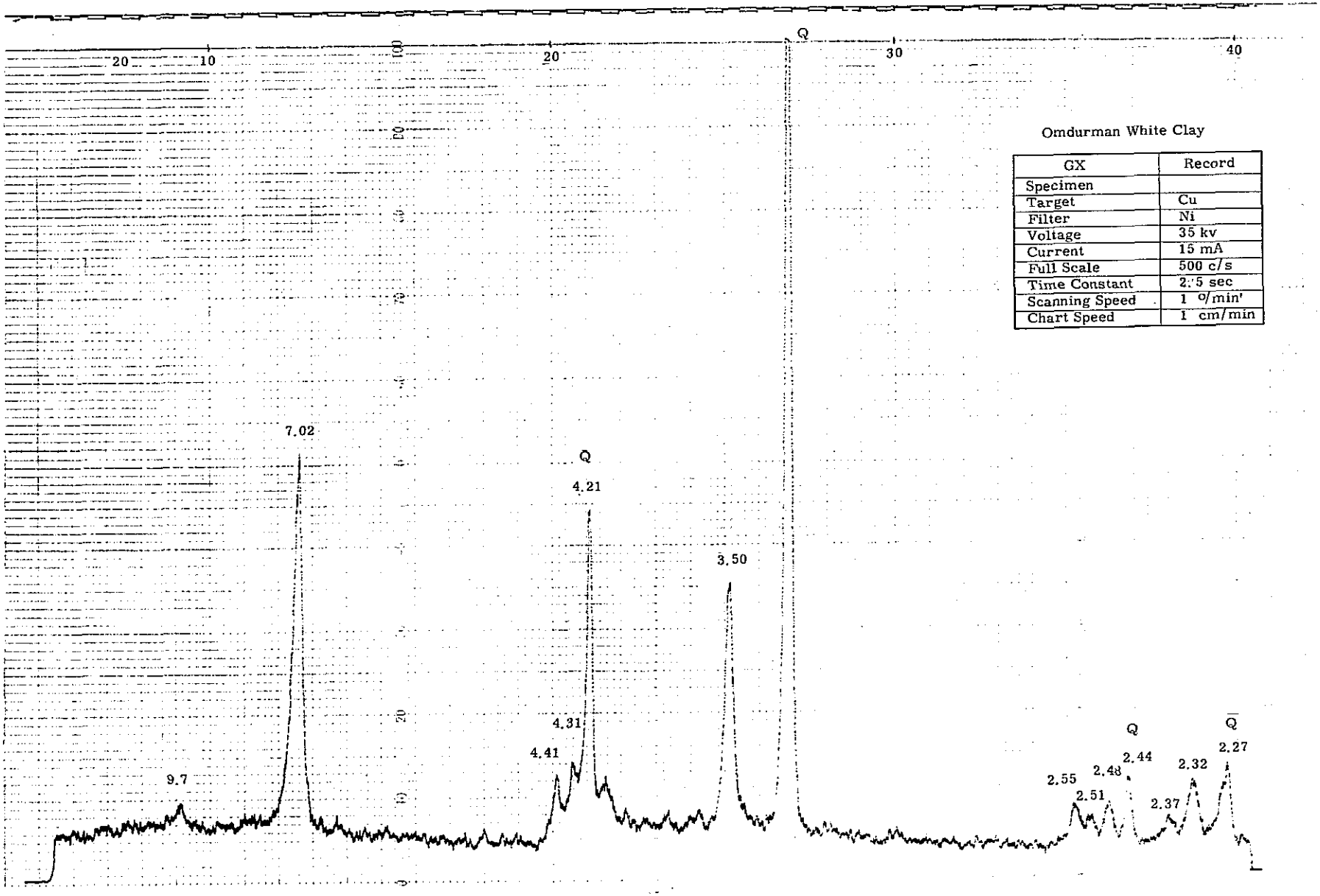

25745-B
Target: Cu
Filter: Ni
Voltage: 35 kv
Current: 15 mA
9.90
7.08
6.30
4.23
4.00
3.83
3.75
3.64
3.5
3.18
2.916
2.54
2.54
2.45
2.273

SUDAN-5 (Ceramic Industry)

Diffraction in X-Ray Powder Examination

Omdurman White Clay

(See Page 9)


Omdurman White Clay
GX | Record
Specimen |
Target | Cu
Filter | Ni
Voltage | 35 kv
Current | 15 mA
Full Scale | 500 c/s
Time Constant | 2.5 sec
Scanning Speed | 1 °/min
Chart Speed | 1 cm/min
20
10
20
30
40
Q
7.02
Q
4.21
3.50
4.31
4.41
9.7
Q
2.44
2.48
2.55
2.51
2.37
2.32
Q
2.27

SUDAN-6 (Ceramic Industry)

Diffraction in X-Ray Powder Examination

Feldspar

(See Page 10)

Microscopic
Photo of
Feldspar of
Abu Hamad

Sudan Feldspar

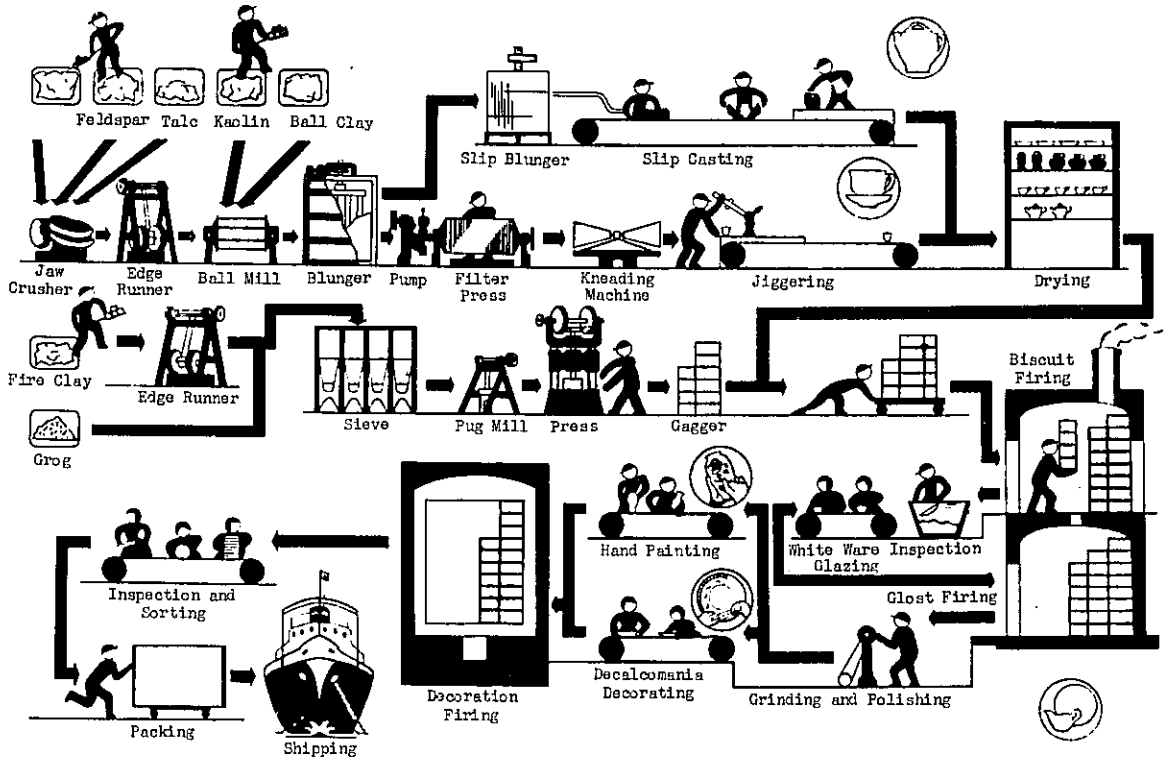
GX	Record
Specimen	
Target	Cu
Filter	Ni
Voltage	35 kv
Current	15 mA
Full Scale	500 c/s
Time Constant	2.5 sec
Scanning Speed	1 °/min
Chart Speed	1 cm/min

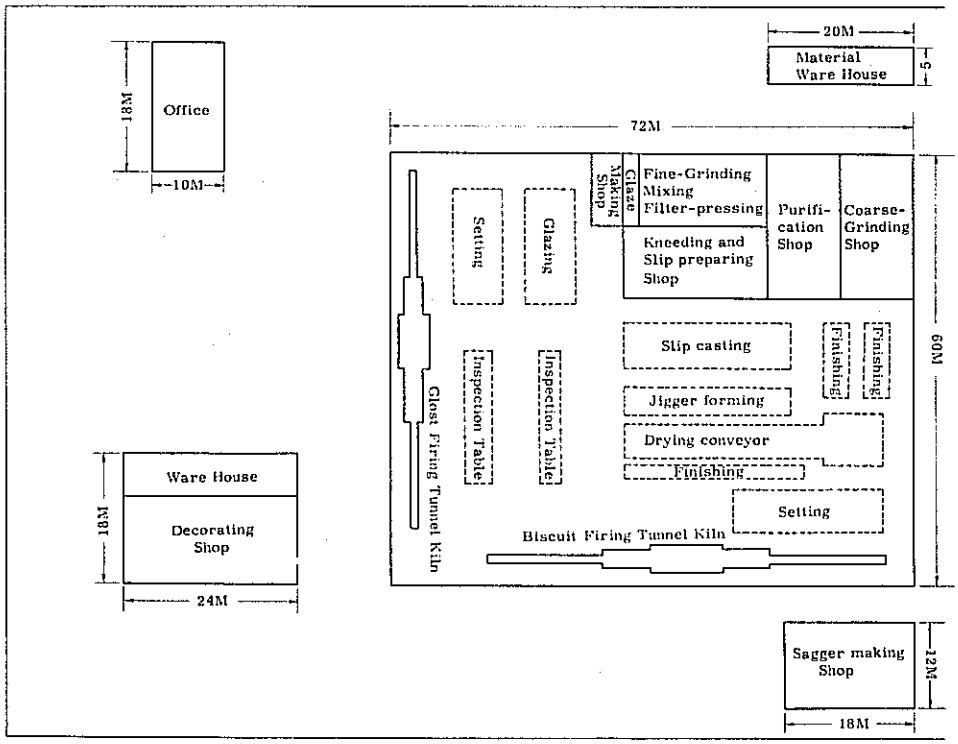
SUDAN-7 (Ceramic Industry)

Flow Sheet and Factory Layout

(See Page 14)

A TABLEWARE MANUFACTURING PROCESS

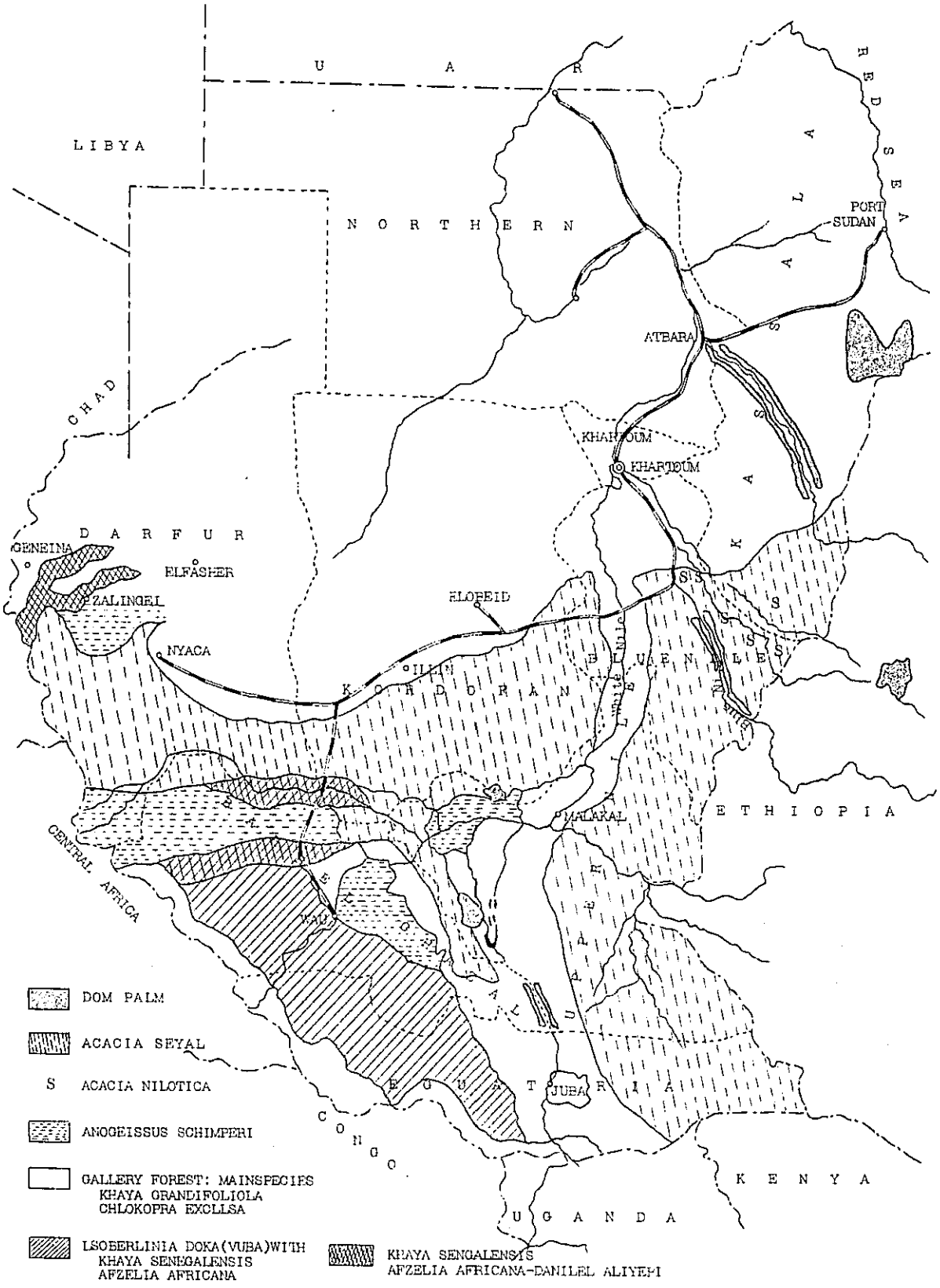




SUDAN-8 (Wood Working Industry)

Distribution Map of Forest Resources

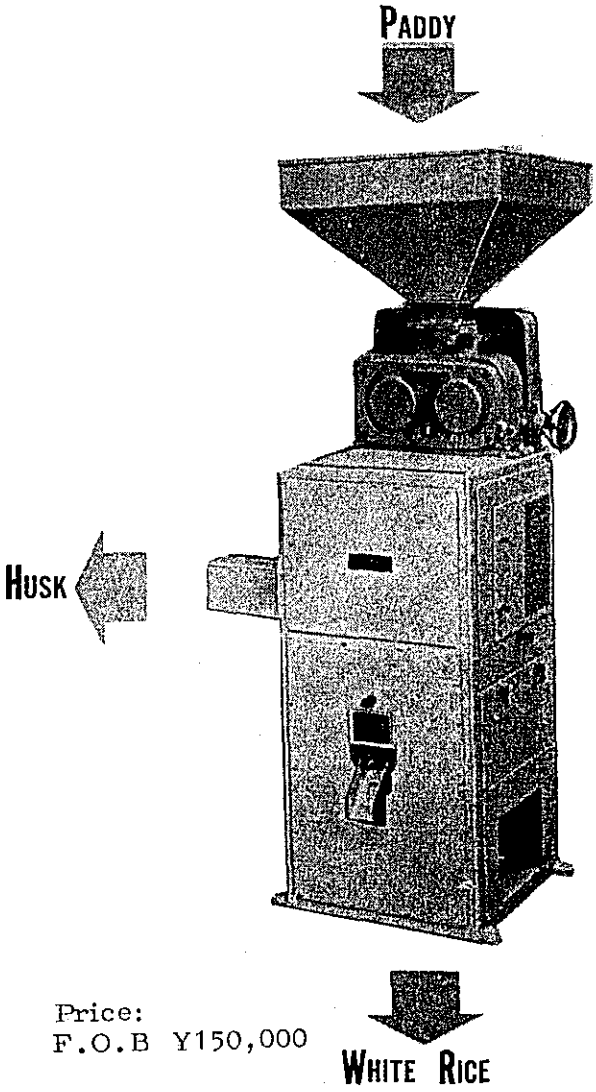
(See page 20)


LIBYA
NORTHERN
RED SEA
PORT SUDAN
ATBARA
KHARTOUM
KHARTOUM
CHAD
DARFUR
GENEINA
ELFASHER
ZALINGEI
NYACA
ELOBEID
KORDOFAN
BLUE NILE
ETHIOPIA
MALARAL
CENTRAL AFRICA
JUBA
CONGO
KENYA
UGANDA
DOM PALM
ACACIA SEYAL
S ACACIA NILOTICA
ANOGEISSUS SCHIMPERI
GALLERY FOREST: MAINSPECIES
KHAYA GRANDIFOLIOLA
CHLOKOPRA EXCLLSA
LSOBERLINIA DOKA(VUBA)WITH
KHAYA SENEGALENSIS
AFZELIA AFRICANA
KHAYA SENGALENSIS
AFZELIA AFRICANA-DANILEL ALIYEPI

SUDAN-9 (Fibre Industry)

ONEPASS RICE PEARLER

COMBINED WITH HUSKER



Price:
F.O.B Y150,000

The most rational roll type husker and jet rice pearler are combined in this new rice whitening machine. It does the complete process from paddy to pearl-white milled rice, first of its kind in the world. The functions of this machine are to husk the paddy, separate the husks and to whiten the cargo rice, removing the bran during the process of milling.

CONSTRUCTION

Paddy fowing down from the upper feeding tank will be husked while passing through the interspace (0.5 mm - 1 mm) between the two rubber rolls which revolve at variant speed each other.

Husks will be separated by the husk separating apparatus equipped under the rubber rolls and will exhaust out of the machine.

The husked rice led into whitening chamber will be whitened by the milling roller which has jet air orifices.

Bran will be blown out from the perforated cylinder by the jet air.
Degree of whiteness can be adjusted by the weight at the outlet of the machine.

SUDAN-9' (Fibre Industry)

CHARACTERISTICS

1. Higher Husking Efficiency and Less Broken Rice:

As the husking is done when the paddy passes through the narrow linear clearance between the two elastic rubber rolls, husking efficiency is higher and brokens will be very little.

2. Loss of Bran is Nil:

When the paddy passes through the closest linear clearance between the two rubber rolls, husking is done instaneously. Therefore, flawless husked rice is obtained without yielding bran during the husking process. Consequently, there will be no loss of bran mixing in the husks.

3. Low Temperature Whitening and Few Brokens:

Air from the high pressure turbine will keep blowing out from the milling roll at the time of operation, preventing temperature rise of the rice being milled. In consequence, low temperature and tasteful rice will be produced.

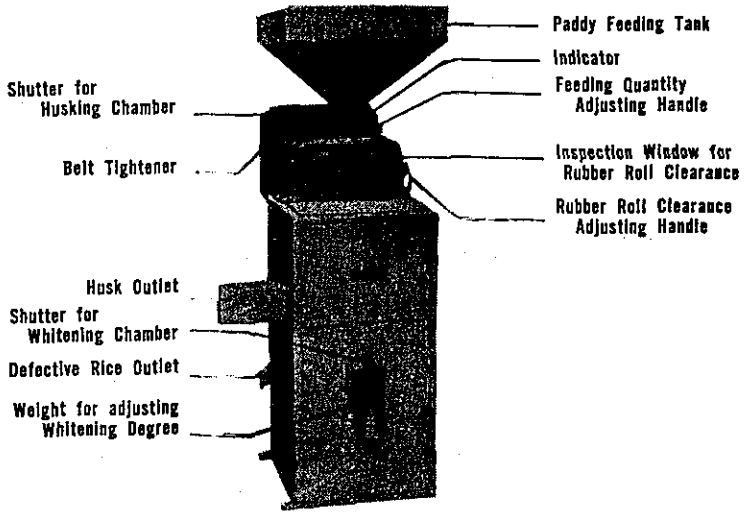
4. Compact Size and Low Price:

Because the husker and pearler are combined vertically for the first time in the world, required installation space is very small and the price is very low.

5. Sample to Use:

Hours of self-operation is possible after initial adjustments of the rubber roll clearance and degree of whiteness by the weight are made.

Type	Req. H.P.	Hourly Capacity on Paddy		Outside Dimensions						Pulley Size (mm)	
				Length		Width		Height		V	Flat
		lbs.	kgs.	inch	mm.	inch	mm.	inch	mm.	Belt Type x Number of Groove x Pitch Dia	Width x Out Dia
SB-2B	3-5	331-397	150-180	24.8	630	24.8	630	59.05	1500	Ax3x230	80x197



SUDAN-10 (Fibre Industry)

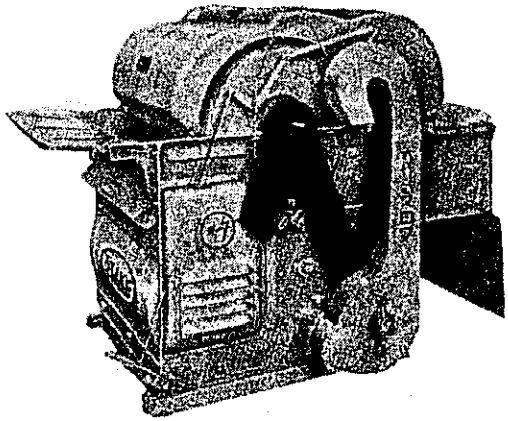
THRESHER

Motor Driven Thresher: Three Models. Driven by electric motor or oil engine composed of three main parts as follows -

Threshing Drum - Threshes off grains from their stalk bundle by its rotating knots. But after ears are separated from stalks, stalks-remainder must be put away from the drum surface and be thrown behind the operator.

Winnower Fan - Sends the wind to the threshed grains continuously in order to blow off eardusts from the grains.

Thrower - Carries the selected grains out of the machine body by its rotating blades.



All steel
Motor-driven Thresher with thrower
(Model AS)

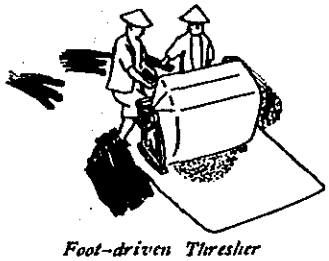
1 HP, F.O.B. Y30,000

Specification :

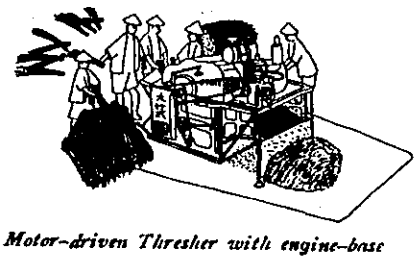
MODEL	AS—1	AS—8	AS—2
TYPE	—With thrower—		
Width of machine (inch)	38.5	35.5	32.5
Length of machine (inch)	55	55	55
Height of machine (inch)	41	41	41
Capacity/hr. (bushels) (max. by Japanese methods.)	abt. 19 (paddy)	abt. 15 (paddy)	abt. 10 (paddy)
Required H. P.	1~2	1~2	1
R. P. M. (Rice)	550	550	550
(Wheat)	650	650	650
(Barley)	750	750	750
Floor Space (inch)	33.5×31	30.5×31	27.5×31
Net Weight (kg)	90	85	80
Gross Weight (kg)	200	190	179
Measurement (c.ft.)	49.9	46.3	42.7

Foot-driven Thresher
(Type Standard)

Motor-driven Thresher with elevator
(Model AS)

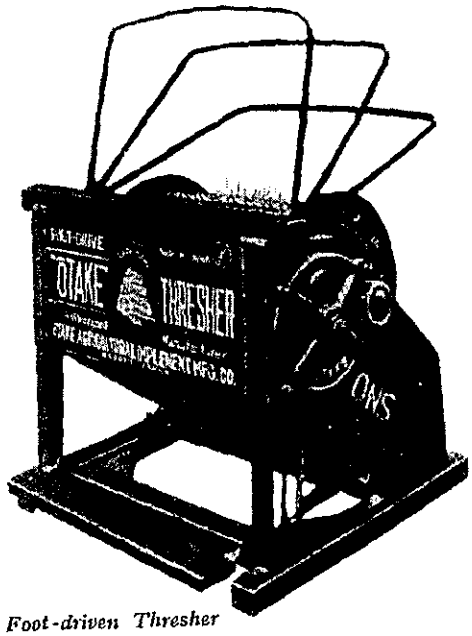


Foot-driven Thresher
(Type Two-men)



Motor-driven Thresher with engine-base
(Model AS)

SUDAN-10' (Fibre Industry)



Foot-driven Thresher
(Type Standard)

FOB ¥25,000

Foot-Driven Thresher: Two Models

Driven by treadling the pedal continuously. Composed mainly of the steel plate frame, threshing drum and pedal. Grains will be threshed off from their stalks being beaten by rotating knots planted on the drum, whereby only ears-parts are to be contacted on the drum surface and while stalks-part must be kept by hands on its bundled part. After the ears are threshed off, stalks must be put away from the drum surface to behind the operator.

Specification :

M O D E L	Y—1	Y—2
TYPE	Standard	Two—men
Width of machine (inch)	27	28
Length of machine (inch)	29	40
Height of machine (inch)	25	25
Capacity/hr. (bushels) (max. by Japanese methods.)	abt. 4 (paddy)	abt. 8 (paddy)
No. of Treading/min.	80~100	80~100
Net Weight (kg)	41	64
Gross Weight (kg)	77	110
Measurement (c.ft.)	15.4	23.3