Forest Raw Materials	*Principal Manufactured Products*

Note: Tree products—e.g. coconut, rubber which are generally grown on an organized plantation basis are listed under Agricultural Raw Materials.

Bamboo	Paper; rafting material; building framing material (untreated and impregnated); building sidings; furniture; floor mats, etc.
Camphor	Drugs.
Cane	Rattan work; baskets; mats; cordage substitute.
Cinnamon	Spices.
Cutch	Tanning agents; dyes.
Hardwoods, not elsewhere classified	Squares, sawn untreated timber and lumber; impregnated timber and lumber; lumber products; chipboard (from sawmill wastes); plywood; tea chests; railway sleepers and keys; charcoal; firewood. Gurjan has most of the characteristics of teak.
Lac	Shellac; sealing wax; phonograph records; varnishes.
Leaves, miscellaneous	Wrapping materials.
Mangrove	Tannin; firewood.
Pyinkado (iron wood)	Untreated and impregnated railroad sleepers; posts; construction timber; tool handles.
Sandalwood	Carvings; chests; fans.
Softwoods, miscellaneous	Matches; boxes.
Teak	Ship and boat decking; timbers and hull planking; building construction; timber and lumber; lumber products; shingles (from butts); chipboard (from sawmill wastes); plywood; furniture.
Thitsi	Lacquers; varnishes; cements.
Vines, miscellaneous	Rope and cordage substitutes.

Note: (1) In connection with all minerals listed in this and the following section, for which only minor occurrences are indicated, it must be remembered that Burma is still underexplored for minerals.

(2) Up to the present most of the ores of metallic minerals have been shipped abroad as concentrates. Lead and silver have been refined to elemental metallic form in Burma.

*Metallic Mineral Raw Material**	*Principal Manufactured Products*
Aluminum (no encouraging deposits of bauxite found in Burma to date)	—
Antimony (slight exploitation to date, but potentially valuable deposits)	Bearings; batteries; type; collapsible tubes; foils, solder; tracer ammunition and primers; paints and lacquers; glass and pottery; matches.
Beryllium (small deposits of beryl ore; no primary deposits known to exist in Burma)	Alloy steels; nonferrous alloys; fluorescent phosphors; incandescent lamp filaments and filament coatings; other heating elements; special crucibles and refractories.
Barium and barites (known deposits in several places including near Mawson in Shan States; some small-scale commerical output in the past)	Sludges for well-drilling; paint filler; glass; rubber filler; steel heat-treating agent; photographic paper coatings; brine purifier for chlorine manufacture; green signal flares; beet sugar purifier; hydrogen peroxide manufacture; steel case hardening.

Metallic Mineral Raw Material (contd.)	*Principal Manufactured Products*
Bismuth (found in small quantity in wolfram-bearing alluvial deposits of Tavoy and Mergui areas; also in the tin-wolfram lode at Kanbauk)	As elemental bismuth, used for medicines; cosmetics; manufacture of thin-walled tubing; seals for nitriding furnaces; electroforming; additive to aluminum alloys; additive to stainless, manganese, and carbon steels; fuze alloys and other low melting point alloys; rectifier coatings; tin-saving solders; bearings. As bismuth subcarbonate, used for ceramic glazes and artificial horn products; as basic bismuth chloride, used for cosmetics, paint pigments and artificial pearls; as basic bismuth nitrate, used for bismuth fluxes for enamels and cosmetics.
Chromium (several occurrences of chromite reported in Arakan Yomas, and several others in Kamaing subdivision of Myitkyina district; no commercial output in Burma to date)	Heat and corrosion resisting alloy steels; nickel chrome resistance wire; tanning compounds; dyeing mordants; oxygen absorber in gas analysis; camouflage pigments; priming pigments for military aircraft, vessels and structural steel; textile processing plating and anodizing aircraft parts and frames; catalysts for petroleum refining; synthetic rubber manufacturing refractories; reagents and chemicals.
Cobalt (no cobalt deposits as such known in Burma, but cobalt forms important part of complex Bawdwin mine ores)	High speed steel alloys; magnets; paint pigments; and porcelain paints; absorbent for military poison gas and ammonia.
Columbium (E. L. G. Clegg, Superintending Geologist, Geological Survey of India, states one specimen of columbite bearing pegmatite found in north of Tavoy district; no large occurrences known in Burma, and no commercial extraction to date)	Corrosion resisting stainless steels.
Copper (only minor occurrences known except for copper constituent of complex Bawdwin ores)	Many major fabricated copper products; many major fabricated brass and bronze products; other copper alloys; paint and paper pigments; roofing specialities; pins; clips; staples; zipper fasteners; insecticides and exterminators; pyrotechnics; artificial flowers; photographic reagents; dyeing mordants; artificial silks; colored glass; electrodes; steel rust retardant; many chemicals; many medicines and drugs.
Gold (only minor alluvial deposits so far known in Burma)	Gold leaf; jewelry and watch cases; dentistry; pens and pencils; church articles; military insignia; stained glass, many gold plated articles; chinaware and porcelain decoration; gilding liquids; photography; drugs.
Iridium (see platinum)	
Iron (some 21 iron-ore deposits have been reported in Burma; none of any size has as yet been found; from 1934	Basic iron and steel manufactured and semi-manufactured products include pig iron, in various grades; ferro-alloys for a variety of

Metallic Mineral Raw Materials (*contd.*)	*Principal Manufactured Products*
through 1940 the Burma Corporation produced around 25,000 tons per year of iron ore from Burma deposits; practically all of this was used as flux in smelting lead and associated ores from Bawdwin mine; extraction of iron ore for flux should be revised; additional reported deposits, especially in the Tavoy and Loikaw areas, should be investigated; scrap, a source of raw material for the iron and steel industry which has recently been under survey)	purposes; steel ingots, blooms, billets, slabs and sheet bars; iron and steel bars and rods, including iron bars, steel concrete reinforcement bars, other steel bars, and wire rods; iron and steel plates, sheets, skelp and strips; iron and steel sheets, galvanized and ungalvanized; tin plate and terne plate. Manufactured steel mill products including structural iron and steel; railway track material; pipe and other tubular products; wire and manufactures; nails and bolts; castings and forgings. Manufactured iron and steel products, other than steel mill products, include tools, other hardware and a large share of the other manufactured products of present-day industrialized economics. Other iron products and derivatives include iron powder, used for batteries, powder metallurgy, veterinary medicals; iron carbybal, used as an antiknock in internal combustion engines; brown iron oxide, used for animal feeds, ceramics, water-paints; red iron oxide, used for polishing glass and metal, pigments in rubber goods, wallpaper pigments, iron paints, ceramics; ferric ammonium citrate, used for blueprints, medicinals and photography; ferric chromate, used for porcelain ceramics and for pigment in paints, varnishes, water colors; ferric dichromate, used for water and oil paints cement paint and green pigment; ferric ferrocyanide, used for paint pigments and for ink and laundry bluing; ferric hydroxide, used for pigments, medicinals, and as a gas absorber; ferric nitrate, used for tanning, textile dyeing mordant, weighting silks; ferrous chloride, used for dyeing and as mordant in textile printing; ferrous sulphate used for inks and dyes, pigments, dyeing and tanning, water purifying, indigo reduction, photography, wood preservative, fertilizers, disinfectants and for making other iron salts; ferrous sulphide, used for making sulphuric acid and as antidote for certain poisons.
Iron pyrites (see below under Sulphur)	
Lead (large deposits of lead-bearing ores at Bawdwin; these have supported large-scale lead production and export; other known deposits may also offer commercial promise; Burma output ran 70–80 thousand long tons of lead per year, 1936–39)	Refined lead metal: ammunition; bearing metals; brass and bronze; cable covering; calking; casting metal; collapsible tubes; foil; solder; storage batteries; terne plate; plumbing supplies. Antimonial lead: bullet case rod; battery lead; industrial vessel linings. Lead pigments: storage batteries; insecticides; ceramics; paints; oil refining; rubber; varnish; linoleum; ink. Other lead-salts, chemicals, derivatives: textile dyeing, printing, weighting: putty; pyrotechny; manufacture of matches and explosives; "anti-knock" for gasoline; numerous drugs; many other products.
Manganese (promising deposit near Ho Pong; other reported deposits also being investigated; some commercial exploitation to date)	Many ferrous alloys; manganese bronze; depolarizer in dry batteries; glass; enamels; paints; varnish dryers; dyes and mordants; fertilizer (agricultural manganese sulphate); leather processing; disinfectants; decorating porcelain and china; pigments in rubber products; drugs.
Molybdenum (no deposits of molybdenum as such known in Burma; some recovered as byproduct in mining and milling of tin and wolfram ores)	Ferrous alloys; pigments and colors; welding rod coatings; filaments, screen-grids for electronic devices; ceramic glazes; chemical reagents.
Mercury (there have been rumors, according to Clegg, of cinnabar mercury ore deposits in the Shan States and Tenasserim; but to date there is no clear evidence of occurrences	—
Monazite (some occurrences of monazite sands reported in Burma, but so far of doubtful commercial value)	Monazite sand the commercial source of the cerium group (the so-called "rare-earth minerals"), consisting of cerium, lanthanum, praseodymium, terbium, yttrium, illinium, and samarium. These made into various alloys, of which the most important (cerium standard alloy) used in lighter flints (spark metal); tracer bullets; electronic tubes; aluminum and magnesium alloys; glass; catalysis in ammonia manufacturing; aniline black; medicals and pharmaceuticals. Oxide, hydrates and fluorides of the rare-earth minerals are used in cores for carbon arc electrodes; special optical glass; glass polishing; miscellaneous chemical compounds. Monazite sands are also a source of thorium, a radioactive element used in X-ray work, mantles for petrol pressure lamps, and as raw material for manufacture of atomic bombs.
Nickel (only known source in Burma is in complex Bawdwin ores, which yield nickel upon treatment abroad; total Burma nickel speiss output ran 3–4 thousand long tons annually 1936–39)	Nickel pig, ingots and shot (granules); bars; rods and tubes; nickel oxide, stainless steels and other nickel-steel alloys; nickel silver (German silver); nickel-chrome electrical resistance wire; nickel salts and compounds; copper-nickel alloys; monel metal (copper - nickel - iron - manganese alloys). Nickel and its salts and compounds also used in plating; coinage; electrotypes; storage batteries; telegraph magnets; lightning rod tips; electrodes and electrical contacts; spark plugs; machinery parts; bearings; fats

Metallic Mineral Raw Materials (contd.)	*Principal Manufactured Products*
	and oils hydrogenation catalysis; ceramic colors and glazes; inks; sun fast pigments in paints, lacquers, cellulose compounds, and cosmetics; porcelain painting, blackening zinc and brass; medicinals and pharmaceuticals.
Platinum and iridium (these metals occur in some of the gold-bearing sands of Burma; apparently no commercial production to date)	Elemental platinum metal used for spinnerets for glass fiber and rayon; laboratory ware; jewelry and watches; incandescent bulbs; electrolytic apparatus; dentistry; pyrometers; thermocautery, catalyst and deoxidizing agent. Platinum salts and compounds used for platinum plating; photography: platinum mirrors; relief etching of zinc; indelible ink; ceramic and glass lusters; X-ray apparatus. Iridium used for alloying with platinum and for tips of gold pen points.
Silver (recovered in significant commercial quantities from Bawdwin ores and as by-product of mining lead and zinc ores in Shan States; other occurrences also likely in Burma)	Coinage; photography; electrical appliances; bearings; military insignia; solders and brazing alloys; silverware; jewelry; watch cases; religious articles; pens and pencils; mirrors; medical and dental supplies; sterilizing water; silver plating; sympathetic and indelible inks; hair dyes; porcelain coloring; ivory etching; chemical reagents; pharmaceuticals.
Tin (about one third of large prewar output recovered from ores of Mawchi mines in Kayah State; many other smaller mines; dredging operations have been conducted in Tenasserim Peninsula; output of concentrates around 7,000 long tons per year, 1936–39)	Elemental tin metal used for tin plate; terne plate (lead and tin); solder; babbitt; bronze and brass; collapsible tubes; lining; foil and powder; chemicals; pipe and tubing; type metal; galvanizing; bar tin; white metal; pewter; other alloys. Tin as stannic chlorides used for mordant; fabric dyeing, weighting silk, electrolytic tinning; colors; silvering glass; organic synthesis. Tin as stannic oxide used for polishing glass and metals; manufacture of ruby glass; enamels and pottery; putty; mordant in printing and dyeing textiles; nail polishes. Tin as stannic sulphide used for gilding and bronzing metals, gypsum, wood and paper.
Tungsten (closely associated with tin-bearing ores in Burma so that occurrence and exploitation pattern conforms to that of tin as given above; prewar output of 7-9 thousand long tons annually of concentrates 1936–39)	Ferrotungsten alloys for high speed cutting tools; tungsten metal powder; tungsten white metal; gun metal (tungsten-manganese-copper); lamp filaments; phonograph needles; contact points for automotive telegraphic and electronic apparatus; tungsten-iron magnet alloys; as tungsten trioxide, for manufacture of tungstates for X-ray screens and for fireproofing fabrics; as sodium tungstate for fireproofing and waterproofing fabrics and for preparation of complex tungsten compounds and reagents.

Metallic Mineral Raw Material (contd.)	*Principal Manufactured Products*
Zinc (Bawdwin mine only present commercial source in Burma; prewar zinc concentrate output of Bawdwin ran 60–75 thousand long tons per year, 1936–39; a large deposit of zinc carbonate recently found at Lough Keng, southern Shan States)	Elemental zinc metal used for galvanized products; brass products; zinc-base alloy products; rolled zinc products; zinc castings; wet and dry batteries; desilvering lead; light metal alloys; zinc dust; bronze powder; gold extraction by cyanide process; manufacture of sodium hydrosulphite for use as bleaching agent for soaps and straw, and as reducing agent dye remover. Zinc chloride used for deodorants; disinfectants and embalming fluids; wood preserving, especially railway sleepers; fireproofing lumber; soldering fluxes; etching metals; manufacture of parchment paper, artificial silk, dyes, activated carbon, cold water glues and vulcanized fiber; galvanizing, browning and copper-plating iron and steel; magnesia cements; petroleum refining; cement for metals and facing stone, mordants in textile dyeing and printing; crepe and crimping fabrics; mercerizing cotton; sizing and weighting fabrics; vulcanizing rubber; solvent for cellulose; dehydrating agent; medicinal uses. Zinc sulphate used for mordants in cotton textile printing and dyeing; paint and varnish processing; rayon manufacturing; preserving wood and skins; paper bleaches; clarifying glue; agricultural sprays and fertilizers; electro-galvanizing; manufacture of other zinc salts and chemical and metallurgical reagents. Zinc sulphide used in pigments for paints, oilcloth, linoleum, leather and dental rubbers and for X-ray and television screens. Lithopone (a white pigment consisting of zinc sulphide, barium sulphate, and zinc oxide, used for paint pigment, as component of lithopone and otherwise); cosmetics; driers; quick-setting cements, including dental cements; opaque glass and some types of transparent glass; enamels; automobile tires; white glue; matches; white printing inks; porcelains; chemical reagents; and pharmaceuticals.

Non-Metallic Mineral Raw Materials	*Principal Manufactured Products*
Amber (only commercial source in Burma has been in Myitkyina district; a few other small, untested deposits)	Jewelry, costume jewelry and related products.
Asbestos (no deposits of commercial size yet found in Burma; a few known minor occurrences)	Asbestos-cement products, including roofing, wallboard and pipe; fire-resistant textiles; lime silica high temperature insulation; brake linings and clutch facings; pipe covering and cement; paper, millboard, rollboard, textiles, yarn and packing.

Non-Metallic Mineral Raw Materials (contd.)	*Principal Manufactured Products*
Clays and kaolin (numerous deposits, including a few rich in kaolin, now being worked; a large kaolin deposit reported in Lower Chindwin district; a fire-clay deposit reported near Moulmein; many other deposits of various types)	Common and face brick; hollow building tile; agricultural tile; roofing and floor tile; chemical brick and rings; china and chinaware; porcelain and semi-porcelain ware; glass melting pots; ornamental tiles; spark plugs; pigments and pigment bases and fillers; filler in paper manufacture; filler in rubber manufacture; cosmetics, polishing agents; special refractories; dental cements; glass industry.
Coal (large deposits of subbituminous coal in Kalewa area; also other deposits possibly including some cokable coal in Shan States; no significant commercial production hitherto; mining of Kalewa deposits planned for near future)	Briquettes for domestic use; industrial fuel for use (to an extent to be determined) in electric power utilities, railroads, steel and rolling mills, cement plants, coal-gas retorts, beehive coke ovens, by-product coke ovens; organic chemicals.
Corundum (according to Clegg there has been commercial extraction of corundum or natural alumina as by-product of gem stone output of the Mogok mines)	Abrasives.
Gem stones (rubies, sapphires and spinels the major gem stones of Burma; all these come mainly from Mogok area; some rubies have also been found in the Sagyin Hills, north of Mandalay, and in Nanyaseik area, northwest of Myitkyina; semi-gem stones, including apatite, aquamarine, chrysoberyl, moonstone, peridot or chrysolite, garnet, lapis lazuli, quartz, and rubellite or red tourmaline are also found in Burma, mainly in the Mogok area)	All gem stones and semi-gem stones listed at left used in jewelry and related products; apatite, composed of calcium phosphate-fluoride, also used as source of certain phosphorous compounds; garnet used as an abrasive; quartz, composed of silicon dioxide, also used for glass manufacture, steel manufacture, sandblast sand.
Grinding media (rounded flint pebbles probably available from mountain streams on slopes of Shan Plateau and in north Burma)	Reduction grinding of pottery clays, feldspar, silica sands, other minerals.
Jade (jade mines in Myitkyina area have been worked from time immemorial; jade has also been produced in at least four other districts in northern Burma; total output of jade, large in prewar years, was small in 1949 and nil in 1950)	Semi-precious stones of considerable value.
Kaolin (see above, clays and kaolin)	
Limestone (found throughout most of eastern Burma, from the Tenasserim north; also at other points in Burma; deposits at present worked on a large scale near Thayetmyo and on a small scale at many places)	Limestone (composed of calcium carbonate), burned lime (calcium oxide), or hydrated line (calcium hydroxide) used for agricultural lime; mason's lime; plasterer's lime; chemical and industrial acid neutralization, manufacturing other alkalies; asphalt and other bitumens; bleaches; brick-making, calcium carbide; cyanamide; chromates and bichromates; purification of coke gas and other coke oven by-products; explosives; food processing, including dairies, gelatin, stock feed; deodorizing vegetable oils; glass manufacturing; glue; lubricating grease; insecticides, fungicides and disinfectants; magnesia; medicines and drugs; ferrous and nonferrous metallurgical flux; ore concentration; wire drawing; solid coating; paints; paper mills; including bleach; petroleum refining; rubber manufacture; salt refining; treatment of sewage and industrial wastes; soap and fats; sugar refining; tanneries; textiles; varnishes, water purification; wood distillation; alcohol, bromine; cement manufacture; photographic supplies; precipitated calcium carbonate; dicalcium phosphate; polishing compounds; retarders; rock wool; sulphur; tobacco; wool, pulling; refractories.
Mica (some mica occurs near Thabeitkyin in Katha district, and along the Indaw River in Myitkyina district; according to Clegg, that from the former source is in small brooks, and that from the latter is in large brooks but is very much cleaved and strained; mica also occurs in Kachin State)	Block, sheet and punch mica used for capacitors; spark plugs; communications instruments; insulations. Ground mica used for roofing; asphalt mats; cable and telephone wire insulation; paints for water proofing textiles; wall paper; rubber; plastics; molded electrical insulation; building insulation; axle grease and oil manufacture; annealing metals; pipe line enamel; oil well drilling; welding; mica splittings used for stove and lantern windows and in-built form for molding plates for commutator rings; channels and mica tube; heater plates; segment plates; flexible insulating tape.
Ochre (occurs in a number of places in Burma, Clegg reports a deposit up to 30 ft. thick in the area of Myingyan; apparently no commercial exploitation to date)	Extensively used for paint pigment; cement additive; filler in linoleum and oilcloth; coloring for plastics, calcimine, stucco, cast stone, ceramic glazes.
Petroleum (bulk of production has been in Magwe area, but also some output at a number of other points; total Burma output in 1951 was 708,000 barrels, or about one tenth of prewar and much below present Burma domestic consumption)	Gasoline; kerosene; fuel oils; lubricating oils; waxes used for paper and paper produce manufacture, candles, sealing materials, etching and engraving, modeling, pattern-making and waterproofing and coating various products; petroleum coke for industrial fuels and domestic heating and cooking; asphalt; liquified gases used for industrial and domestic fuels and for rubber and chemicals manufacturing; liquid and solid petroleum; isopropyl alcohol; medicinals; a wide variety of other organic compounds.
Phosphate rock (no deposits known as yet in Burma)	—

Non-Metallic Mineral Raw Materials (contd.)	*Principal Manufactured Products*
Salt (no solid beds of sodium chloride, or rock salt, known to exist in Burma; most of Burma salt output is from evaporation of sea water, which is done on large scale at a number of points, especially in the Tenasserim and at Akyab and other Arakan coast points; salt also produced on small scale basis in central and northern Burma by evaporation of natural inland brines)	Sodium chloride used for chlorine and bleaches; soda ash; dyes and organic chemicals; soap precipitant; textile processing; hides and leather; meat packing; fish curing; dairy products; other food processing and preserving; refrigeration; livestock; dust and ice control for highways, railroads, airports; table and household uses; water treatment; agricultural uses; source of a number of manufactured sodium compounds, of which the following are most important: sodium acetate used for photography; dyeing mordant; thermos bottles; chemical reagents; sodium aluminate used for white glass; soap, building stone hardening; water softening. Sodium bicarbonate used for manufacture of carbon dioxide; fire extinguishers; baking powder; effervescent salts; cleaning compounds; manufacture of other sodium salts. Sodium bisulphite used for bleach and disinfectants; dyeing; paper manufacturing; soap stripper in laundering; coagulant for rubber latex; fermentation industries. Sodium borate used for soldering; glazes and enamels; tanning; cleaning compounds; preservatives; fireproofing. Sodium bromide for gold solvent. Sodium bromide used primarily in photography. Sodium carbonate used for glass manufacture; soap manufacture; wool washing; linen and cotton bleaching; water softening; photography; as chemical reagent and for manufacture of other sodium salts. Sodium chlorate used for explosives; matches; dyeing and printing fabrics; leather tanning and furnishing; weed killers; oxidizer in dye manufacture. Sodium cyanide used in metallurgy of gold and silver; electroplating baths; fumigant; case hardening steel; hydrocyanic acid manufacture. Sodium fluoride used as disinfectant; insecticide; preserving wood; paste and mucilage. Sodium nitrate and other nitrates used in manufacture of nitric acid; as catalyst in sulphuric acid manufacture; fertilizers; glass; pottery enamels; smoking tobacco; meat pickling. Sodium sulphate used for paper-making; textile dyeing and printing; freezing mixtures; standardizing dyes. Sodium sulphide used for artificial soil manufacture; dyeing; hide dehairing; dye manufacture; rubber manufacture; engraving and lithography. Sodium sulphide used for photography developer and fixature; bleaching wool, straw and silk; generating sulphur dioxide gas; dyes; silvering glass; paper manufacturing; food preservation.
Sand, glass (some 360,000 tons of iron-free glass sands estimated to be available in northern Mergui Archipelago; reported deposits in southern Mergui Archipelago and in Kachin States also being investigated	Glass products.
Sand, other (molding sands found near Rangoon and perhaps elsewhere in Burma; sand suitable for general concrete work and other purposes found in many parts of Burma)	Molds for metallurgical casings; concrete; mortar; other construction and paving applications; grinding and polishing; refractory sands; engine traction sand; filtering.
Sodium sulphate (main known sources are brines of Yega Lake, near Mandalay, and waters near Bawgyo, Northern Shan States)	See under Salt.
Stone, building, miscellaneous (granite and gneiss, laterite, limestone, sandstone and trap rock are found in various parts of Burma; white marble available from Sagyin Hills, north of Mandalay)	Construction.
Sulphur (no known deposits of elemental sulphur in Burma; minor occurrences, probably of no economic importance, of hydrogen sulphide and of iron pyrites containing some 53 % sulphur; sulphur in form of sulphuric acid may be by-product of proposed electrolytic reduction of zinc in Burma	As elemental sulphur, used as raw material for fertilizers; insecticides; pulp and paper industries; explosives; dyes and coal tar products; rubber; paints and varnishes; food products; vulcanizing; plastics; bleaching; medicinals; manufacture of sulphuric acid, sulphites and other chemicals. As sulphuric acid, used for petroleum purification; chemicals; coal tar products; iron, steel and other metallurgy; paints and pigment; industrial explosives; rayon and cellulose film; textiles; parchment paper; glue.
Talc (talc formerly produced near the town of Minbu on the Irrawaddy River; these mines abandoned; additional deposits may exist in Burma)	Insecticides; paper; roofing; rubber manufacture; toilet preparations; refractories; plaster; insulation; bleaching; mine and sawing dust; textiles; panels and switchboards; soap lubricants; ceramics; foundry facings; non-reflecting paints; metal workers' crayon; blackboard pencils.

2. INDUSTRIAL PRODUCTS FOR POSSIBLE MANUFACTURE IN BURMA

To assure a comprehensive review of the industrial potential of Burma, an independent check list of products and processes was compiled. This list was derived from a complete tabulation of manufactured products published by the United States Bureau of Census, reduced to include those products and processes that, because of the raw materials available and conditions existing in Burma, appear to warrant consideration in an ultimate industrial development.

TABLE XXII – 2

INDUSTRIAL PRODUCTS FOR POSSIBLE MANUFACTURE IN BURMA

Food and Kindred Products
- Meat packing
- Condensed and evaporated milk
- Fishing industry (canned fish)
- Flour and other grain-mill products
- Prepared foods (including mineral) for animals and fowls
- Rice cleaning and polishing
- Sugar
- Cooking and other edible fats and oils
- Oleomargarine

Tobacco Manufactures
- Cigars
- Cigarettes
- Pipe tobacco

Textile-Mill Products and other Fiber Manufactures
- Cotton manufactures
- Knit goods
- Dyeing and finishing textiles
- Jute goods (except felt)
- Cordage and twine
- Household furnishings (except curtains, draperies and bedspreads)
- Canvas products

Lumber and Timber Basic Products
- Logging
- Sawmills, veneer mills and cooperage
- Planing and plywood mills

Furniture and Finished Lumber Products
- Household furniture
- Office furniture
- Public building furniture
- Laboratory, hospital and other professional furniture partitions, shelving, cabinet work and office and store fixtures, wooden containers
- Baskets for fruits and vegetables
- Rattan willowware and baskets other than vegetable and fruit baskets
- Cigar boxes: wooden, part wooden
- Wooden boxes except cigar boxes
- Cooperage
- Tea chests
- Window and door screens, shades and venetian blinds
- Caskets, coffins, burial cases, and other morticians' goods

Miscellaneous Wood Products
- Excelsior
- Cork products
- Matches
- Wood preserving
- Lasts and related products
- Mirror frames and picture frames
- Wood products not elsewhere classified

Paper and Allied Products
- Pulp, paper and paperboard
- Converted paper products
- Coated and glazed paper
- Envelopes
- Paper bags
- Fiber cans, tubes and similar products
- Paperboard containers and boxes
- Die-cut paper and paperboard, and converted cardboard
- Wallpaper
- Converted paper products not elsewhere classified

Printing, Publishing and Allied Industries
- Newspapers
- Periodicals
- Books
- General commercial (job) printing
- Lithographing and photo-lithographing
- Greeting cards
- Gravure, rotogravure and rotary photogravure
- Bookbinding and related industries

Service Industries for the Printing Trades
- Machine and hand typesetting
- Engraving (steel, copperplate and wood); plate printing
- Photograving not done in printing establishments (including preparation of plates)
- Electrotyping and stereotyping, not done in printing establishments

Chemicals and Allied Products
- Paints, varnishes and colors
  - Paints, varnishes and lacquers
  - Colors and pigments
- Cottonseed oil, cake, meal and linters
- Soyabean oil, cake and meal
- Fish and other marine oils, cake and meal
- Vegetable and animal oils
- Drugs, medicines, toilet preparations, insecticides and related products
  - Drugs and medicines (including drug grinding)
  - Perfumes, cosmetics and other toilet preparations
  - Insecticides, fungicides and related industrial and household chemical compounds
- Soap and glycerin
- Hardwood distillation, charcoal and naval stores
  - Hardwood distillation and charcoal manufacture
  - Wood naval stores
  - Gum naval stores (processing but not gathering or warehousing)
- Fertilizers
- Plastic materials
- Salt
- Compressed and liquified gases not made in petroleum refineries or in natural gasoline plants
- Chemicals sodium sulphate
- Ammunition
- Candles
- Products of petroleum and coal
  - Fuels, oils and petrol
  - Fuel briquettes
- Coke and by-products
  - Beehive coke
  - Oven coke and coke-oven by-products
- Paving and roofing materials
  - Paving blocks and paving mixtures; creosoted, wood and composition
  - Roofing, built-up and roll; roof coating (except paint)
- Rubber products
  - Tires and inner tubes
  - Rubber boots and shoes
  - Reclaimed rubber
  - Rubber products not elsewhere classified
- Leather, tanned, curried and finished
- Footwear (except rubber)

Stone, Clay and Glass Products
- Flat glass
- Glassware, pressed or blown
  - Glass containers
  - Tableware, pressed or blown glass
- Cement
- Brick
- Roofing tile
- Floor and wall tile (except quarry tile)
- Sewer pipe and kindred products
- Clay refractories, including refractory cement (clay)

Stone, Clay and Glass Products (contd.)
- Pottery and related products
  - Vitreous china plumbing fixtures
  - Hotel china
  - Whiteware
  - Porcelain electrical supplies
  - China firing and decorating
  - Pottery products not elsewhere classified
- Concrete products
- Wallboard and wall plaster, building insulation, and floor composition
- Lime
- Asbestos products (except steam packing and pipe and boiler covering)

Iron and Steel and their Products, except Machinery
- Tin cans and other tinware
- Wire products
- Cutlery, tools and hardware
- Enamelled iron sanitary ware and other plumbers' supplies
- Heating and cooking apparatus, except electric
- Firearms
- Screw-machine products and wood screws

Nonferrous Metals and their Products
- Primary smelting and refining of nonferrous metals
- Alloying and rolling and drawing of nonferrous metals except aluminum
- Secondary smelting and refining of nonferrous metals and alloys
- Silverware and plated ware
- Aluminum ware, kitchen, hospital and household
- Aluminum products (including rolling and drawing and extruding)
- Sheet-metal work
- Electric lamps
- Batteries, storage and primary (dry and wet)

Machinery
- Agricultural machinery
- Machine-shop products
- Machine-shop repairs
- Railroad equipment
- Ship and boatbuilding and repairing
- Musical instruments and parts
- Toys and sporting and athletic goods
  - Games and toys
  - Dolls
  - Children's vehicles
  - Sporting and athletic goods
- Buttons
- Brooms
- Brushes
- Fabricated plastic products
- Umbrellas, parasols and canes
- Tobacco pipes and cigarette holders

3. MARKETING POTENTIAL

As neither the raw material list, nor the products and processes list, reflects market demand, a study was made to assess the market potentialities of Burma. This study was based principally upon a review of all imports and exports of the Union of Burma, both prewar and postwar. Considerable research was required to subdivide general classifications into minor commodity classifications in order that the types and grades of major commodities might be determined. The information on imports was supplemented by investigations of the use or consumption of commodities produced or manufactured nationally. The existing national manufacturing industrial plant was investigated wherever possible to determine its capacity and efficiency. Based upon data from the sources outlined above, estimates were made of the future market for each major commodity under consideration.

The raw materials list and the product and process list were cross checked and the surviving consolidated product list was checked against the market list. This procedure eliminated products for which there was little or no apparent demand in Burma, and raw materials required for the products which were eliminated. Products were deleted in other cases where the supporting raw materials were lacking.

The final list became the foundation for an industrial development program for the Union of Burma.

C. AN INDUSTRIAL DEVELOPMENT PROGRAM FOR BURMA

1. THE BASIC PROGRAM

A study of the final list of products revealed that in many cases one or more were related, being produced from the same basic raw materials, or from combinations of primary, and/or secondary products, stemming from the same or similar raw materials. These related products were arranged into groups based upon the use of raw materials. This allowed an entire related group to be treated as a single project. The economics of manufacturing related products in single manufacturing plants influenced this grouping.

An evaluation was made of all factors influencing the site selection for certain key industries. It was found that one should be located in or near Akyab, one near Myingyan, and others in the Rangoon area. Establishing the locations for these key industries also determined the locations of other related industries. The establishment of three primary industrial centers, one each in the Akyab, Myingyan and Rangoon areas, was found to be the optimum arrangement for an industrial development program.

These groupings are favorable from all industrial viewpoints, and are equally favorable from a social point of view. A dispersion of industrial development is needed to promote the welfare of the interior and coastal regions of Burma.

The ramifications of the relationships between the groups of industries manufacturing products stemming from more or less similar raw material sources, and between other industries, comprising the industrial development program, were so complex that it was difficult to visualize them.

To facilitate the study of the industrial development program, and to clearly present the entire program so it could be easily understood, the complete program was reduced to graphic form. The master chart on which the program is outlined, is reproduced here in five plates entitled, "Projected Industrial Development of Burma." The master chart is divided into three major industrial groups centering on Akyab, Rangoon and Myingyan, and shows each major industry, the basic raw materials required for the manufacture of its products, and the minor industries which are dependent upon it (see Plates Nos. 1 to 5).

It will be noted that 45 major projects have been included in the plan. It must not be assumed that all are recommended for immediate or near future implementation. The chart was prepared to permit comprehensive consideration of the products that may be made from indigenous raw materials, to show the relationship and interdependence between the various industries, and to show the minor industries that can or should be developed after the products of the major industry become available. Each project, major or minor, must be investigated separately as to its economic feasibility, including market demand, probable cost of its manufactured product in competition with imports, its value to the country from the viewpoint of self-sufficiency, its dependence upon supporting industries, and other pertinent factors that may vary with each case. There are several regional duplications of the charts where it appears uneconomical to ship products from one industrial area to another.

The chart includes some projects in the field of mineral development and some existing industries, shown to present the over-all industrial picture, to show possible sources of products required by the included industries, and to indicate uses for industrial products.

Certain projects are impractical if other projects, not included in the master program, are not implemented. The fertilizer or ammonia chemical projects (Nos. 42, 44, and 45) depend upon the Kalewa coal project. Others would be affected if the hydroelectric power projects are not constructed.

Project reports have been prepared for certain of the process groups, and for major and minor industries. These projects are discussed in brief form in the following sections.

a. The Akyab Industrial Group

The availability of low cost power from Saingdin Falls and the decision to establish the new pulp and paper factory at Ponnagyun, thirteen miles above Akyab, on the west bank of the Kaladan River, were the primary factors in selecting Akyab as the center of a new industrial development.

The establishment of the pulp and paper industry at this point will require the location of the supporting caustic chemical industry and related industries in the same locality. The major supporting raw materials for this group, bamboo, salt and limestone, are all located within reasonable shipping distances by water. The deep Kaladan River affords excellent harbor facilities for ocean vessels bringing in the necessary imported raw materials and fuel, for outbound shipments of finished products in either domestic or export movement, and will be used to bring bamboo to the plant site. Water and labor are available in abundance.

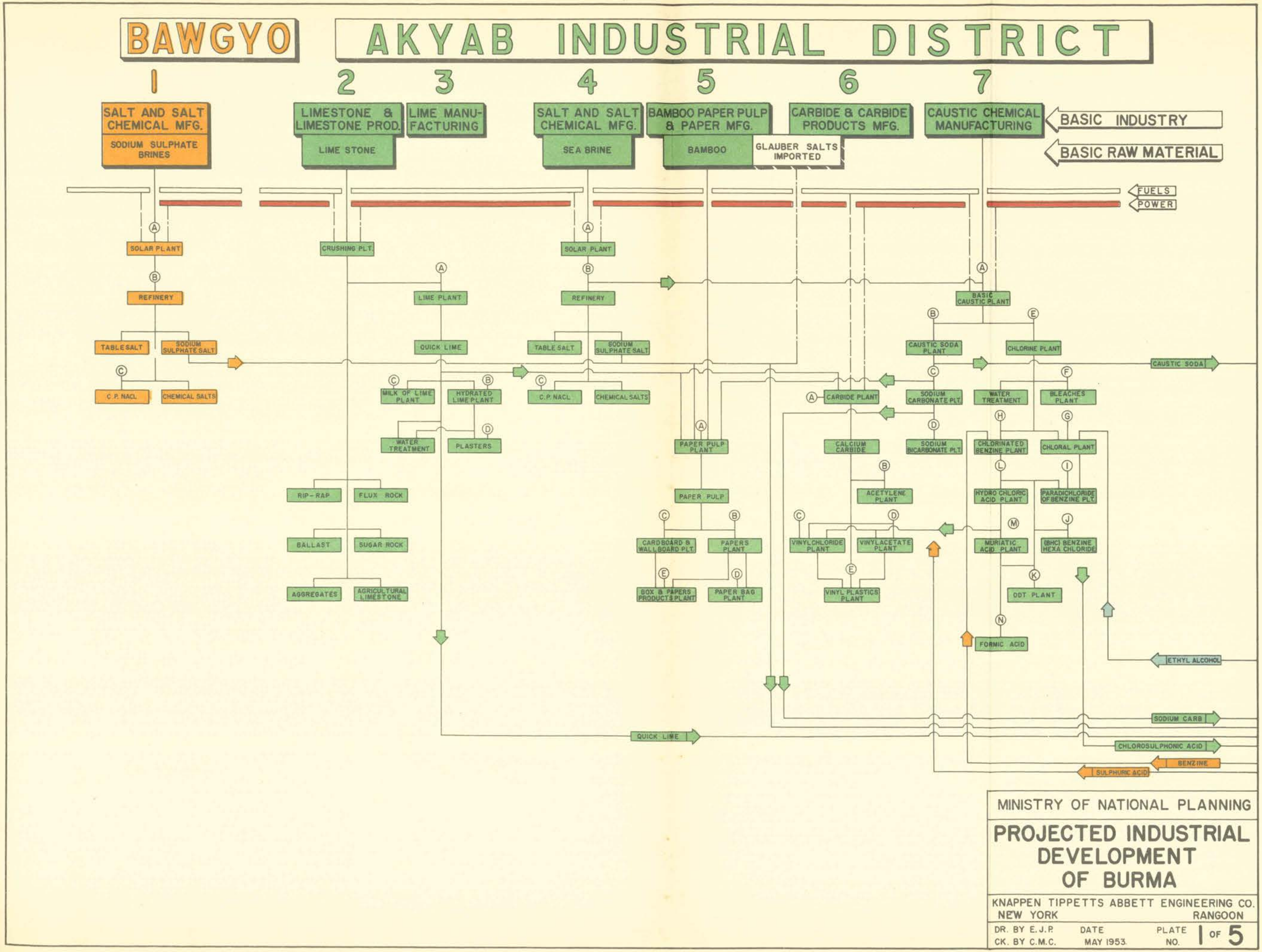
Akyab is also the important commercial city of the Arakan Division, which is isolated from central Burma by a long chain of high mountains. Like Rangoon, it is the seaport, industrial and distribution center for the western coastal area and the northwestern part of Burma.

The establishment of these new industries in this important section of Burma will do much for its future growth and development. The projects to be included in this industrial district are:

(1) Sodium Sulphate

Sodium sulphate is a material required for the operation of the projected pulp and paper factory. It is not recommended that this chemical be produced in Burma in the immediate future. During the initial stages of the operation of the pulp and paper factory, the chemical in the form of Glauber's salts will be imported. The only source of sodium sulphate known in Burma, at the present time, in commercial quantities is in the brines of Yega Lake, which contains roughly about 0·91% of the chemical. Investigation of the possibilities of solar and heat extraction of the salt indicated that its cost would be too high, particularly because of the great distance from the lake located in central Burma to the paper factory site above Akyab, via the Irrawaddy River.

It is recommended, however, that exploratory drillings be made under the supervision of a qualified geologist in an effort to find the vein or lode from which the salt is apparently leached. Such explorations have been common practice in other countries in the past and have successfully located subterranean deposits of common salt. If an appreciable subterranean deposit of sodium sulphate is found, and it is not too far below the ground surface, mining may result in a supply of salt at very low cost. If a deposit is found at a depth which precludes shaft mining, one of the conventional methods is to pump water into the deposit, obtain a saturated solution and evaporate the outflow to dryness. If a subterranean deposit of



BAWGYO
AKYAB INDUSTRIAL DISTRICT
1
SALT AND SALT CHEMICAL MFG.
SODIUM SULPHATE BRINES
2
LIMESTONE & LIMESTONE PROD.
LIME STONE
3
LIME MANU-FACTURING
4
SALT AND SALT CHEMICAL MFG.
SEA BRINE
5
BAMBOO PAPER PULP & PAPER MFG.
BAMBOO
GLAUBER SALTS IMPORTED
6
CARBIDE & CARBIDE PRODUCTS MFG.
7
CAUSTIC CHEMICAL MANUFACTURING
BASIC INDUSTRY
BASIC RAW MATERIAL
FUELS
POWER
SOLAR PLANT
REFINERY
TABLE SALT
SODIUM SULPHATE SALT
C.P. NACL
CHEMICAL SALTS
CRUSHING PLT.
LIME PLANT
QUICK LIME
MILK OF LIME PLANT
HYDRATED LIME PLANT
WATER TREATMENT
PLASTERS
RIP-RAP
FLUX ROCK
BALLAST
SUGAR ROCK
AGGREGATES
AGRICULTURAL LIMESTONE
SOLAR PLANT
REFINERY
TABLE SALT
SODIUM SULPHATE SALT
C.P. NACL
CHEMICAL SALTS
PAPER PULP PLANT
PAPER PULP
CARDBOARD & WALLBOARD PLT.
PAPERS PLANT
BOX & PAPERS PRODUCTS PLANT
PAPER BAG PLANT
CARBIDE PLANT
CALCIUM CARBIDE
ACETYLENE PLANT
VINYLCHLORIDE PLANT
VINYLACETATE PLANT
VINYL PLASTICS PLANT
BASIC CAUSTIC PLANT
CAUSTIC SODA PLANT
CHLORINE PLANT
SODIUM CARBONATE PLT.
SODIUM BICARBONATE PLT.
WATER TREATMENT
BLEACHES PLANT
CHLORINATED BENZINE PLANT
CHLORAL PLANT
HYDRO CHLORIC ACID PLANT
PARADICHLORIDE OF BENZINE PLT.
MURIATIC ACID PLANT
(BHC) BENZINE HEXA CHLORIDE
DDT PLANT
FORMIC ACID
CAUSTIC SODA
ETHYL ALCOHOL
QUICK LIME
SODIUM CARB
CHLOROSULPHONIC ACID
BENZINE
SULPHURIC ACID
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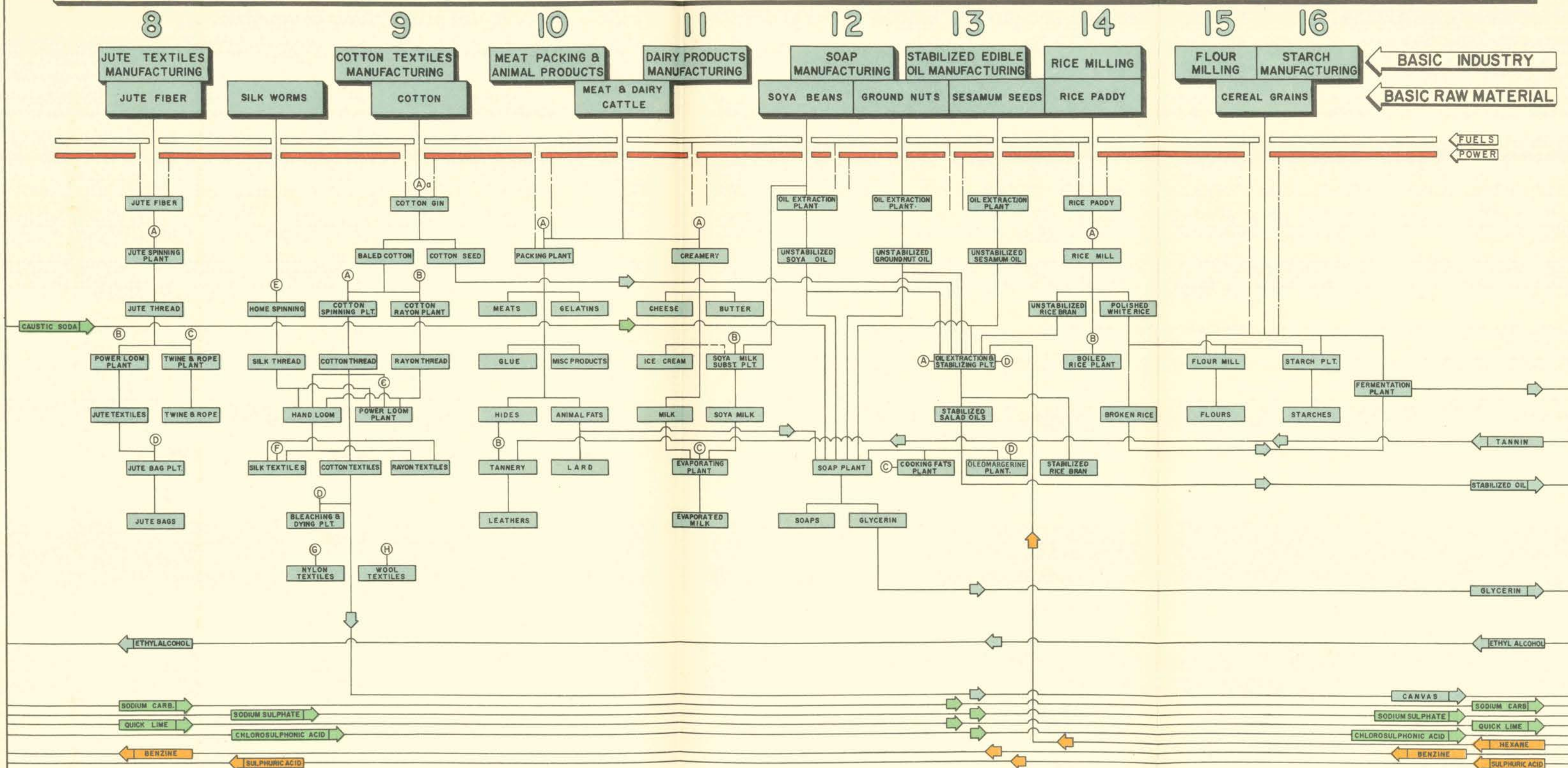
DATE MAY 1953
PLATE NO. 1 OF 5

R A N G O O N   I N D U S T R I E S



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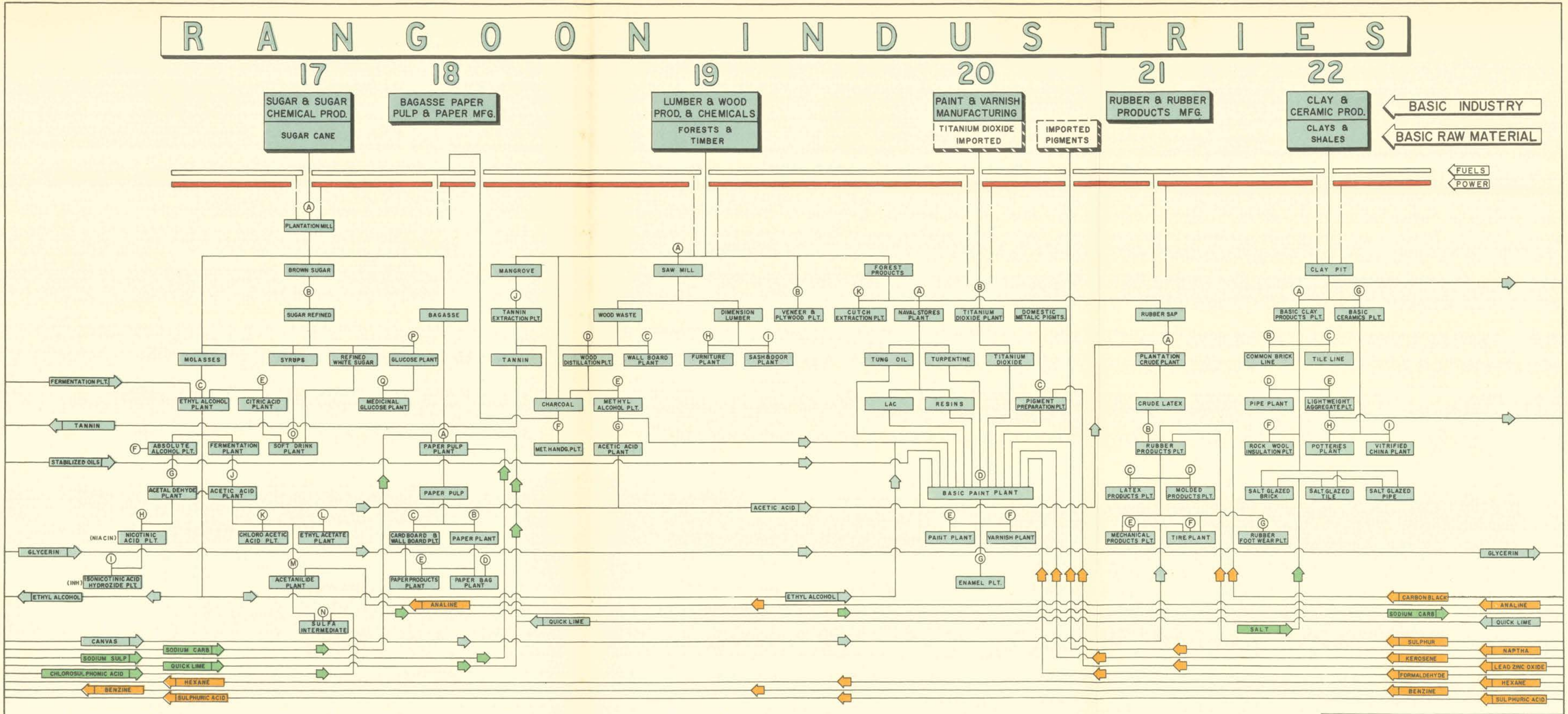

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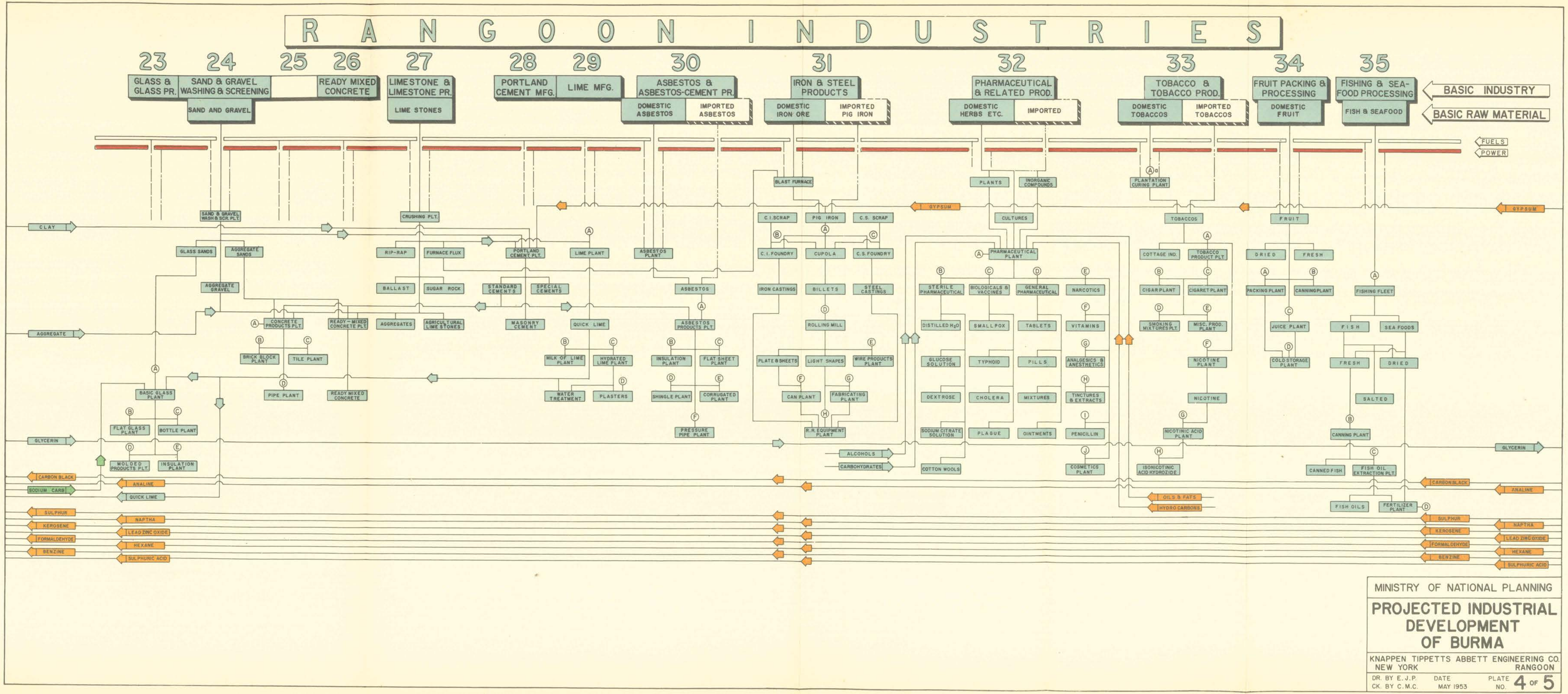

RANGOON INDUSTRIES
23 GLASS & GLASS PR.
24 SAND & GRAVEL WASHING & SCREENING
SAND AND GRAVEL
25
26 READY MIXED CONCRETE
27 LIMESTONE & LIMESTONE PR.
LIME STONES
28 PORTLAND CEMENT MFG.
29 LIME MFG.
30 ASBESTOS & ASBESTOS-CEMENT PR.
DOMESTIC ASBESTOS
IMPORTED ASBESTOS
31 IRON & STEEL PRODUCTS
DOMESTIC IRON ORE
IMPORTED PIG IRON
32 PHARMACEUTICAL & RELATED PROD.
DOMESTIC HERBS ETC.
IMPORTED
33 TOBACCO & TOBACCO PROD.
DOMESTIC TOBACCOS
IMPORTED TOBACCOS
34 FRUIT PACKING & PROCESSING
DOMESTIC FRUIT
35 FISHING & SEA-FOOD PROCESSING
FISH & SEAFOOD
BASIC INDUSTRY
BASIC RAW MATERIAL
FUELS
POWER
CLAY
AGGREGATE
GLYCERIN
CARBON BLACK
SODIUM CARB
SULPHUR
KEROSENE
FORMALDEHYDE
BENZINE
ANALINE
QUICK LIME
NAPTHA
LEAD ZINC OXIDE
HEXANE
SULPHURIC ACID
GYPSUM
SAND & GRAVEL WASH & SCR. PLT.
GLASS SANDS
AGGREGATE SANDS
AGGREGATE GRAVEL
BASIC GLASS PLANT
FLAT GLASS PLANT
BOTTLE PLANT
MOLDED PRODUCTS PLT.
INSULATION PLANT
CONCRETE PRODUCTS PLT.
BRICK BLOCK PLANT
TILE PLANT
PIPE PLANT
READY-MIXED CONCRETE PLT.
READY MIXED CONCRETE
CRUSHING PLT.
RIP-RAP
FURNACE FLUX
BALLAST
SUGAR ROCK
AGGREGATES
AGRICULTURAL LIME STONES
PORTLAND CEMENT PLT.
STANDARD CEMENTS
SPECIAL CEMENTS
MASONRY CEMENT
LIME PLANT
QUICK LIME
MILK OF LIME PLANT
HYDRATED LIME PLANT
WATER TREATMENT
PLASTERS
ASBESTOS PLANT
ASBESTOS
ASBESTOS PRODUCTS PLT.
INSULATION PLANT
FLAT SHEET PLANT
SHINGLE PLANT
CORRUGATED PLANT
PRESSURE PIPE PLANT
BLAST FURNACE
C.I. SCRAP
PIG IRON
C.S. SCRAP
C.I. FOUNDRY
CUPOLA
C.S. FOUNDRY
IRON CASTINGS
BILLETS
STEEL CASTINGS
ROLLING MILL
PLATE & SHEETS
LIGHT SHAPES
WIRE PRODUCTS PLANT
CAN PLANT
FABRICATING PLANT
R.R. EQUIPMENT PLANT
ALCOHOLS
CARBOHYDRATES
PLANTS
INORGANIC COMPOUNDS
CULTURES
PHARMACEUTICAL PLANT
STERILE PHARMACEUTICAL
BIOLOGICALS & VACCINES
GENERAL PHARMACEUTICAL
NARCOTICS
DISTILLED H_2O
SMALL POX
TABLETS
VITAMINS
GLUCOSE SOLUTION
TYPHOID
PILLS
ANALGESICS & ANESTHETICS
DEXTROSE
CHOLERA
MIXTURES
TINCTURES & EXTRACTS
SODIUM CITRATE SOLUTION
PLAGUE
OINTMENTS
PENICILLIN
COTTON WOOLS
COSMETICS PLANT
OILS & FATS
HYDRO CARBONS
PLANTATION CURING PLANT
TOBACCOS
COTTAGE IND.
TOBACCO PRODUCT PLT
CIGAR PLANT
CIGARET PLANT
SMOKING MIXTURES PLT.
MISC. PROD. PLANT
NICOTINE PLANT
NICOTINE
NICOTINIC ACID PLANT
ISONICOTINIC ACID HYDROZIDE
FRUIT
DRIED
FRESH
PACKING PLANT
CANNING PLANT
JUICE PLANT
COLD STORAGE PLANT
FISHING FLEET
FISH
SEA FOODS
FRESH
DRIED
SALTED
CANNING PLANT
CANNED FISH
FISH OIL EXTRACTION PLT.
FISH OILS
FERTILIZER PLANT
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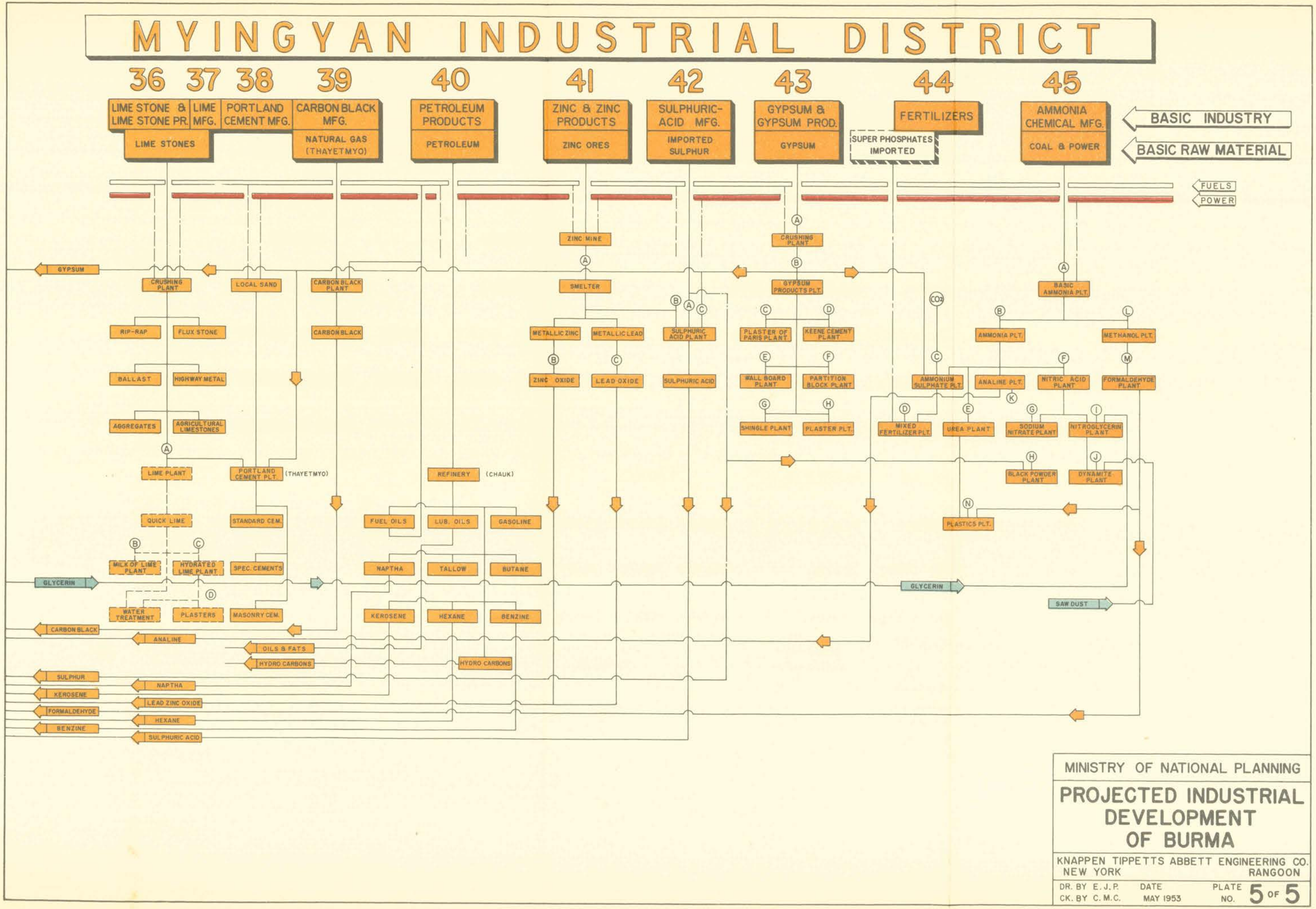

MYINGYAN INDUSTRIAL DISTRICT
36 37 38 39 40 41 42 43 44 45
LIME STONE & LIME STONE PR.
LIME MFG.
PORTLAND CEMENT MFG.
CARBON BLACK MFG.
PETROLEUM PRODUCTS
ZINC & ZINC PRODUCTS
SULPHURIC-ACID MFG.
GYPSUM & GYPSUM PROD.
FERTILIZERS
AMMONIA CHEMICAL MFG.
LIME STONES
NATURAL GAS (THAYETMYO)
PETROLEUM
ZINC ORES
IMPORTED SULPHUR
GYPSUM
SUPER PHOSPHATES IMPORTED
COAL & POWER
BASIC INDUSTRY
BASIC RAW MATERIAL
FUELS
POWER
GYPSUM
CRUSHING PLANT
LOCAL SAND
CARBON BLACK PLANT
ZINC MINE
SMELTER
CRUSHING PLANT
GYPSUM PRODUCTS PLT.
BASIC AMMONIA PLT.
CO2
RIP-RAP
FLUX STONE
CARBON BLACK
METALLIC ZINC
METALLIC LEAD
SULPHURIC ACID PLANT
PLASTER OF PARIS PLANT
KEENE CEMENT PLANT
AMMONIA PLT.
METHANOL PLT.
BALLAST
HIGHWAY METAL
ZINC OXIDE
LEAD OXIDE
SULPHURIC ACID
WALL BOARD PLANT
PARTITION BLOCK PLANT
AMMONIUM SULPHATE PLT.
ANALINE PLT.
NITRIC ACID PLANT
FORMALDEHYDE PLANT
AGGREGATES
AGRICULTURAL LIMESTONES
SHINGLE PLANT
PLASTER PLT.
MIXED FERTILIZER PLT.
UREA PLANT
SODIUM NITRATE PLANT
NITROGLYCERIN PLANT
LIME PLANT
PORTLAND CEMENT PLT.
(THAYETMYO)
REFINERY
(CHAUK)
BLACK POWDER PLANT
DYNAMITE PLANT
QUICK LIME
STANDARD CEM.
FUEL OILS
LUB. OILS
GASOLINE
PLASTICS PLT.
MILK OF LIME PLANT
HYDRATED LIME PLANT
SPEC. CEMENTS
NAPTHA
TALLOW
BUTANE
GLYCERIN
GLYCERIN
WATER TREATMENT
PLASTERS
MASONRY CEM.
KEROSENE
HEXANE
BENZINE
SAW DUST
CARBON BLACK
ANALINE
OILS & FATS
HYDRO CARBONS
HYDRO CARBONS
SULPHUR
NAPTHA
KEROSENE
LEAD ZINC OXIDE
FORMALDEHYDE
HEXANE
BENZINE
SULPHURIC ACID
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PLATE NO. 5 OF 5

commercial importance is found a study should be made of the two methods of extraction mentioned above and a decision made based on economy. Sodium sulphate is available in many countries, including India and Japan, and is fairly cheap if bought and shipped in large quantities. The paper factory's annual requirement will be about 3,000 tons, and, since the factory will be the only large consumer in the immediate future, it is recommended that the salt be imported. At current prices for large shipments the annual expenditure will be about K1,80,000.

(2) Limestone

The operation of the pulp and paper factory requires the use of a considerable quantity of quicklime, which should be made in a lime plant adjacent to the paper factory. A high calcium limestone is required for conversion into quicklime. The rock formation in the Akyab area is entirely sandstone. Consequently limestone must be brought in. Limestone of good quality was reported on Ramree Island, on Cheduba Island, on Ye Island, and near Sandoway, on the mainland.

(a) Ramree island deposits. The Ramree island deposits are all located in the region of the city of Ramree and south. Security restrictions made it impossible to inspect these deposits. The deposits were reported as being extensive, that they were being worked for the manufacture of quicklime. It was reported that all limestone quarried could be transported by country boats to Doratha, the port of call for coastal vessels. A sample of the burned lime was obtained and analysed by the Burma Research Laboratories Ltd., of Rangoon. The analysis follows:

Calcium Carbonate	$CaCO_3$	64·36%
Calcium Oxide	CaO	15·04%
Aluminum Oxide	Al_2O_3	7·92%
Iron		Trace
Silica		0·36%
Moisture		12·32%
		100·00%

The limestone from which this lime was made should be satisfactory for the paper factory use.

(b) Cheduba island deposits. An inspection of some of the deposits on Cheduba Island was made, and samples of two deposits were obtained. The lack of transport on this island, and limited security conditions, prevented inspection of deposits farther inland. One small limestone deposit was found about four and one-half miles inland, to the southwest of the town of Cheduba, near the village of Budaunggwe. The vertical height of the deposit was approximately 40 ft., it was oval in shape with a long axis about 100 ft. and the short axis about 50 ft. The extent of the formation below ground was not determined. Samples of this were analyzed as follows:

Calcium Carbonate	$CaCO_3$	67·22%
Calcium Oxide	CaO	30·85%
Iron Oxide	Fe_2O_3	0·47%
Silica	SiO_2	0·47%
Moisture		0·99%
		100·00%

This is a very good limestone, but the visible deposit is too small to support the operation of the paper factory.

A second deposit which appeared to be coral was inspected. This deposit was much larger, being at least $\frac{1}{4}$ mile long by $\frac{1}{8}$ mile wide, extended about 20 ft. above the ground surface. This deposit was being worked for building stone. The rock was soft and porous, and was easily cut out with a wood saw. Samples of this material were analyzed as follows:

Calcium Carbonate	$CaCO_3$	95·72%
Calcium Oxide	CaO	0·72%
Iron Oxide	Fe_2O_3	0·52%
Silica	SiO_2	1·29%
Moisture		1·75%
		100·00%

This would make excellent lime, and if the deposit proved large enough, would be satisfactory as a limestone source. Larger deposits farther inland were reported, but could not be verified.

It is believed that there is enough limestone on this island of suitable quality, to support the operation of the paper factory. Roads must be built to bring any limestone to the port of Cheduba. The harbor at Cheduba is shallow but would permit the operation of barges of a minimum draft of eight feet at high tide.

The deposits reported on Ye Island, southeast of Cheduba Island, might be more accessible. This is a smaller island, so any inland hauling would be minimized. Also, the water is deeper. These deposits were not inspected, but are believed to be of the same formation as the limestone on Cheduba Island. The distance from Cheduba to the paper factory site would be about 125 miles.

The Sandoway deposits were not inspected, but are believed to be of the same character as the island formations.

Lime for use for water treatment, for plaster, and for mortar, in the Arakan area, could be manufactured from any of the limestones found. The lime plant at the paper factory should include some margin of production for these purposes.

Aggregates for the Akyab area could be produced cheaper from dolomite shingle available between 30 and 40 miles north of Akyab on the Kaladan River.

An additional small amount of limestone will be required for the manufacture of calcium carbide, Project 7. This would come from the same source. Agricultural lime is another possible use if the cultivated land is sour, as it may well be in such a predominantly sandstone area.

An initial production of about 2,400 long tons of limestone per year will be required for producing the 1,500 long tons of quicklime needed by the pulp and paper factory. Other uses should at least double this capacity. This production of 16–20 long tons a day will require only a simple plant. This should be located at the limestone deposit. A small crushing and screening plant of this size, with quarry equipment and trucks will cost about K5,00,000 for the equipment alone. The production cost should not exceed K7.00 per long ton, f.o.b. plant. The cost of delivery from the quarry site to the factory is estimated at K33.00 per long ton, which would make the delivered cost, f.o.b. paper factory, K40.00 per long ton.

A special vessel will probably have to be constructed to carry the salt and the limestone from the production points to the paper factory.

(3) Lime

Because there is no limestone in the Kyaukpyu–Akyab area, no quicklime or hydrated lime is manufactured. The nearest known point of manufacture is near Ramree, on Ramree Island. There is a subnormal use of lime in this area for plaster and for mortar for brick. None is known to be used for water treatment or for sanitary purposes. The pulp and paper factory to be erected near Ponnagyun will require about 1,500 long tons of quicklime per year, or five long tons per day. It is estimated that the other market for quicklime and for hydrated lime will total from five to ten long tons per day.

While it is possible to ship in lime for use in this area, as is now done, the freight on such shipments makes the delivered cost too high for any industrial use at least. It is certain that even a small lime plant could produce quicklime or hydrated lime at a lower delivered price than that of any lime shipped in.

The location of any lime plant in the Arakan district is dependent upon the cost of transporting the raw material and fuel to the plant compared to the cost of transporting the finished lime to the principal market. Power and labor must also influence the selection of a plant site.

The manufacture of quicklime consists of calcining a high calcium carbonate limestone, so that calcium oxide is produced. The burning process drives off a large quantity of carbon dioxide gas and some water. It thus requires almost two tons of limestone to produce one ton of quicklime. If the quicklime is hydrated, which is done by adding water until the quicklime is slaked, almost the original weight of the limestone is regained. Thus transportation makes little difference in delivered cost if hydrated lime is to be made, and the lime plant can be located either at the limestone deposit or at the principal market.

Quicklime will hydrate naturally to some degree in humid climates. It may well be better to manufacture hydrated lime at Ponnagyun as the pulp and paper factory will preferably use quicklime. The lime plant could then supply the paper plant with fresh quicklime, and hydrate the balance of the production. Some economies would result from such a location as the technical staff of the paper plant, its managerial staff, its shops, power and other facilities could be utilized in common, thus reducing the cost of both operations.

Limestone as concrete aggregate could also be made available if the limestone were to be produced and crushed at the limestone quarry. Barges will be required for transporting salt to Ponnagyun. These could be used to transport the limestone as well. Fuel and power and labor would be more available at Ponnagyun than at the quarry site. It is therefore recommended that a lime plant of 15 to 25 long tons per day of quicklime be constructed adjacent to the paper factory, if found to be practical.

A lime plant of this capacity is estimated to cost approximately as follows:

	Kyats
Basic Machinery and Equipment	9,44,000
Electric Motors and Controls	47,200
Electrical Distribution	94,400
Laboratory Equipment	47,200
Shops and Tools (partial)	94,400
Office Equipment (partial)	25,000
Stores Equipment (partial)	25,000
Water, Air, Sewer, and Process Pipe Lines	94,400
Fuel Oil Storage and Pipe Lines	94,400
Automobile Equipment	94,400
	15,60,400
Building Materials	3,87,600
Ocean Freight and Insurance	1,55,000
Engineering, Erection and Construction	7,75,000

	Kyats
Construction Overhead	4,72,000
Contingencies	4,72,000
Total less Real Estate	38,22,000
Real Estate	1,90,000
Total Plant Cost	40,12,000
Working Capital	4,72,000
Total Capital Required	44,84,000

The estimate does not include cost of limestone quarry equipment or of barges. The total cost may be divided between local currency and foreign exchange, as follows:

Local Currency	K15,40,000
Foreign Exchange	K29,44,000
	K44,84,000

It will take about 18 months to complete a lime plant of this capacity, dating from the time engineering services are retained.

The first-year expenditures will consist of acquiring a plant site, grading it, making, a preliminary report drawing up specifications, field engineering, foundation construction work, and initial payments on machinery and materials.

These are estimated to total:

Local Currency	K 6,00,000
Foreign Exchange	K11,00,000
	K17,00,000

Because such a lime plant should be under the same ownership and top management as the pulp and paper factory, it should be financed in the same manner. The two plants will probably be either wholly GUB owned corporations, or owned jointly by GUB and private interests. If a wholly GUB owned corporation, it would be financed by a 100% capital loan made to the corporation by the GUB and secured by the assets of the lime plant corporation. Such a loan would be repaid out of earnings in equal annual installments over the number of years corresponding to the estimated useful life of the machinery and structures. The loan would bear compound interest at the rate of 4% for all local currency advanced, and at 5% for all foreign exchange funds required. In this case a weighted average useful life of the machinery, equipment and buildings has been estimated at 25 years.

The amount of the annual payments required to recover 100% of the capital loaned, including interest, is determined as follows:

	Factor	Annual Payment
Local Currency K15,40,000	·06401	K 98,575
Foreign Exchange K29,44,000	·07095	K2,08,875
Total per year		K3,07,450

This total amount should be charged against production costs on a per ton basis.

No depreciation, as such, should be charged into costs, as it is not intended to establish a capital reserve. Therefore any new capital required would have to be obtained and repaid in the same manner as the original loan. All such wholly GUB owned corporations should be operated as tax free, nonprofit units which would also be exempt from the payment of import duties on machinery, repair parts, or supplies brought into Burma.

If the corporation became a joint venture operation, the financing and operation would be different, as private capital cannot invest unless allowed to make a fair profit with assurance that it can export dividends and capital recovered.

The operating cost, and cost of sales, of the proposed 25 long ton per day lime plant are estimated below. It is assumed that the limestone will cost K40.00 per long ton delivered at the plant site. About 10,000 long tons per year of limestone will be required.

Quicklime	*Annual Cost*	*Cost per Long Ton*
	K	K
Operating and Repair Labor	80,000	
Operating and Repair Supplies	50,000	
Limestone	4,00,000	
Fuel Oil	1,73,000	
Power	35,000	
General Works Expense	50,000	
Administration and OH Expense	50,000	
Insurance	20,000	
Amortization of Loan	2,07,450	
Total cost of Quicklime	10,65,450	
(Divisor 5,000 L.T./Year)		213.09
Hydrated Lime (4,000 L.T./Year)		
Quicklime (3,000 L.T.)	6,38,886	
Operating and Repair Labor	33,600	
Operating and Repair Supplies	20,000	
Power	20,000	
General Works and Expense	25,000	
Administration and OH Expense	25,000	
Insurance	10,000	
Amortization of Loan	1,00,000	
Total Cost of Hydrated Lime	8,72,486	218.12

The cost of paper sacks must be added to all costs except bulk sales. Imported paper bags will cost about K16.00 per long ton of lime. The pulp and paper plant will take delivery in bulk. The total costs would then be as follows:

1,500 L.T. Bulk Quicklime at K213.09	=	K 3,19,635
500 L.T. Sacked Quicklime at K229.09	=	K 1,14,545
4,000 L.T. Sacked Hydrated Lime at K234.12	=	K 9,36,480
Total Annual Cost		K13,70,660

The estimated costs are high compared to the current Rangoon selling prices for quicklime and hydrated lime, and are much higher than the estimated costs for a 100 L.T. per day plant for Rangoon, see Project 29. A very small plant such as the one proposed here cannot produce as cheaply as a larger plant. If the freight rate on lime from Rangoon to Akyab is less than the difference in the manufacturing costs of the two plants, then these products should be manufactured in Rangoon, or at some other point.

The freight rate on Portland cement from Rangoon to Akyab is K75.00 per long ton on the coastal vessels. Using the same freight rate for lime, lime manufactured in Rangoon, delivered at the paper plant, would cost K187.62 for quicklime, and K195.39 for hydrated lime. Both prices are below the estimated costs for the Ponnagyun plant.

The investment in the equipment for the limestone crushing plant, estimated to be K5,00,000 (see Project 1 (2)), would also be eliminated if the lime were manufactured in Rangoon. Also, initially, a single and larger plant at Rangoon would be a more stable investment if the Arakan market were to be included in its market territory.

An alternative method of supplying lime for the paper plant would be to install a vertical lime kiln plant, instead of the more efficient rotary kiln plant estimated here. The investment and manufacturing costs would be less, but the quality of the quicklime would not be as good. Considering all factors, it is recommended that the lime be manufactured in the larger plant in Rangoon as discussed in Project 29. This would be most beneficial for the nation as a whole.

If this freight rate can be reduced by 50% the lime from Rangoon could be delivered at Ponnagyun at about K15250 per long ton, in paper sacks. This is very little above the present Rangoon ex-warehouse price in jute sacks and containers.

(4) Salt

(a) The market. Implementation of an industrial expansion program even on a small scale will increase the demand for salt. Specifically, development of the paper mill, DDT, and other insecticide and repellent manufacturing facilities using chlorine and caustic soda as basic or auxiliary raw materials, will create a demand estimated at 45 tons of salt per day. The importation of only 13 tons of table salt in 1951–52 is indicative of the limited market for this grade. High grade, imported, refined table salt sells for about K3 per pound in the shops. This prices the commodity beyond the reach of most families.

Production costs of 64 salt factories in the Ganga district (Kyaukpyu) average about K90 per 1,000 viss (3,600 lbs.) and the annual outturn is about 1,800,000 lbs. The salt is shipped in bulk to Kyaukpyu, loading and freight being about K25 per 1,000 viss. GUB salt tax is K70 per 1,000 viss making the salt f.o.b. Kyaukpyu K185 per 1,000 viss. High freight rates prevent this salt from reaching Rangoon.

The proposed saltern development is specifically for the Ganga area although general arrangements and techniques are applicable to any sea water extraction operation regardless of location if suitable acreage is available. Some of the existing salterns may be consolidated or modified for higher production rates of purer material supplemented by new evaporating ponds and methods. One refinery may be built to handle the entire output of the existing and new ponds. Details of the project will be given in a project report bring prepared.

(b) Possibility of domestic production. All of the elements necessary for the low cost production of high grade salt are present in the country: the long coast line, a five months' dry season and plenty of marginal land. Salt making is an ancient art which modern technology has improved to the point where salt is one of the cheapest basic commodities in most countries. There are no proven mineral salt deposits in Burma, all salt traditionally being extracted from sea water or brine wells and springs. Salt factories are dispersed in several areas around the coast line and inland near salt springs and lakes.

Salt extraction from sea water has been practiced in Burma for many years. Before World War II, it was produced by private licensed operators under government supervision to insure quality. At present there is no GUB supervision except for the Salt Revenue Service which only collects a tax on all salt produced.

A project report is being prepared, detailing techniques and arrangements used in modern solar salterns for mass production of several grades of industrial and table salts. The scheme detailed in the project is for a 1,000-acre saltern, producing some 35,000 short tons of salt annually. However, efficient salterns can be in any reasonably sized units. A market analysis should therefore precede determination of size.

(c) Economic feasibility

(1) *Description of plant*

A modern solar production unit consists of nine or ten concentrating ponds and several crystallizing ponds. Concentrating ponds should be 15 times the area of crystallizing ponds.

There are several methods of building evaporating ponds. The best method to use in any given area depends upon construction equipment available and topography of the land. One pond found to be efficient is made by building levees (bunds) about four feet high on ground low enough that water may be admitted through floodgates at high tide without pumping. A small clamshell dredger, if available, is particularly suitable for this type of construction.

Concentration ponds may be irregular in size and shape and may, more or less, follow the contour of the land, but crystallizing ponds must be regular in size and shape with flat, well compacted bottoms sloping gently to allow the bittern to drain. Five to seven years are usually required to make a pond system impervious and to bring it to "maturity" after which it can produce up to 40 tons of salt per acre per year.

The production cycle is analogous to a large scale agricultural operation. The first concentrating pond is flooded after the rains have ceased long enough to permit the salt content of the water to return to normal (about 2·6% for the Bay of Bengal). As its density increases due to evaporation, the water in the ponds is moved slowly forward through the concentrating areas, gravity and natural tidal flow being used as much as possible. Algae and other microscopic vegetation cause the ponds to change color, gradually, from blue green through green and yellow to a deep rust. These growths have no deleterious effects.

After traversing the concentrating ponds and having attained a density of 24·6° to 24·0° Baume, the brine is pumped to crystallizing ponds where it is retained until it attains a density of 29°. Between 26·6 and 29°, the maximum quantity of high purity sodium chloride is deposited; most of the calcium sulphate (gypsum) having settled out when the brine had reached 25° in a previous pond. Magnesium salts do not precipitate in quantity before the brine reaches about 30°. Carbonates of calcium, magnesium and iron also are precipitated at about the same time as the calcium sulphate, i.e., at 25° Baume.

The entire crystallizing area is flooded to a depth of 14 inches with saturated brine from the final concentrating (pickle) pond. The level is kept constant until density reaches 29° after which the brine is allowed to flow to the bittern pond. The crystallizing pond is then refilled from the pickle pond, the cycle being repeated until harvesting begins. By using this method of controlled crystallization, about 15% of the sodium chloride is deposited as large crystals, about 98% pure, in a layer four to six inches deep in the crystallizing pond.

Approximately 8,600 gallons of Bay of Bengal water will yield one ton of sodium chloride and 300 gallons of bittern. The harvest from the crystallizing ponds is of sufficient purity for most industrial uses. For special industrial, commercial and human use, the salt is further refined by a series of washings and evaporations to desired purities.

(2) *Capital cost*

The estimated capital cost based on United States prices for a saltern producing 30,000 tons annually is:

Pond Construction	K 1,00,000
Buildings and Equipment	52,20,000
Construction and Erection	15,20,000
Ocean Freight and Insurance	3,15,000
Total	K71,55,000

The estimate foreign exchange expenditure is 60% or K42,93,000.

(3) *Production Cost per Ton:*

Harvest labor 300 men for 60 days at K5.00/day—K90,000	K 3.00
Process labor 50 men for 300 days at K5.00/day—K15,000	0.50
Fuel and Electric Power	40.00
Maintenance and Repairs	1.00
Fixed Charges	
Depreciation on 20 Year Life, Foreign Exchange Capital K42,93,000 at 8·02%—K 3,42,000	11.40
Depreciation on 20 Year Life-domestic Currency Capital K28,62,000 at 7·36%—K2,10,000	7.00
Total Production Cost	K62.90

Present production cost in Ganga factories is about K90 per 100 viss or K62 per ton. These costs are not exactly comparable, as Ganga salt is not refined.

Further, plant capital costs were based on United States prices. Equipment from soft currency sources may be cheaper. Production of 30 tons per acre per season was taken as a conservative figure, as yields up to 40 tons per acre per season are not unusual.

(d) Recommendations. In order that an adequate supply of salt be available when the consumer industries based upon this material are ready for operation, the following implementation program is recommended.

(1) Initiate an instruction program among present saltern operators for improvement of evaporating and crystallizing ponds.

(2) Design and construct a refining plant possibly on a cooperative basis between Government and individual producers.

(3) Enlarge existing salterns in the Ganga district either through existing private owners or by state enterprise.

(4) Further study the salt transport problem. Present transportation facilities preclude widespread distribution.

(5) Undertake geological surveys including drilling in inland areas to locate mineral salt veins evidenced by salt springs, wells and lakes from which salt has been extracted for many years. After location, methods of extraction and refining can be developed.

(5) Bamboo Pulp and Paper

(a) Market. Except for a small amount of hand-made paper, Burma imports all paper and paper product requirements. The four types of paper that comprise the bulk of imports are packing and wrapping, writing, printing and old newspapers used for wrapping merchandise in the smaller shops. Since the manufacture of newsprint is not contemplated it is not included in this report.

It is estimated that average annual consumption of the four types of paper under discussion is 7,000 tons. Burma's 1952–53 population is estimated at 18·99 million; the per capita consumption of the papers mentioned is estimated at 0·8 pounds. A population of 20·8 million is expected by 1960. On the basis of present per capita consumption this would bring annual paper requirement to some 7,600 tons.

It is difficult to estimate with any degree of accuracy an increase in consumption engendered by a rise in the standard of living and availability of a lower cost product. However, the history of paper consumption in most other countries shows a rise proportional to these factors. The increase for Burma is estimated at an additional 20% by 1960. This would result in an annual consumption of 9,100 tons.

Limitation of the types and grades of paper that can be produced from bamboo are technological. The range of possible papers is considerable and is dictated by the process used and by plant design. It is not possible, at present, to produce newsprint from bamboo competitively with the standard imported product made from soft woods. However, a well designed and operated process can produce high grade papers of several types from bamboo competitively.

In addition to domestic markets, export outlets for several grades of paper and pulp exist in some of the countries in the east with which Burma normally trades, India and Japan in particular. Both countries are potential customers for pulp. Japan now imports pulp from both dollar and sterling areas while India, which now produces only about 60% of her paper requirements, would probably become a customer for both pulp and paper. Markets, both domestic and export, are accessible through sea transport. Inland domestic distribution will be by truck and rail following usual channels.

(b) Possibility of domestic production. (1) A project report has been completed on a pulp and paper mill having an annual pulp capacity of 30,000 tons of which 10,000 tons will be converted to paper, the remaining 20,000 tons being available for export. The project report shows that a return of about 16% can be expected on an estimated investment of K6·0 crores of which about K4·1 crores will be in foreign exchange and K1·9 crores in domestic currency. The landed cost of imported papers is such that there is sufficient margin to make the operation attractive.

(2) The basic raw material grows in profusion in Burma. Chlorine and caustic soda, two of the principal chemicals, will be produced at the mill. Other necessary chemicals will be imported. The most attractive feature of establishing a pulp and paper industry in Burma is the vast amount of quickly regrowing (eight years) bamboo, a material that excels many other grasses and grain straws in pulping qualities and paper making characteristics. It is amenable to mechanical harvesting, the most efficient method for which constitutes a problem to be worked out in the course of project design.

The Saingdin Falls hydro development will provide a source of power. Fuel, either oil or coal, will be imported. With the exception of chemicals such as sodium sulphate, resin, alum and others in small amounts, and fuel, adequate resources are available economically within the country to support the operation.

(c) Benefits. The paper mill's contribution to the nation's welfare will be considerable. Employment at full capacity will reach about 3,500 persons including mill operators, forest workers and raftsmen. Of the total, about 1,500 will be full time workers and the remainder employed about seven months in the year cutting and rafting. The full impact on the economy of the vicinity in which it is located is, of course, difficult to evaluate. However, a pay roll approximating K50 lakhs annually in a predominantly agricultural region will undoubtedly go far to increase business, trading and the general welfare in the area.

(d) Training requirement. A technical training program featuring on-the-job training in paper mills abroad for operational workers and in the shops of equipment manufacturers has been submitted and is under consideration by the proper authorities for activation.

(e) Management. There are several ways by which over-all top management may be provided. If Government elects to form a joint venture with an existing manufacturer, management would be provided by the partner company. An alternative scheme would entail entire financing by Government and retaining management under contract from an operating firm, preferably on an incentive basis.

(f) Economic feasibility. The plant proposed is a modern high production mill using the sulphate process. A tentative site has been selected on the west bank of the Kaladan River about 13 miles north of Akyab. This location has the multiple advantage of being at the confluence of three water routes over which bamboo will be rafted, and of being on deep water. Water depth at plant dockside will accommodate ocean-going vessels which would eliminate the necessity for trans-shipment.

(g) Production cost. Production costs for purposes of this report have been departmentalized for simplicity into three divisions: wet pulp (for paper making in the mill), dried pulp (for export), and paper. Provisional production cost estimate per ton (2,240 lbs.) for 30,000 tons annually of wet (slush) pulp follows:

PRODUCTION EXPENSES

	Quantity per Ton of Pulp Tons	*Cost per Ton of Material. Kyats*	*Cost per Ton Pulp. Kyats*	
(*a*) Bamboo	3·0	35.00	105.00	
(*b*) Glauber's Salt	0·100	174.00	17.40	
(*c*) Lime	0·067	166.00	11.10	
(*d*) Caustic Soda	0·019	110.00	2.08	
(*e*) Chlorine	0·100	392.00	39.20	
(*f*) Coal for Process Steam	1·2	90.00	108.00	
(*g*) Labor	96 man hours	0.51	49.00	
(*h*) Administrative and Executive Expenses			15.00	
(*i*) Maintenance and Repairs			7.00	
Total			353.78	353.78
Fixed Charges				
(*j*) Depreciation on wet pulp plant at 15 year life [1]				
Foreign capital—K3,51,40,000 at 9·634%—K33,80,000			101.00	
Domestic capital—K1,50,60,000 at 8·994%—K13,55,000			45.20	
(*k*) Local Taxes and Insurance—K5,02,000			16.70	
Total			162.90	162.90
Mill cost per ton of slush pulp				516.68

COST OF DRIED AND BALED PULP (KYATS)—
19,500 TONS ANNUALLY

Item	*Quantity per Ton Pulp*	*Cost per Ton of Material*	*Cost per Ton Pulp*	
Wet Pulp (brought forward)	1·0	516.68	516.68	
Labor	20 man hrs.	0.51	10.20	
Coal and Power	0·6 ton	90.00	54.00	
Administrative, Executive and Sales Cost			5.00	
Total			585.88	585.88
Fixed Charges				
Depreciation on pulp drying, baling, storage and handling equipment at 15 year life [2]				
Foreign Capital—K24,50,000 at 9·634%—K2,36,000			11.80	
Domestic Capital—K10,50,000 at 8·994%—K94,437			4.72	
Local Taxes and Insurance K35,00,000 at 1%—K35,000			1.75	
			18.27	18.27
Mill cost of dried and baled pulp				604.15

[1]Depreciation is computed as a uniform annual installment necessary for capital recovery together with interest payable on capital investment. The interest rates are 5% for foreign and 4% for domestic capital.

[2] Computed on basis of 20,000 tons of slush pulp annually.

COST OF PAPER (KYATS)—10,000 TONS ANNUALLY

Item	*Quantity per Ton Paper*	*Cost per Ton of Material*	*Cost per Ton of Paper*	
Wet Pulp	1·05	516.68	541.00	
Resin	0·02	3000.00	60.00	
Soda Ash	0·005	584.00	2.92	
Alum	0·050	284.00	14.20	
Methyl Violet	0·033 lb.	89.50lb.	2.95	
Clay	0·120	182.00	21.90	
Coal for Process Steam and Power	1·25	90.00	113.00	
Labor	40 man hrs.	0.51 K/hr.	20.40	
Maintenance and Repairs			5.00	
Administrative, Executive and Sales Cost			5.00	
			786.37	
Fixed Charges				
Depreciation on paper making equipment at 15 year life				
Foreign Capital—K38,50,000 at 9·634%—K3,65,000			36.50	
Domestic Capital—K16,50,000 at 8·994%—K1,48,000			14.80	
Local Taxes and Insurance—K55,00,000 at 1·0%—K55,000			5.50	
			56.80	56.80
Mill cost per ton paper				843.17

(h) Earnings

(1) *Pulp*

The recent trend of pulp prices has been downward, but because the demand for paper continues strong throughout the world it is not expected that the wholesale prices for imported pulp will drop much below \$165 per long ton (£59 or K785). Bamboo pulp, being a relatively new commodity on the world market, may bring a slightly lower price than that given above. Its mill selling price is estimated in this Report at \$154 per long ton (£55 or K730).

The gross return from pulp sales would be as follows:

Selling price f.o.b. mill	K730 per ton
Production Cost	K605 per ton
Gross Profit	K125

The annual gross profit would be:

K125 × 19,500 tons = K24,40,000

(2) *Paper*

Paper production is intended for internal consumption and only the surplus would be available for export. Imported paper has been costly in Burma and consequently its consumption has been limited. An average selling price of white book paper, conversion coated, for example, will be about K1,400 per ton f.o.b. mill. On this basis the gross profit per ton will be K1,157 or K1,15,70,000 annually. This "profit" is not a true representation, as 93% of over-all plant depreciation has been charged to basic, wet and dry pulp departments. Production costs shown in paragraph (g) were computed for average general use printing and writing papers.

The over-all annual gross profit on the estimated K5·92 crore investments:

Gross Profit—Pulp Sales	K24,40,000
Gross Profit—Paper Sales	K55,70,000
	K80,10,000

This represents a 13·5% return on the investment.

Cost of management is deductible from the gross return which appears adequate to provide for management fees and a reasonable net profit.

(i) Recommendations. Pulp and paper have a more assured market than many other industrial products. It is estimated that "normal" consumption in Burma is between 4,000 and 7,000 tons per year, exclusive of newsprint. Consumption probably would be higher were it not for high import prices. It is practically certain that demand will increase considerably. In order to implement the project, the following construction and expenditure schedules are recommended:

Construction

(*1*) Dry season, September 1954, through May 1955.
- (*a*) Dock with necessary dredging.
- (*b*) Clearing and grading site for principal buildings.
- (*c*) Godowns to be used for storage of incoming materials.
- (*d*) Excavations and foundations for bamboo preparation and digester house.
- (*e*) Clear reservoir area.
- (*f*) Begin construction of reservoir dams.

(*2*) Wet season, May 1955, through August 1955.
- (*a*) No outside construction.
- (*b*) Receipt of building materials and equipment for open storage.
- (*c*) Receipt of materials and equipment for indoor storage up to capacity of roofed godowns.

(*3*) Dry season, September 1955, through May 1956.
- (*a*) Erection of bamboo preparation and digester house.
- (*b*) Foundations for pulp preparation, drying and baling building.
- (*c*) Foundations and erection of boiler power house and chemical recovery system.
- (*d*) Complete reservoir and water supply including treatment plant.
- (*e*) Construction of bamboo storage facilities.

(4) Wet season, May 1956, through August 1957.

(a) Erection of machinery, piping and wiring.
(b) Erection of paper making machinery and finishing.
(c) Complete inside construction throughout.
(d) Prepare mill for first operation.

Expenditures

(1) Fiscal Year 1953–54. Designing engineer's costs:		
(a) Preliminary survey, travel and living expenses in Burma.		
(b) Engineers' and draftsmen's time plus office overhead and monthly *pro rata* fixed fee and final design and purchasing.		
(c) Engineers' out-of-pocket expenses. Engineers' average monthly bills for above equivalent of US $45,000, or K213,000 per month for 12 months.	K25,56,000	
Payments on equipment and material purchases:		
(a) Paper machine: letter of credit for 50% of estimated $600,000 = $300,000, or	K14,30,000	
(b) Chip preparation, digestion and pulp washing: 25% of $200,000 = $50,000, or	K2,38,000	
(c) Bleaching, presser, driers, cutters layboys and presser for pulp: 25% of $500,000 = $125,000, or	K5,95,000	
(d) Chemical recovery system: 25% of $200,000 = $50,000, or	K2,36,000	
(e) Power and steam generating equipment: 25% of $900,000 = $225,000, or	K10,70,000	
(f) Caustic and chlorine plant: 25% of $150,000 = $37,000, or	K1,78,000	
Material and initial construction.		
(a) Building material for godowns and buildings to be used as storage facilities during construction $50,000, or	K2,38,000	
(b) Dock construction material $20,000, or	K1,00,000	
Dock construction $20,000	K1,00,000	
(c) Initial site preparation $20,000, or	K1,00,000	K68,41,000
(2) Fiscal Year 1954–55:		
(a) Balance of payments to engineers	K10,00,000	
(b) Payments with order on equipment not previously ordered	K1,50,00,000	
(c) Balance of payments on material and machinery commitments	K2,00,00,000	
(d) Progress payments on construction contract	K20,00,000	K3,80,00,000
(3) Fiscal Year 1955–56:		
(a) Balance of payments on equipment and material commitments	K20,00,000	
(b) Balance of payments on construction contract	K1,13,59,000	K1,33,59,000
TOTAL		K5,82,00,000

(6) Calcium Carbide

(a) Introductory. One of the manufactured products used in every nation is calcium carbide, the source of acetylene gas. Acetylene gas is required in every garage, every shop, and in every factory for heating and cutting metals. It is used for illumination and for house heating and in laboratories when other gas is not available. The acetylene gas is generally shipped from the gas generating plant in steel cylinders, which being portable, may be used anywhere. Large users often generate their own acetylene gas and pipe it to points of use in their plants.

As no calcium carbide is manufactured in Burma, it must be imported. Yet it is easily manufactured from raw materials that are found in abundance in Burma. These are limestone, charcoal, (or coke) and electric power.

(b) The market. The past and current use of calcium carbide is shown in the accompanying table of imports:

IMPORTS OF CALCIUM CARBIDE

Fiscal Year	*Quantity*		*Value*	
	Cwt.	*Tons*	*Total Ks*	*K per Ton*
1936–37	11,225	561	1,52,752	272.28
1937–38	12,965	648	1,63,830	252.82
1938–39	7,937	397	97,737	246.18
1939–40	11,579	579	1,71,362	295.96
1940–41	12,933	647	2,04,541	316.18
1945–46	58	3	3,933	1,311.00
1946–47	363	18	9,917	550.94
1947–48	9,386	469	2,44,560	521.02
1948–49	2,159	108	57,567	533.02
1949–50	N.A.	N.A.	N.A.	N.A.
1950–51	2,698	135	56,328	417.24
1951–52	2,805	140	96,733	690.95

The prewar use averaged about 600 long tons per year. The future use will increase rapidly as more industrial plants are built. The new steel products plant will require a large quantity for cutting up steel scrap. The estimated future demand should easily reach 3,000 to 5,000 long tons per year.

While the amount of calcium carbide imported into Burma does not require the expenditure of much foreign exchange it is an essential industrial material that should be produced nationally. It is therefore proposed to establish in Burma a calcium carbide plant having a capacity of 10 long tons per day, or 3,000 long tons per year.

(c) Plant location. The plant can be located anywhere that the raw materials and power are available. The Akyab area has been selected as the best location for the plant not only because the raw materials and power are available, but because a large portion of the product will be used for the manufacture of vinyl plastics. The hydrochloric acid required for this process will come from the caustic and chlorine chemical plant to be operated in connection with the pulp and paper factory.

(d) Raw materials. The 10-ton-per-day calcium carbide plant will require the following materials:

9·50 long tons of quicklime per day
6·50 long tons of coke or charcoal per day
60·00 long tons of water for cooling
38,000 kWh of electric current for the 1,800 kW furnace.

The quicklime will be furnished from the same source that will supply the pulp and paper factory. The charcoal will be produced locally. Power will be supplied from the Saingdin Falls hydroelectric project.

(e) The process. Quicklime and charcoal (or coke) are crushed separately to a minus one inch size and stored in separate bins. As required, the two materials are withdrawn from the storage bins, weighed separately, mixed thoroughly, and placed in the furnace charging bins. The furnace is of the electric arc type, operating continuously.

The heat causes the mixture to melt and the calcium carbide is formed. The molten product is tapped from the furnace at intervals. Special chill cars receive the molten material. After solidifying in the cars the solid carbide is dropped into a breaker pit to be broken into chunks. Crushers reduce the chunks into desired final sizes. The finished carbide is then packed in air- and water-tight containers.

(f) Cost of plant. A plant to produce 10 long tons per day of calcium carbide is estimated to cost as follows:

Item	*Installed Cost*
	K
Coke and Lime Storage and Crushing Equipment	1,04,784
Weighing and Charging Bins and Equipment	1,57,176
Furnace and Equipment	2,78,480
Chilling, Breaking and Drum Loading	2,10,512
Buildings	5,47,520
Ocean Freight and Insurance	1,00,000
Misc. Construction and Engr.	4,72,000
Construction Overhead	1,00,000
Total less Real Estate	19,70,472
Real Estate	50,000
Total Plant Cost	20,20,472
Working Capital	4,72,000
Total Capital Required	24,92,472

Approximately K17,44,730 will be foreign exchange and K7,47,742 local currency. It will require about 18 months to complete the plant after engineering services have been retained.

(g) Financing. The proposed plant may be either a wholly owned GUB corporation, or be owned jointly by the GUB and private interests. If a wholly owned GUB corporation, the entire capital requirement will be furnished by the GUB to the carbide manufacturing corporation formed for this purpose. This loan will bear interest at the rates of 4% and 5% for the local and foreign currency advanced, respectively. The loan, with compound interest, will be repaid in equal annual payments whose number will coincide with the estimated useful life of the equipment, which has been placed at 25 years.

The annual cost of carrying the capital loan is calculated as follows:

	Factor	*Annual Cost (K)*
Local Currency	K7,47,742 × ·06401	47,865
Foreign Currency	K17,44,730 × ·07095	1,23,790
Total Annual Cost		1,71,655

This cost will be prorated into the unit cost of production. No depreciation, as such, will be assessed against costs as no capital reserve will be accumulated. Any additional capital will therefore be obtained and repaid in the same manner as the original loan. Such wholly owned GUB corporations would operate as tax free, non-profit units, and would be exempt from import duties.

(h) Manufacturing cost. The manufacturing cost has been estimated as follows:

	Annual Total Cost K	*Cost per Long Ton* K
Operating and Repair Labor	1,50,000	
Operating and Repair Supplies	80,000	
Lime	4,27,500	
Charcoal	75,000	
Power	5,38,080	
Electrodes	60,000	
General Works Expense	2,36,000	
Containers	1,00,000	
Administration and Sales Expense	2,36,000	
Amortization of Loan	1,71,655	
Insurance	1,00,000	
Cost of Sales	21,74,235	
Divisor (3,000 L.T.Year)		724.74

Power must be furnished at K0·0472 per kWh to make this project feasible.

	K	K/L.T.
Ex-Warehouse Cost Rangoon of Imported Product	22,38,690	746.23
Cost of Sales	21,74,235	724.74
Gross Profit	64,455	21.49

The above ex-warehouse value in Rangoon is the declared c.i.f. import value of calcium carbide plus port charges, stevedoring and warehousing costs. No duty or dealer's markup and profit is included.

The duty and dealer's markup and profit on the imported carbide are believed to be sufficient to offset the freight charges from Akyab to Rangoon, which should not exceed K50 per long ton. The current selling price per long ton of carbide ex dealer's warehouse in Rangoon is K913. It is thus believed that carbide manufactured near Akyab can be sold at a fair profit at the present Rangoon prices for imported carbide. The project is thus justified from an economic standpoint as well as from the viewpoint of national interest. It should be implemented in the intermediate plant.

(i) Acetylene. The ultimate use of calcium carbide is to produce acetylene gas, which is obtained in a generator when water is added. Eventually acetylene gas will be distributed in tanks as is done in every industrial country. The cost of such acetylene generating plants varies with the size. Commercial plants are rated in accordance with the weight of calcium carbide charged into the unit. A one-ton plant complete will cost about K1,13,280, and a three-ton plant will cost about K1,69,920.

A production of 4·5 cu. ft. of acetylene gas may be generated from one pound of calcium carbide at 60° F., and 30 in Hg pressure. Thus a one-ton generator will yield 9,000 cu. ft. or 620 pounds of gas, and a three-ton unit will produce 27,000 cu. ft. or 1,860 pounds.

(6a) Vinyl Compounds

An important series of industrial chemical products can be manufactured from calcium carbide as a base raw material. Two of these are vinyl acetate and vinyl chloride. These vinyl compounds would be particularly useful in Burma as a substitute or replacement for leather because of the particular advantage of vinyl over leather in a tropical climate where leather deteriorates rapidly due to mold.

Much imported vinyl is presently used in Burma, although the quantity is concealed in the import statistics under other classifications. It is seen in many consumer goods. Much enters the country in the form of ladies' hand bags, belts or suspenders, all of which could be made in Burma. The process is simple and should be profitable. It might be desirable to sell the material in either sheet, molding powder, or other forms, to other industries which would manufacture the consumer goods.

Because the calcium carbide would be made at the chemical industry center near Akyab, and because pure hydrochloric acid would be produced as a by-product in the same group of plants, the vinyl plants should be located on the same site.

The proposed plant would use five tons per day of calcium carbide (50% of the plant output), plus additional in the form of acetylene. The vinyl plant proposed would produce the following products:

	L.T./Day
Vinyl Chloride Monomer	3·0
Vinyl Acetate Monomer	1·0
Vinyl Chloride-Acetate Polymers	4·0

	K
The Vinyl Chloride Plant and equipment, erected, is estimated to cost	6,51,360
Buildings and Utilities	4,29,520
Engineering, Construction and Start-up	2,16,176
Contingencies	1,29,704
Ocean Freight and Insurance	95,110
	15,21,870
Real Estate	50,000
Total Plant Cost	15,71,870
Working Capital	2,26,560
Total Capital Required	17,98,430
The Vinyl Acetate Monomer Plant	
Total Capital	10,70,685
The Vinyl Chloride-Acetate Copolymer Plant	
Total Capital	42,60,085

It is estimated that the vinyl chloride monomer can be produced for about K0.54 per pound, or K1,219.60 per long ton. The production cost of the vinyl acetate monomer is estimated to be K0·944 per pound, or K2,114.56 per long ton. The production cost of the vinyl chloride acetate copolymer is estimated to be K1·541 per pound, or K3,451.84 per long ton.

It is believed that at such prices the plants could produce these materials and sell them profitably in Burma below the prices of imported products of the same grade and type. A complete project should be developed covering these plants. If this reveals them to be economically feasible they should be placed in the intermediate plan for implementation.

(7) Caustic Soda and Chlorine

(a) The market. This production facility is intended to operate in conjunction with the projected pulp and paper mill whose annual demand for caustic soda is 640 short tons and for chlorine, 3,360 tons. Location of the plant adjacent to the paper mill will result in lower production costs since management of the two operations will be combined into one. Furthermore, it will not be necessary to prepare the chemicals for shipment as they may be piped directly to the paper mill in gaseous and liquid form.

The proposed capacity of the plant is 25 tons of chlorine and 28 tons of caustic soda per day. On the basis of 300-day-per-year operation, about 3,800 tons of chlorine in excess of paper mill consumption will be available for use in the proposed chlorine-base chemical industries, and about 7,500 tons of caustic soda will be available for sale in domestic and export markets.

Soap production in the country is increasing to the extent that about 3,000 tons of caustic soda will be used for this purpose alone. There will remain about 4,500 tons for other general industrial uses.

The existing market for chlorine in the country has been negligible due to the high cost of importation. Imports have averaged only about 300 cwt. annually. Besides an expected greater general use for water purification, the introduction of domestically produced chlorine will permit the manufacture of chlorine-based chemicals such as DDT, hypochlorides and disinfectants, a project which, as an aid to the public health program, should receive priority. A DDT plant of optimum size for Burma, would produce about five tons of the insecticide per day requiring 6·2 short tons of chlorine. Paradichlorobenzene and other chlorine derivatives recommended for future production require chlorine as a basic raw material.

(b) Possibility of domestic production. (1) The process is essentially the electrolytic decomposition of common salt when dissolved in water into its component sodium and chlorine, the former recombining with water to form caustic soda. Besides salt, the other basic requisite is electric power. Salt is available, and, with modifications to existing salt farms, could be produced in sufficient quantity to fulfill anticipated future needs.

Location of the plant adjacent to the paper mill will permit using the latter's electricity supply whether from Saingdin Falls hydro development or from its own generating power plant. About 4,000 kVA will be required for full operation.

(2) Chlorine can be produced for about K216 per short ton and caustic soda for about K197 per short ton. Production costs are detailed in the project report.

Caustic soda in excess of that required for the paper mill will be available. While caustic soda (lye) is a basic chemical and used to a greater or less degree in almost every country in the world, export possibilities in competition with the large chemical companies in both the east and the west are rather uncertain.

(3) Like most chemical manufacturing processes, a relatively small labor force is required although it must be drawn from the ranks of skilled labor or those amenable to training for skilled jobs. Since the labor force will be small, about 11, the employment opportunities will not be a major contribution to the general welfare. Operation will, however, present opportunities to chemical graduates of local schools and university for practical manufacturing training and employment.

(c) Recommendations. The subject plant is a necessary adjunct to the paper mill, a project that has a high priority in the industrial development scheme. Schedules for expenditure and construction should coincide with those for the paper mills.

It is possible and probably desirable to correlate capacity of the plant with demand. It may not be advisable to construct the plant initially for a capacity in excess of paper mill demand until such times as the chlorine based chemical plants are finalized. Such procedure is technically possible and costs of additions would not exceed losses and idle equipment if full production capacity were prematurely installed.

(d) Economic feasibility. The proposed plant will be of conventional design using 76 Hooker S type (diaphram) cells. Auxiliary equipment description and process details are contained in the project report. The total capital cost is estimated at K1·07 crores of which 70% or K74 lakhs will be required in foreign exchange.

The raw materials, which will be available in the country, are salt, sulphuric and hydrochloric acid, and electricity.

Annual raw material requirements are:

Salt	15,800 tons
Sodium Carbonate	200 tons
Sulphuric Acid	890 tons
Graphite (anodes)	12 tons
Hydrochloric Acid	14 tons

Graphite in the form of anodes and sodium carbonate will be imported. Chemicals that must be imported are available in India and Japan as well as in Europe and the UK.

(e) Production costs. Total mill cost for both products averages K408 per ton. Since both products are produced coincidentally mill costs are divided as follows: chlorine K216, and caustic soda K192 per ton. Selling prices based on these mill costs should compare favorably with imported costs for general market consumption and will be under imported costs for direct use in the paper mill.

(8) Jute Bag and Twine Mill

(a) The market. Burma's average annual postwar importation of jute rice bags is about 24 million requiring an average annual foreign exchange outlay of about K3,00,00,000. The demand for bags and the outlay of money required to purchase them warranted consideration of ways and means of lowering costs by developing domestic sources of supply and processing plants. Prior to the war, consumption of jute bags of all types averaged 52 million.

A project report on the economic feasibility of producing rice bags and twine from imported raw fiber until such time as domestic jute harvests can supply the demand, has been completed, and submitted to Government. This project study indicates the feasibility of establishing a bag and twine mill having an annual two-shift capacity of 6,000,000 bags and 281,000 lbs. of seam and mouth sewing twine as an initial unit in an industry that will eventually supply the total domestic demand.

In the interest of low-cost production, the State Agricultural Marketing Board was consulted regarding standardization of export rice bags. A preference based on experience in their use was expressed for the type of bag known in the trade as Heavy "C," having the following specifications.

Size	*Bag Weight*	*Rice Capacity*
40 in. × 28 in.	2·25 lb.	210 lb.
36 in. × 26½ in.	2·00 lb.	160 lb.

The present annual demand for bags of the above sizes is approximately 19,000,000. Since the proposed mill's capacity is about one third of the demand, a steady market for entire output is assured.

(b) Possibility of domestic production. (1) The proposed mill will use imported raw jute from Pakistan until such time as domestic harvests satisfy the demand. The mill will provide a stimulus to local jute growing, since harvests can be processed at a profit rather than being supported by subsidy and stored for an uncertain length of time and for an uncertain end use as would be the case if Government continued to support the growing program without having any immediate use for the raw fiber.

The prime criterion of the project is economy. For the proposed mill's principal product, the current costs are:

Imported Heavy "C" selling price in Rangoon	K1,240.00/ton
Domestic Heavy "C" selling price in Rangoon	1,173.00/ton
Difference	67.00/ton

The imported bag price above is exclusive of the current Indian export duty of K174 per ton. Over the past four years, this duty has varied widely. Under pressure from trade groups, the Indian Government is considering abolition of export tax on bags, hence no consideration was given to savings from that source.

The K67 per ton saving amounts to an annual total of K40,20,000 or a return of 5·4% on the capital investment. Reduction in foreign exchange expenditures for the first years of the operation is not important since raw material purchases will be made in sterling. Financial circles anticipate devaluation of 40% in Pakistani currency in 12 to 18 months. Jute circles expect a reduction of 15% in raw fiber as a result. This currency value adjustment is speculative as far as the subject mill is concerned, but is mentioned as a probable aid in the first few years of operation.

(2) Although a commodity of prime importance in the economy, jute has not been grown on a commercial scale. Bengal fields kept pace with world demand making cultivation in other countries unnecessary. However, people in the Indian jute trade have stated that there is no reason why it should not grow in commercial quantities in Burma. Experimental plantings have indicated that the plant will grow in the country. However, plantings have not been sufficiently diversified to disclose the best growing areas. The proposed mill will consume the harvest from about 12,000 acres. It should not be difficult to bring that acreage under production in four years.

(3) The project will provide much-needed employment opportunities in a town (Akyab) where they would be particularly welcomed. Besides the direct employment of over 600 persons in the mill, indirect employment of twice that number including cultivators is estimated. The mill payroll will undoubtedly contribute to the general economic welfare of the Akyab area and stimulate its growth.*

(4) Experience in the cotton spinning and weaving factory has demonstrated that machine operators can be readily trained for the relatively simple tasks of textile machine tending. The manual dexterity of Burmese workers is as good as that of their counterparts in other countries. The same experience, however, has revealed an absence of discipline and responsibility on the part of the labor force. The jute mill's products will be competitive with imports; its labor must be as efficient and productive as that of its competitors, else it has little chance of success.

It is suggested that the manager, mechanical and production overseer, and office master and accountant be recruited from the jute mill center along the banks of the Hooghly River in India. There are qualified persons there with years of experience in all phases of the jute business who are available and who would respond to attractive offers. Given proper authority, the suggested three-man team could handle the mill. The operation is not believed to be large enough to warrant a management contract.

(c) Economic feasibility. (1) A 140-loom mill using the latest type high production and labor saving equipment to the extent justified by relative equipment and labor costs, commensurate with the type of material produced, and capable of using as low cost fiber as possible, is proposed for production of the bags specified above. The proposed capacity is based on a 70% loom efficiency. The capital cost of the plant installed and ready to operate is estimated as:

Machinery and equipment	K49,59,000
Buildings	K25,07,000
	K74,66,000

The estimated foreign exchange expenditure is £436,000 and local currency expenditure K16,68,000.

(2) Production costs on a per ton of raw jute basis are summarized below (see project report for details):

	K
Jute	638.40
Other Materials	28.10
Labor	165.20
Power	104.60
Maintenance and Repairs	9.83
Management and Office Overhead	10.65
Fixed Charges	141.11
Mill cost per ton	1,097.89

Total Landed Cost Per Ton:

Mill Cost	1,097.89
Loading at Akyab and unloading at Rangoon per ton	5.00
Freight Akyab to Rangoon	70.00
Total cost at Rangoon	1,172.89

Say K1,173 per ton.

(3) The project's contribution to the national welfare will depend primarily upon the income the cultivator will receive. Jute will be competitive with rice from the cultivator's point of view. The paddy cultivator's average gross revenue is K85 per acre; net revenue varies so widely that an average is difficult to establish.

(4) As stated, average mill cost of imported fiber is K640 per ton. Assuming a crop yield of one half ton per acre of average grade, which is a reasonable expectation, and similar prices for domestic and imported fiber, the cultivator could receive about K300 per acre less charges of brokers and middlemen. Net revenue to the cultivator for jute fiber may not exceed that for paddy since the man-hours of labor required per acre are at least twice that for paddy production.

(5) It would be speculative to predict long range over-all benefits to cultivators for a new commodity. Jute growing has afforded a living to thousands in India and Pakistan, and once established in Burma there is no apparent reason why it should not become a profitable cash crop in those areas where it will grow best.

(6) It is not necessary that all fiber grown be high grade. On the contrary, the use of an undue proportion of high grade fiber in bags would be wasteful since they have been traditionally and satisfactorily woven from the lower grades. High grade jute goes into hessian (burlap) a product for which there is little use at present in Burma.

* It is now proposed to construct the initial plant at Rangoon.

(d) Recommendations. It is recommended that the mill project be initiated. Expenditure and construction schedules are suggested below:

(1) *Expenditure Schedule*

	K	£
Fiscal year 1953–54:		
Payment on order for machinery ⅓ of £372,320	—	124,107
Payment on order for structural steel ½ of £22,500	—	11,250
Site preparation and preliminary construction foundations, etc.	3,00,000	—
Fiscal year 1954–55:		
Final payments on machinery ⅔ of £372,320	—	248,214
Final payment on structural steel ½ of £22,500	—	11,250
Progress payments on building construction and machinery erection	10,00,000	33,060
Fiscal year 1955–56:		
Final payments on construction and machinery erection	3,68,000	8,334
Total	16,68,000	436,215

(2) *Construction Schedule*

Jute machinery manufacturers promise 18 month initial equipment delivery with final deliveries within 28 months of order placement which permits early plant completion. In general, construction will parallel the expenditure schedule. The following schedule is proposed to provide for completion of the mill within a three-year period after placement of principal equipment and material order:

Fiscal year 1953–54

(*a*) Complete design of building in accordance with machinery manufacturer's layout.
(*b*) Grade site.
(*c*) Preliminary construction work on dock or improve existing one. Type of dock, if any is required, depends upon final site selected.
(*d*) Prepare building and machinery foundations.

Fiscal year 1954–55

(*a*) Estimated delivery of structural steel six months from order placement. Erection of structural steel framing, building walls and roof of mill building.
(*b*) Begin wiring and piping.
(*c*) Begin machinery erection.

Fiscal year 1955–56

(*a*) Complete machinery erection.
(*b*) Installation of all piping and sprinkler system.
(*c*) Construction of godowns and auxiliary buildings.
(*d*) Initial start of production under supervision of manufacturer's engineers.

b. The Greater Rangoon Industrial Group*

Rangoon has become the chief industrial center of the Union of Burma. It is the terminal of ocean vessel routes, of river transport routes, of the railway system, of the highway system, and of the air transport system of Burma. It is, therefore, the banking, commercial, importing and exporting, manufacturing and distributing center of the nation, in addition to being the seat of the Government.

Agricultural and other products move to market through Rangoon. Some are processed in Rangoon and are exported. Others are processed for both the export and domestic markets. The proposed industrial products derived from materials now moving into Rangoon should therefore be manufactured in Rangoon.

In addition, products manufactured in or imported through Rangoon can be distributed throughout the nation more readily from Rangoon than from any other point. As many of the products to be manufactured in the proposed new industrial plants are for domestic use only, the availability of these multiple transportation systems dictates the selection of Rangoon as their best location.

(9) Cotton and Cotton Textile Products

(a) The market. The value of cotton textiles annually imported into Burma is greater than the value of any other commodity. Cotton represents a basic need in the living conditions of this country where over 75% is used for clothing and the remainder for necessary household and industrial items. For the year of 1951–52, Burma imported over K20 crores of cotton goods from foreign countries, and for the preceding year of 1950–51, cotton imports into Burma totaled almost K25 crores. The greater part of these imports were composed of cotton piecegoods; cotton twist and yarn being next in value. The following table shows the interrelation between the main classes of textile imports in regard to both value and quantity.

COTTON IMPORT SUMMARY

Year 1950–51

Type of Import	*Quantity*	*Value*
Cotton Piecegoods (undyed)	70,785,273 yds.	9,31,30,410
Cotton Piecegoods (colored, printed, dyed)	51,522,407 yds.	11,03,76,498
Cotton Twist and Yarns	8,739,197 lbs.	4,26,02,023
Raw Cotton	1,162,560 lbs.	22,72,042
Total		K24,83,80,973

* The Rangoon District has been named "greater" so as to include Moulmein and some other points.

Year 1951–52

Type of Import	*Quantity*	*Value*
Cotton Piecegoods (undyed)	41,022,057 yds.	4,11,78,556
Cotton Piecegoods (colored printed, dyed)	27,899,655 yds.	4,49,28,384
Cotton Twist Yarns	13,698,666 lbs.	10,89,20,982
Raw Cotton	4,118,016 lbs.	81,36,471
Total		K20,31,64,393

From this picture, it can be seen that there is a substantial weavers' market for imported cotton twist and yarn as well as a consumers' market for cotton piecegoods. Also, there is a preference for colored, printed or dyed cotton piecegoods as compared to undyed piecegoods.

The bulk of cotton yarn used in Burma lies between Nos. 11 to 20 count* as indicated by the following cotton yarn import table. For the year of 1951 the percentage of Nos. 11 to 20 count of imported yarn is shown as approximately 75% by weight. For counts of No. 21 and over, the proportion consumed is approximately 24%, and for counts No. 10 and under the remainder is slightly less than 1% of total imported counts.

GREY (UNBLEACHED) COTTON YARN IMPORT CLASSIFIED BY COUNT

Count of Weaving Yarn	*1950–51*		*1951–52*	
	Pounds Weight	%	*Pounds Weight*	%
Nos. 1–10	64,412	0·9	752,001	6·3
Nos. 11–20	5,575,292	75·4	10,345,087	85·9
Nos. 21–30	235,527	3·2	95,206	0·8
Nos. 31–40	1,079,300	14·7	845,782	7·0
Nos. 41 and over	430,150	5·8		
Totals	7,384,681	100	12,038,076	100

Cotton cloths woven from No. 20 count yarn and less are used mostly by the rural population in longyis and in long cloth for shirting. Heavier counts of No. 10 yarn are made into blankets and fishing twine. The No. 5 yarn is utilized for candlewicks, fishing twine and canvas. Inasmuch as approximately 80% of Burma's population is rural, a proportionately large amount of No. 20 count yarn is utilized in longyis and wearing apparel.

The lighter weights of cotton cloth woven from No. 21 to No. 80 count yarn are used in longyis principally by the urban population of Burma which consists of about 20% of the total populace. The higher counts of No. 80 to No. 100 are used in en-gees and shirting, also by the urban people.

The weaving of the various count yarns into cloth varies on much the same ratio. Of the 250,000 hand looms in Burma, most are located in the rural districts. The output of the greater number of hand looms goes directly to serving the needs of the rural people for cloth made from No. 20 count yard and similar grade. The power looms, on the other hand, have a tendency to weave the finer grades of material such as are used by the urban people. The number of power looms is extremely limited. Private industry may be credited with possibly 200 power looms. Another 200 power looms are operated at Thamaing by the Government cotton spinning and weaving factory. The Government mill does not weave cloth from the higher counts of imported yarn, but utilizes its own production of yarn which is composed of No. 10 to No. 20 count for the greater part. The 200 power looms operated by private industry rarely use any yarn heavier than single No. 30 and often utilize double No. 80, sometimes going to double No. 120 when permit for import is available, which is seldom.

The over-all market potential of Burma and current consumption of cotton goods can most effectively be determined by calculating the total amount of cotton cloth annually produced in Burma from the amount of cotton yarn consumed, and adding all cloth imports to this figure. This annual yardage divided by the population will render an accurate picture of the consumption of cloth and wearing apparel per person per year. By comparing this figure to similar rates of other countries, a close estimate of Burma's market potential can be obtained.

The total amount of cotton cloth produced in Burma by hand looms and machine looms alike can be determined directly by the amount of cotton yarn consumed. The availability of cotton yarn is from two sources only: the cotton yarn imported and the cotton yarn spun from cotton by the Government spinning factory. At the present time, there are no other spinning mills in operation other than the Government factory*; and the amount spun by hand is small and carries no commercial significance.

For the year of 1951–52, the total amount of cotton cloth yardage available through import and indigenous production is estimated as follows:

* All "counts" refer to weaving counts unless otherwise specified.

* Capacity rated at 4,675,000 lbs./yr. (90,000 lbs./wk.), or 92% of absolute efficiency.

TOTAL ANNUAL CONSUMPTION OF BURMA COTTON CLOTH YARDAGE 1951–52

Cotton yarn imported	13,698,666 lbs.
Cotton yarn spun by Government mill, 1951 at 55·5% capacity*	2,600,000 lbs.
Total cotton yarn available at 5 yds. cloth to 1 lb. cotton yarn (average)	16,298,666 lbs.
Cotton cloth produced in Burma	81,493,330 yds.
Imported cotton piecegoods (undyed)	41,022,057 yds.
Imported cotton piecegoods (colored, dyed, printed)	27,899,655 yds.
Cotton cloth total for year 1951–52†	150,415,042 yds.

If the total amount of this cloth is divided by 18,500,000 people (estimated 1951–52 Burma population), the quotient of 8·1 yds. is the amount of cotton cloth used per person per year of 1951–52 in Burma. If this amount were further increased to 10 yds. per person per year, this would be sufficient for:

5 yds. = 2 longyis/year
5 yds. = 2 shirts/year

10 yds/person/year .. cotton cloth

In comparison to other countries, Burma should set an objective of approximately 30 yds. per person per year where 75% would be utilized for clothing and the remainder for household (curtains, blankets) and industrial (canvas, tire fabric, shoes, power transmission, conveyor belts) requirements. A table of cotton cloth consumption averages of other countries is as follows:

CONSUMPTION BY COUNTRY OF COTTON PIECEGOODS PER PERSON PER YEAR

USA	60 yds/person/year	
Europe	54 „ „ „	
Japan	35 „ „ „	
Burma Objective	30 „ „ „	=555,000,000 yds/year
India	28 „ „ „	
China	20 „ „ „	
Burma (1951)	8 „ „ „	=150,415,042 yds/year

* The Violin Hosiery Works at Insein has 5,000 spindles used mostly for producing "knitting" yarns which are different from "weaving" yarns spun by the Government factory. These spindles are not now being used at the Violin Hosiery Works.

† No exports of cotton piecegoods or yarn are listed for this year.

These figures demonstrate the current textile market in Burma and also the possible future indigenous textile market.

The operation of spinning and weaving of cotton is of basic and over-all importance in the textile field. The end operation of bleaching, finishing, dyeing and printing is a comparatively light and inexpensive phase of textile treatment, but the return investment is considerably greater. Finished cloth will bring an approximately 50% greater price than unfinished cloth of the same quality. Due to the lack of finishing service, almost all handloom products remain unfinished and are consequently sold at a much lower price than similar imported cloth that has been finished at little additional expense. A partial view of market requirement is the imported total of colored, dyed and printed cotton piecegoods into Burma which is considerable and is reflected in the following:

BURMA IMPORT OF COLORED, DYED AND PRINTED COTTON PIECEGOODS

Year	*Quantity*	*Value*
1949–50	54,363,849 yds.	K6,60,04,793
1950–51	51,522,407 yds.	K11,03,76,498
1951–52	27,899,655 yds.	K4,49,28,384

The variety and types of cotton textiles are considerable. Many of the imported lists alone show a classification of as many as 120 different cloth and yarn types. The following list is for the year 1950–51 and gives a tabulated return for 71 different textile items. Each item represents a potential market to be replaced by indigenous production. Many of the higher counts of yarn cannot be spun from indigenous Burma cotton due to the short length of its fiber. But the greater part of all cotton imported into Burma is between the counts of No. 1 and No. 20 and represents about 80% of all textiles consumed. The table opposite gives the total quantity, value, and average unit cost of textile imports.

(b) Possibility of domestic production. The basic consideration in regard to cotton spinning and weaving in Burma is the question of producing the yarn and cloth at a cost equal to or lower than the landed imported cost. There is a plurality of factors that presently make the economic production of textiles an undertaking that requires the utmost in expert technical handling and control. Every phase in the development of cotton from the field to its ultimate use as cloth, demands the most judicious and experienced handling. The world competition in textiles is

CLASSIFIED COTTON TEXTILE IMPORTS, 1950–51

Product	Quantity (Pounds)	Value (Kyats)	Unit Cost per lb. or per yard (Kyats)
1. Cotton Raw	1,160,000 lbs.	22,72,042	1.95/lb.
2. Cotton Waste	6,720 lbs.	3,147	0.47/lb.
Total	1,166,720 lbs.	22,75,189	1.94/lb.
Cotton twist and yarn			
3. Grey (unbleached) Nos. 1–10	64,412	1,71,569	2.66/yd.
4. „ „ Nos. 11–20	5,575,292	2,51,95,400	4.51
5. „ „ Nos. 21–30	235,527	12,00,970	5.09
6. „ „ Nos. 31–40	1,079,300	43,74,135	4.05
7. „ „ Nos. 41 and over	430,150	25,91,774	6.02
8. Grey twofolds (doubles) Nos. 1–50	48,000	1,56,689	3.26
9. „ „ „ Nos. 51 and over	154,400	11,66,798	7.55
10. White (bleached) Nos. 1–40	451,862	25,37,877	5.61
11. „ „ Nos. 41 and over	112,239	8,44,725	7.52
12. „ twofolds (doubles) Nos. 1–50	12,800	1,07,652	8.41
13. „ „ „ Nos. 51 and over	43,380	3,67,502	8.47
14. Colored cotton yarn Nos. 1–20	nil	nil	
15. „ „ „ Nos. 21–40	716	9,527	13.30
16. „ „ „ Nos. 41 and over	6	8	1.33
17. „ twofolds (doubles) Nos. 1–50	826	9,399	11.37
18. „ „ „ Nos. 51 and over	nil	nil	
19. Mercerized cotton yarn Nos. 1–40	12,221	1,31,141	10.73
20. „ „ „ Nos. 41 and over	87,000	8,98,668	10.32
21. „ „ „ twofolds (doubles) Nos. 1–50	nil	nil	
22. „ „ „ „ „ Nos. 51 and over	99,013	12,86,208	12.99
23. Unspecified cotton yarn and twist Nos. 1–50	254,600	8,76,355	3.44
24. „ „ „ „ „ Nos. 51 and over	77,453	6,75,626	8.72
25. Cotton thread for sewing or darning	451,184	63,15,992	13.99
26. Other sorts of cotton thread	97,288	9,87,744	10.15
27. Yarn made of staple fiber mixed with other materials	nil	nil	
Totals	9,287,669	4,99,05,759	5.37/yd.
Cotton Piecegoods	*Quantity (Yards)*	*Value (Kyats)*	*K/yd.*
28. Plain grey chadars of cotton	10	80	8.00
29. „ „ dhotis, saries and scarves of cotton	12,324	10,399	0.84
30. „ „ drill and jeans of cotton	889,559	16,79,708	1.88
31. „ „ jaconets including madapollams, mulls and cambrics of cotton	9,970	8,568	0.85
32. Plain and grey longcloth and shirting of cotton	8,763,123	2,33,80,658	2.66
33. Plain grey shirtings of cotton	71,805	1,10,464	1.53
34. „ „ cloth of unspecified descriptions of cotton	130,058	1,15,132	0.88
35. Checks, spots and stripes in white of cotton	246,068	3,59,385	1.46
36. White dhotis, saries and scarves of cotton	174,567	2,49,637	1.43
37. White drills and jeans of cotton	197,329	3,54,164	1.79
38. White cotton flannels and flannelettes of cotton	36,630	40,590	1.10
39. White jaconets, madapollams, cambric and muslins of cotton	3,110,699	56,98,826	1.83
40. White lawns of cotton	4,766,269	73,72,188	1.54
41. White longcloth and shirtings of cotton	10,886,628	5,19,71,173	4.77

Cotton Piecegoods (contd.)	*Quantity (Yards)*	*Value (Kyats)*	*K/yd.*
42. White mulls of cotton	761,834	6,70,687	0.88
43. White shirtings of cotton	45,428	73,682	1.62
44. White twills of cotton	75,684	1,68,979	2.23
45. Other cotton piecegoods (white bleached)	607,288	8,66,090	1.42
46. Printed cambrics including madapollams, muslins, mulls, and jaconets of cotton	5,720,691	99,98,686	1.74
47. Printed checks, spots and stripes of cotton	7,000,178	1,19,62,077	1.70
48. Printed dhotis, saries and scarves of cotton	12,314	26,032	2.11
49. Printed drills and jeans of cotton	8,010	9,679	1.20
50. Printed cotton flannel and flannelettes of cotton	nil	nil	
51. Prints and chintz of cotton	504,590	7,60,739	1.50
52. Printed shirtings and twills of cotton	26,243,826	7,07,20,336	2.69
53. Other printed piecegoods of cotton	2,138,680	2,92,63,668	1.38
54. Dyed cambrics including madapollams, muslins, mulls, and jaconets of cotton	1,016,193	12,11,314	1.19
55. Dyed checks, spots and stripes of cotton	175,427	2,73,547	1.55
56. Dyed dhotis and scarves of cotton	nil	nil	
57. Dyed drills and jeans of cotton	621,427	10,35,985	1.66
58. Dyed flannels and flannelettes of cotton	56,987	55,086	0.96
59. Dyed prints and chintz of cotton	24	73	3.04
60. Dyed shirtings and twills of cotton	4,669,315	56,92,122	1.21
61. Dyed cotton material for coats and trousers	246,887	3,65,062	1.47
62. Other dyed cotton piecegoods	1,382,673	27,80,843	2.01
63. Woven colored cambrics including madapollams, muslins, mulls, and jaconets of cotton	2	20	10.00
64. Woven colored checks, spots, and stripes of cotton	74,826	1,16,001	1.55
65. Woven colored cotton materials for coats and trousers including cashmeres, serges and tweeds of cotton	123,714	1,70,826	1.38
66. Woven colored drills and jeans of cotton	—	30	
67. Woven colored flannels and flannelettes of cotton	504	5,525	10.96
68. Woven colored cotton longyis and sarongs	745,185	10,34,533	1.38
69. Woven colored cotton shirtings	233,717	3,25,923	1.39
70. Colored cotton velvet and velveteens	45,497	1,75,057	3.84
71. Other sorts of woven colored cotton piecegoods	501,740	6,93,874	1.38
Total Yards	83,307,680	20,35,07,448	2.44/yd.

Grand Total:

Raw Cotton and Waste	1,166,720 lbs.	K25,56,88,396
Cotton Twist and Yarn	9,287,669 yds.	
Cotton Piecegoods	82,307,680 yds.	

so great and prices are so delicately balanced that there is small margin for error or inefficiency. Agricultûral control and guidance for the growth and distribution of cotton and cotton seed receives keen attention from other competing countries, and Burma will fall behind, if it neglects this basic issue.

Cotton ginning, hydraulic packing presses and efficient utilization of valuable cotton seed for its many by-products must be effectively controlled. Market prices for cotton from the field to the gin and through the spinning, weaving and finishing processes to the consumer must be supervised and controlled for the continued welfare of the farmer, manufacturer and merchant. If a section of one phase experiences bankruptcy due to unbalanced market prices, the entire economy of cotton operations can be imperiled.

When indigenous raw cotton is utilized for the manufacture of yarn and cloth, the margin of operations is slightly greater than when imported yarn is used to weave cloth. This does not imply that it is impractical to import yarn and manufacture cloth here in competition with the huge mills of India, Japan and England. The greater number of textile mills presently operating in Burma utilize imported yarn to advantage. Their operations are eclipsed by the tremendous textile industries of other countries, but with their own careful management and with general import control by the Government they are operating soundly. The textile industry must endeavor to operate with minimum import control so as to minimize any added burden of increased living costs. Much encouragement should be given to their operation in order that they may grow in size and that their efficient operation may result in reduced costs and greater comforts for the Burmese people. With continued improvements and increased availability of trained personnel, a future objective will exist in the direction of textile exports. But at the present, attention must first be directed to satisfying indigenous consumption.

Advantages which will assist Burma greatly in meeting the competition of foreign imports are the following:

1. Use of high speed machinery.
2. Working the factory at 3 shifts around the clock 24 hours per day (or even a fourth shift to meet 350 working days per year).
3. Integration of spinning, weaving, finishing and coloring processes.
4. Concentration on continuous production of standard counts of yarn and standard cloth types.
5. Comparative freedom from restrictions by the workers on such things as the number of machines one man is permitted to handle.
6. The best points of English, Japanese, Chinese, Indian and American systems of textile production can advantageously be adapted.

(c) Input materials and utilities. Burma cotton is essentially a short staple cotton and is not adaptable to spinning the higher count yarns. For weaving purposes, it is best adapted for spinning No. 5 to No. 12 counts. A count of No. 16 is possible but No. 12 count is considered the highest count of commercially competitive yarn now practicable from present Burma cotton. The following table is a classified list of the most readily available types of cotton.

For most spinning requirements a percentage of Burma cotton is folded with other long staple cotton and a higher count of yarn is spun from this mixture. Rayon is often used in place of long staple cotton because of its artificial fiber length and its competitive price, and because there is no spinning waste as in cotton.†

† Spinning waste is 8% with American cotton and about 16% with Burma Wagale.

GENERAL COTTON TYPES, BURMAN AND OTHER

Cotton Type	*Approx. No. of Acres Grown in Burma*	*Staple Length of Cotton*	*Highest count Weaving Yarn it will produce**
BCF, also known as MRF, Wagale	246,000	$\frac{1}{2}$ in. to $\frac{5}{8}$ in.	No. 5 to No. 10
BCPF, Waggyi	40,000	$\frac{3}{4}$ in.	Up to No. 16
SSS, (Grown in Aungban, north of Shan States)	3,000	$\frac{3}{4}$ in.	,,
Cambodia, (Shan States)	200	$\frac{3}{4}$ in.	,,
M3, (Mahlaing Area)	8,000	$\frac{3}{4}$ in.	,,
M4, (Mahlaing Area)	3,000	$\frac{3}{4}$ in. to $\frac{7}{8}$ in.	,,
M5, (Mahlaing Area)	3,000	$\frac{3}{4}$ in. to $\frac{7}{8}$ in.	,,
M3, Special Experimental (Mahlaing Area)	Experimental	$\frac{25}{32}$ in.	No. 17
Pakistan Cotton	Imported	$\frac{7}{8}$ in.	No. 20
American Cotton	,,	$\frac{7}{8}$ in. to $\frac{15}{16}$ in.	No. 20
M3X, Special Experimental (Burma)	Experimental	$\frac{29}{32}$ in.	No. 26
M4X, Special Experimental (Burma)	,,	1 in.	No. 31
Other General Cotton Types:	Imported	—	—
$\frac{15}{16}$ in. to 1 in Fiber	,,	$\frac{15}{16}$ in. to 1 in.	No. 20
1 in. Full	,,	1 in. Full	No. 24
$1\frac{1}{32}$ in.	,,	$1\frac{1}{32}$ in.	No. 30
$1\frac{1}{16}$ in.	,,	$1\frac{1}{16}$ in.	No. 40
$1\frac{1}{8}$ in.	,,	$1\frac{1}{8}$ in.	No. 50
$1\frac{3}{16}$ in. to $1\frac{1}{4}$ in.	,,	$1\frac{3}{16}$ in. to $1\frac{1}{4}$ in.	No. 60
$1\frac{5}{8}$ in.	,,	$1\frac{5}{8}$ in.	No. 150

* These counts are all for weaving yarns; knitting yarns require a longer fiber as they are a soft twist.

TOTAL ANNUAL CONSUMPTION OF BURMA COTTON CLOTH, IN POUNDS WEIGHT 1951–52

Imported cotton piecegoods (undyed)	41,022,057 yds.
Imported cotton piecegoods (colored, dyed, printed)	27,899,655 yds.
Total imported cotton piecegoods at 5 yds. cloth to 1 lb. cotton yarn (average)	68,921,712 yds.
Approx. total weight of imported cotton piecegoods consumed	13,784,342 lbs.
Cotton yarn imported	13,698,666 lbs.
Cotton yarn spun by Government mill	2,600,000 lbs.
Approx. total weight of cotton yarn consumed. (10% allowed for spinning waste)	30,083,008 lbs.
Estimated total cotton lint required to produce annual Burma consumption of cotton goods, 1951	33,400,000 lbs.

As Burma's chief objective is to produce a sufficiency of cotton textiles within her borders so as to reduce imports to a minimum, it is of primary importance to first establish the basic raw materials requirements. An estimate of Burma's total current consumption of all cotton goods will be balanced against the total acreage of cotton necessary to grow the raw product. For the consumption total of cotton goods, the figures on the previous page for the year 1951–52 are indicative of the approximate weight consumed.

The total sown acreage of cotton (at an average of 75 pounds cotton lint per acre sown) necessary to produce 33,400,000 lbs. of cotton lint is 445,000 acres. For the year 1952–53 only 294,000 acres of cotton were sown. This amount is only equivalent to 66% of the acreage required to produce the necessary cloth which Burma now consumes. A table of cotton-sown acreage in Burma follows:

BURMA COTTON SOWN ACREAGE AND COTTON LINT PRODUCED

Year	*Acres*	*Per cent of Prewar Acreage*	*Pounds of Cotton Lint*	*Per cent of Prewar Cotton Total*	*Pounds per acre of Cotton Lint*
1937–41	453,000	100%	45,800,000	100%	106
1938–39	408,000	90%	42,000,000	92%	103
1946–47	171,000	38%	8,720,000	19%	51
1947–48	222,000	49%	17,230,000	38%	78
1948–49	219,000	48%	17,230,000	38%	79
1949–50	216,000	48%	15,850,000	35%	73
1950–51	221,000	49%	17,230,000	38%	78
1951–52	255,000	56%	15,400,000	34%	61
1952–53	294,000	65%	20,600,000	45%	70

A primary consideration of the cotton lint to be used in indigenous production is quality. At the present time, over 80% of all Burma cotton is BCF, or Wagale, cotton. Due to the short $\frac{1}{2}$ in. to $\frac{5}{8}$ in. strand of this cotton, it cannot be utilized for spinning normally above a No. 12 count weaving yarn. This factor restricts its use considerably so that only a comparatively small proportion of all weaving cotton consumed in Burma can use Wagale as the basic material. Consequently, it is of the utmost necessity to develop increased acreages of Burma with a longer staple cotton that can be used to spin up to at least No. 20 count. If this can be accomplished, then eventually, 80 to 90% of all Burma cotton cloth and yarn can be produced from Burma cotton; and imported cotton textiles, as the largest single source of all imports, will be greatly reduced.

The volume and type of cotton that must be grown in Burma to make this country self-sufficient and eliminate imports has been previously reviewed. The next step to consider is the necessary implementation for the indigenous manufacture of textiles which Burma now consumes. On the following page is a chart based on the equipment required to produce the textiles currently consumed as well as those required in future years when Burma will be able to provide its people with 30 yards per person per year on a par with other countries.

(d) Justification. The production and availability of cotton textiles are basic in the provision of clothing, household articles, and industrial goods. Clothing alone will consume approximately 75% of all cotton goods produced and affects vitally the health and welfare of city, village and rural people alike.

(e) Importance of project in relation to Burma economic program. One of the major objectives of the economic development program is to utilize Burma's basic resources to increase her independence of imports. Prior to the war, Burma had an average of 450,000 acres of cotton producing an average of 45,800,000 pounds of cotton lint. Over 95% of this cotton was exported for a value of approximately K95 lakhs. In return, over K4·5 crores of finished cotton textiles and yarns were imported. The Burma economic program will plan to produce a large part of these textiles in Burma with the eventual implementation of the necessary spinning, weaving and finishing machines. These facilities will result in minimizing the import of cotton textiles and conserve foreign exchange expenditure. The difference in the value of the raw cotton and the finished textile will go to labor, factory and merchant within Burma rather than be expended on imports from abroad.

(f) Direct employment. The average cotton spinning factory composed of 20,000 spindles will require approximately 900 workers for three full shifts per day. This number includes both factory workers, clerical and office staff. The average 200-loom weaving plant will require about 125 workers for three full shifts. The average bleach and finish section handling ten million yards per year* and dye and print section handling five million yards per year* will require about 150 workers for three full shifts.

To produce the amount of cotton textiles currently consumed by Burma† would require approximately 5·2 spinning factories (for No. 20 count and under), 28·7 weaving mills, and about 13 finish and dye plants of the above indicated size. On a three-shift basis, the total workers and staff for all plants would amount to slightly over 10,000 people.

Skilled Workers. Almost all textile workers are obtained presently from the cottage industries. As there is estimated to be approximately 250,000 hand looms in Burma, it follows that there are a great

* 24 hour day operation.

† Refer to "Burma Implementation Chart for Self Sufficiency," on Part C 1 (c).

BURMA IMPLEMENTATION CHART FOR TEXTILE SELF SUFFICIENCY

Total Cotton Textiles Consumed	*No. of Spinning Factories equivalent of present Government Spinning Factory[3] of 20,000 Spindles*		*Number of Weaving Mills 200 Loom[6] Size*	*Capacity of Bleach and Finish Facilities at 90% of all Yarn Consumed*	*Capacity of Dye and Printing facilities at 50% of all Yarn Consumed*
	To Spin all Textile Yarn Counts, 100% of all Yarn Consumed	*To Spin only Count No. 20 and under, about 80% of all Yarn Consumed*			
Current[1] Burma Textile Consumption at 8 yds/person/year 150,415,042 yds/year	6·4[4]	5·2 (inclusive of present factory)	28·7[7]	135,500,000 yds./year	75,207,521 yds./year
Burma Objective[2] Textile Consumption at 30 yds./person/year 555,000,000 yds./year	23·7[5]	19·0	105·5[8]	499,500,000 yds./year	277,500,000 yds./year

[1] Refer to "Total Annual Burma Cotton Cloth Yardage, 1951–52" on page L 152.
[2] Refer to "Consumption by Country of Cotton Piecegoods Per Person Per Year" on page L 152.
[3] Capacity rated at 4,675,000 lbs./year/2½ shifts (90,000 lbs./wk.) or 92% of absolute efficiency. (Note: If factories were operated with an extra fourth shift for 365 working days/yr. production would be increased approximately by 60%).
[4] Refer to "Total Annual Consumption of Burma Cotton Cloth in Pounds Weight, 1951–52" on page L 155.
30,083,008 lbs. Tot. Cloth: 4,675,000 lbs. Govt. mill/yr.=6·43 factories.
[5] 111,000,000 lbs. Tot. Cloth: 4,675,000 lbs. Govt. mill/yr.=23·74 factories.
[6] Present accommodation of Govt. spinning and weaving factory.
[7] For present calculation, hand looms have been discounted. But machine looms are:
at 35 yds./loom/8 hrs.=87·5 yds./loom/2½ shifts/day.
87·5 yds. x 300 working days/yr. =26,250 yds./yr./2½ shift.
26,250 yds./yr. x 200 looms=5,250,000 yds./yr./200 looms.
150,415,042 yds./yr. total consumption: 5,250,000=28·65 Govt. mills.
[8] 555,000,000 yds./yr. total consumption: 5,250,000=105·5 Govt. mills.

number of people experienced in this work. The Burman is well adapted to mechanical work of this nature. An inexperienced man can do well with six months apprentice training in the mill.

For highly skilled workers of the administrative level, a good botanist and entomologist are needed for the agricultural research required in developing a longer staple of Burma cotton with a high yield per acre and which is healthy and fairly immune to insects and disease. A limited number of other skilled administrative workers are required such as experienced spinning, weaving, finishing, printing and dyeing experts.

(g) Foreign exchange conservation. The conservation of foreign exchange is one of the basic and most outstanding reasons for Burma to become self sufficient in the supply of textiles. For the year of 1950–51, Burma paid out almost K25 crores for imported cotton goods alone.

(h) Economic feasibility. The present period is not well adapted for immediate expansion in the field of cotton textiles especially in regard to spinning and weaving. A condition of overstocked cotton goods throughout world markets has resulted in a considerable decrease in both price and demand. Due to an unusually large USA crop and with India and Pakistan pressing for sales, the over-all world market for cotton dropped from K700 per bale in 1951 to a low of K395 per bale in 1952. Prices are increasing slowly, but the normal market probably will not fully return for another few years.

The Government cotton spinning and weaving factory at Thamaing is just recently commencing to show progress towards profitable operation. Its inception took place under extremely adverse conditions in the world cotton market. Many experienced and long-standing mills were forced to shut down or curtail operations in other countries. The Government spinning factory has been handicapped in the following ways:

(*1*) Labor difficulties within Government factory resulting in top-heavy labor costs and lowered efficiencies and standards.

(*2*) Inability of Government factory to weave higher than a No. 12 count* from 100% Burma cotton.

(*3*) Unstable cotton market and high prices paid for Burma cotton used.

* A limited amount of No. 16 count yarn is spun from a select portion of indigenous cotton, but this is not available in quantity.

(4) Lack of satisfactory or sufficient sales representation. (A separate, well-staffed sales office is required to sell the output of the spinning factory months in advance).

(5) Necessity of importing foreign cotton for mixtures capable of spinning higher than a No. 12 count.

(6) Excessive drop in over-all world cotton market with an oversupply of cotton.

(7) Necessity for cooperative and well designated authority within the plant to simplify administrative directives.

(8) Necessity for closer cooperation and contact between the Government spinning factory and the directors of the Government Agricultural Cotton Board toward developing and producing a longer staple indigenous cotton.

(9) Lack of a textile and agricultural laboratory for testing fibers both in raw cotton and in finished cloth. (All work must now be sent to Matunga Cotton Laboratory, Bombay).

(10) Facilities for finishing, dyeing and printing are completely lacking, and bleaching capacity is too limited (800 lbs. cloth).

(11) Facilities for doubling, or twisting, yarn is not available.

(12) Spinning machinery suitable for producing yarn up to No. 40 count only.

(13) Weaving of cloth is confined to widths commensurate with reed spaces of 50-inch on looms.

(14) Lack of advertising. Government factory is in competition with private mills and should advertise to encourage buying. (Many textile people have been unacquainted with Government mill products).

(i) Description and cost of plant. A cotton spinning and weaving factory comparable to the present Thamaing plant of 20,000 spindles and 200 looms would cost about K1,75,00,000 inclusive of machinery, buildings and installation to replace at the present time* The machinery would cost K1,25,00,000 installed, and the buildings are estimated at K50,00,000. The 200 looms would cost K12·5 lakhs installed as a separate unit, exclusive of building, but have been included in the above over-all price.

A bleach, finish, dye and print plant composed of facilities for handling ten million yards per year† in bleach and finish section and five million yards per year in dye and print section† will cost K20 lakhs, installed in Burma inclusive of drainage, foundations and buildings.

(j) Raw material cost. The price of lint cotton purchased in bales for the Government spinning factory is as follows:

* Not including land.

† Operating 24 hrs./day at 300 days per year.

Price of Cotton Lint, 1952:

K1.95/lb.—$\frac{1}{2}$ in. staple, Wagale, Burma Cotton
K2.20/lb.—$\frac{3}{4}$ in. staple, M3, Burma Cotton
K2.14/lb.—$\frac{7}{8}$ in. staple, American Cotton
K2.20 lb.—$\frac{7}{8}$ in. staple, L.S.S., Pa.

Price of Cotton Lint, 1953:

K1.10/lb.—$\frac{1}{2}$ in. staple, Wagale, Burma Cotton
K1.25/lb.—$\frac{3}{4}$ in. staple, M3 and M5, Burma Cotton
K2.00/lb. $\frac{7}{8}$ in. staple, American Cotton

The price of cotton yarn sold by the spinning section of the Government factory, and which is used also by the weaving section, is as follows:

Selling Prices of Government spinning factory yarn

K1.70/lb.—No. 5 count weaving yarn.
K2.40/lb.—No. 10 count weaving yarn.
K2.50/lb.—No. 16 count weaving yarn.
K2.60/lb.—No. 20 count weaving yarn.

(k) Production cost and earnings. The production cost of No. 10 count yarn should be as follows:

Item	*K/lb*	*Per cent of Total Cost*
Wagale Burma Cotton	K1·100	50·5%
Direct Labor	K0·263	12·1%
Overhead and General Labor	K0·817	37·4%
Total Cost Price	K2·180	100·0%

The selling price is K2.40 per pound; therefore the profit is equal to K0.22 per pound of yarn, or about 10% of the cost price.

In recent years, however, both the cost price of Wagale cotton and the general labor and overhead have been excessive. This has resulted in eliminating what otherwise would have been profit for operational investment. In the last six months, much of this overhead has been reduced, and cotton prices are tending also to return to more normal figures. With continued improvement in operating efficiencies, the Government spinning factory stands to make a much improved showing for the year 1953–54.

Of course, Burma will be unable to grow all the types of cotton needed to weave the piecegoods that are now imported. For the manufacture of the higher counts of cotton, possibly above No. 22 or No. 30 count, cotton will always have to be imported. But other competing countries such as India, Japan and the UK must also import their cotton from Egypt and America for these higher counts. This fact places their competition on much the same footing as Burma. And with increased efficiencies, the Government mills of Burma will be able to meet favorably this competition when it is later necessary. For indigenous consumption, the privately operated Burma weaving factories have been profitably importing the high count yarns for some years. Whether it is possible to export profitably the cloth woven from imported yarns is another question. This would place Burma in direct competition with such worldwide textile leaders as India, Japan and even the UK. At the present time, the textile industry in Burma is not sufficiently aged or experienced to qualify for such competition, nor is it necessary with the present undeveloped and unexpanded condition of the indigenous market.

(l) Existing production facilities. The Government spinning factory at Kamayut has 70 frames totaling 20,160 spindles at 288 spindles to the frame. This is the only active spinning factory presently in Burma* and its maximum capacity is rated at 4,675,000 lbs. per year per $2\frac{1}{2}$ shifts at 92% of absolute efficiency.

In regard to weaving equipment, it is estimated that there are approximately 400 power looms: 200 are in the Government spinning and weaving factory and the remaining number are divided among about six factories in the Rangoon area with only a few in Mandalay. The output of the average powerloom is between 30–35 yds. per eight-hour day. As most powerlooms are now operated on a $2\frac{1}{2}$ shift day, the output per loom per year of 300 operating days is 26,250 yards.† For 400 looms, this totals 10,500,000 yds. per year.

The output of the average hand loom is estimated at six yds. per eight-hour day. Out of the 250,000 handlooms in Burma, it is estimated that only 60,000 are in use owing to present conditions of poor communication and difficulty in obtaining the right type of yarn and labor. Much handloom operation is seasonal for periods of non-agricultural activity where the operator will work in the fields for planting and harvest and then operate his loom when not otherwise occupied.

There is a definite scarcity of textile bleaching, finishing, dyeing and print works in Burma. For bleaching and finishing, a few of the larger textile mills have their own facilities, but there are far too few to service the greater amount of cloth required. Consequently, most handloom products are not finished and are sold at much lower prices than similar quality cloth that has been finished at little additional expense. Cloth dyeing is often handled by either the finishing plant or printing establishment. Yarn is often dyed by the handloom operators themselves. Most dyeing is poor both in respect to colors and finish. There is an urgent need for training printers and dyers, and a technical dye chemist is needed.

There are less than 100 printing establishments in Burma. About 80 handwork printing shops are in Rangoon, but, with the exception of a few semi-mechanized plants, all work is done by hand. Each table of handblock printing can turn out 150 yards per day. The largest printing works in Burma uses wooden rollers and is in Mandalay. This shop turns out approximately 3,000 yds. per day, or 900,000 yds. per year of printed material using Azo dyes.

(m) Recommendations. Burma can absorb another four cotton spinning mills of a size equivalent to the present Government spinning factory. It is debatable as to whether the size should be smaller or larger than the present plant. As a larger plant is more economical to operate, it may be advantageous to establish a twin to the present 20,000-spindle plant in the Mandalay or Myingyan area. This plant will be so designed that an additional 20,000-spindle plant can be annexed to it at will. The size of the plant will be determined in part by the availability of workers, access to the market, shipment of raw materials, and finally by the economics of the world cotton market.

At the present time, the world textile markets are overstocked and raw cotton has been selling at a comparatively high price while cotton goods have been selling at a low price. This factor, coupled with unsettled labor conditions, lack of established plant routine, lack of buyer's market, and need for continued development of a longer staple indigenous cotton, make it inadvisable to consider a second plant whilc the first plant has been unable to satisfactorily circumvent or bridge such difficulties. This coming year may find many improvements in operational routine and if sales and production efficiency are on the way to establishing a plant of beneficial economic returns, then the construction of further spinning mills can be profitably considered. In another five years, however, the present plant will have provided indispensable experience and the other plants to follow will be able to benefit materially and financially by this pioneering.

* The Violin Hosiery Works at Insein has 5,000 spindles used mostly for producing "knitting" yarns which are different from the "weaving" yarns spun by the Government factory. These spindles are not now in continuous active use.

† At 35 yds. per loom per eight-hour day.

With the consideration of the second and third spinning factory being located in the Mandalay district, the fourth plant can be annexed as an additional section to the existing Thamaing plant in Rangoon. If a fifth plant is still later considered, it can either again be added to the existing Thamaing plant or it might be located in the Moulmein area. The Thamaing plant is so located and designed that there is sufficient space and facility for expansion.

In regard to weaving mills, the average total annual consumption of cotton piecegoods in Burma is slightly over fifteen million yards per year. To replace this entire amount would require about 28 weaving factories of about 200 looms each*. The total amount of cotton piecegoods imported for 1951–52 was 68,921,212 yards. If the capacity of 200 looms is 5,250,000 yds./year per 2½ shifts, then these imports would require the work of 13·1 such 200-loom plants.

Imports of cotton goods for the year of 1950–51 were much heavier, being almost twice as great or 122,307,680 yards, which would require the work of 23·3 such 200-loom plants.

At the present time, there are only about 400 powerlooms in Burma which together would form the equivalent of two plants at 200 looms each. The remainder of the indigenous supply of cloth comes from Burma's estimated 250,000 handlooms which can each produce six yds. per eight-hour day, although only a fraction of these looms are producing. The handloom fits well into the economy of the country at the present time. It provides additional income for many rural families between the harvesting periods of their crops which is often their principal livelihood. But with open competition, the handloom cannot compete with the inexpensive machine-made cloths and still continue to pay its operators a living wage. At the present time the indigenous production of cloth is protected by certain import regulations levied against foreign machine-made goods. But this is an artificial temporary protection at its best, and when indigenous machine-made goods can compete successfully without this tax, the living cost of the people will be greatly reduced as clothing is a necessity used by everyone. India, Japan and the UK import much of their raw cotton the same as Burma and they can still ship their products often thousands of miles to Burma and undersell the indigenous market here. Raising the tariff rates will not lower the price of cloth. The textile industry in Burma is just starting, but eventually it will be able to meet foreign competition on an equal footing. In the meantime, much experience and wide adaptation to the many complexities of textile production is being effected. The handloom will fit somewhat into the picture of present high cost production, but if the economies of the machine-loom are mastered and foreign competition is evenly met, the resulting price of textiles, household materials, and clothing will play an important part in reducing the present exorbitant living costs. With the efficient installation of the necessary machinelooms, the handlooms will be too costly to operate with the exception of the better artcraft of ornate and unusual patterns.

* The size of the present Government weaving factory at Thamaing.

The current season, however, is hardly the time to institute machineloom factories in the Burma economy. For the past few years, the world cotton market has been greatly overstocked and oversupplied with the result that prices have been reduced to a minimum. Other countries with far greater textile experience have been forced to curtail the operations of their plants. The private machineloom industries in Burma have also been reduced in their operations, although a few have as much business as they can handle. The Government weaving factory at Thamaing is operating at only one-third capacity due to lack of orders. When the buying market returns more to normal for cotton piecegoods and the present Government weaving factory has improved the efficiencies of its operation, and can meet competing prices, and has stocked a healthy log of orders through an expanded sales department, then the installation of further machineloom plants can be considered. With this in mind, it is recommended that a 200-loom weaving plant be later added alongside of the present Government weaving factory at Thamaing. Later, the districts of Mandalay, Moulmein and Akyab will qualify for consideration as possible machineloom locations.

A bleach, finish, dye and print section is recommended currently for annexation to the Government spinning and weaving factory at Thamaing. This section should have a capacity for the following:

Bleach Section†	—10,000,000 yds./yr. (33,300 yds. per 24-hr. day)
Finish Section	—10,000,000 yds./yr. (33,300 yds. per 24-hr. day).
Dye Section	— 5,000,000 yds./yr. (16,600 yds. per 24-hr. day).

The output of the present 200 looms at the Government factory is 5,250,000 yds. per year per 2½ shift capacity. This amount is just about half the capacity of the bleach and finish sections, although yarn from the spinning factory will also be processed here.

† Production of all sections is for 24-hr./day operation.

TABLE OF COTTON TEXTILE IMPORTS–EXPORTS

COTTON PIECEGOODS (COLORED, PRINTED OR DYED)

Year	Imports Quantity Yards	Imports Value Per Yd. K	Imports Value Total K	Exports Quantity Yards	Exports Value Per Yd. K	Exports Value Total K
1936–37	79,083,937	0.21	1,72,29,628	399,719	0.25	103,359
1937–38	93,889,127	0.23	2,18,94,446	5,903	0.36	2,136
1938–39	74,519,952	0.22	1,68,23,447	7,454	0.33	2,510
1939–40	101,059,930	0.22	2,32,08,618	947	0.86	815
1940–41	98,421,326	0.26	2,60,46,688	5,910	0.48	2,870
1945–46	5,529,319	1.56	86,58,757	nil	nil	nil
1946–47	5,864,265	1.58	93,20,979	nil	nil	nil
1947–48	43,494,536	1.46	6,37,41,919	12	5.83	70
1948–49	15,228,351	1.59	2,42,72,971	nil	nil	nil
1949–50	54,363,849	1.21	6,60,04,793	N.A.	N.A.	N.A.
1950–51	51,522,407	2.14	11,03,76,498	N.A.	N.A.	N.A.
1951–52	27,899,655	1.61	4,49,28,384	N.A.	N.A.	N.A.

N.A. = Not available.

COTTON PIECEGOODS (UNDYED)

Year	Imports Quantity Yards	Imports Value Per Yd. K	Imports Value Total K	Exports Quantity Yards	Exports Value Per Yd. K	Exports Value Total K
1936–37	80,789,703	0.20	1,61,63,977	208,650	0.22	45,915
1937–38	76,610,646	0.22	1,70,51,067	nil	nil	nil
1938–39	63,091,287	0.19	1,24,21,696	1,600	0.25	400
1939–40	77,829,430	0.19	1,48,43,781	nil	nil	nil
1940–41	75,077,220	0.21	1,56,67,456	nil	nil	nil
1945–46	3,750,618	1.18	44,44,172	nil	nil	nil
1946–47	24,249,265	0.92	2,25,47,141	nil	nil	nil
1947–48	30,273,896	1.16	3,53,11,854	nil	nil	nil
1948–49	7,357,936	1.23	90,73,295	nil	nil	nil
1949–50	15,478,504	0.88	1,37,00,157	N.A.	N.A.	N.A.
1950–51	70,785,273	1.31	9,31,30,410	N.A.	N.A.	N.A.
1951–52	41,022,057	1.00	4,11,78,556	N.A.	N.A.	N.A.

N.A. = Not available.

COTTON TWIST AND YARN

Year	Imports Quantity Tons	Imports Quantity Pounds	Imports Value Per lb. K	Imports Value Total K	Exports Quantity Pounds	Exports Value Per lb. K	Exports Value Total K
1936–37	5,548	12,429,449	0.50	62,70,770	42,380	1.18	50,010
1937–38	5,146	11,529,069	0.58	67,49,680	nil	nil	nil
1938–39	7,380	16,564,275	0.60	1,00,86,110	nil	nil	nil
1939–40	9,960	22,328,452	0.55	1,23,32,443	nil	nil	nil
1940–41	21,100	47,404,983	0.53	2,53,32,895	374,850	0.45	188,724
1945–46	nil	nil	nil	nil	nil	nil	nil
1946–47	386	86,713	4.13	3,58,210	nil	nil	nil
1947–48	1,350	3,034,590	2.53	76,87,848	nil	nil	nil
1948–49	2,440	5,484,524	2.81	1,54,43,068	nil	nil	nil
1949–50*	5,680	12,704,966	3.45	4,38,92,543	N.A.	N.A.	N.A.
1950–51	3,900	8,739,197	4.87	4,26,02,023	N.A.	N.A.	N.A.
1951–52	6,120	13,698,666	7.95	10,89,20,982	N.A.	N.A.	N.A.

Government imports excluded. N.A. = Not available.

* Figures for 1949–50 includes cotton thread also.

RAW COTTON

IMPORTS

Year	Quantity Tons	Quantity lbs.	Value Per lb. K	Value Total K
1936–37	3	6,720	0.20	1,345
1937–38	2	4,480	0.21	977
1938–39	4	8,960	0.14	1,260
1939–40	10	22,400	0.12	2,872
1940–41	84	188,160	0.20	39,434
1945–46	nil	N.A.	N.A.	181
1946–47	1,114	2,495,360	0.63	15,85,937
1947–48	5,103	11,430,720	0.67	76,63,222
1948–49	nil	N.A.	N.A.	34
1949–50	34	76,160	0.94	71,650
1950–51	519	1,162,560	1.95	22,72,042
1951–52	1,838·4	4,118,016	1.97	81,36,471

N.A. = Not available.

EXPORTS

Year	Quantity Tons	Quantity lbs.	Quantity Bales at 400 lbs. each	Value Per lb. K	Value Total K
1936–37	23,455	52,539,200	128,138	0.24	1,26,96,505
1937–38	18,606	41,677,440	104,211	0.21	88,10,000
1938–39	16,648	37,291,520	93,257	0.20	75,43,955
1939–40	17,979	40,272,960	100,659	0.25	1,02,23,068
1940–41	16,579	37,136,960	92,811	0.21	78,70,324
1945–46	nil	nil	nil	nil	nil
1946–47	2,389	5,351,360	13,320	1.10	59,15,513
1947–48	9,572	21,441,280	61,885	0.97	2,08,11,581
1948–49	4,276	9,578,240	676,723	0.75	72,42,372
1949–50	N.A.	N.A.	N.A.	N.A.	N.A.
1950–51	N.A.	N.A.	N.A.	N.A.	N.A.
1951–52	N.A.	N.A.	N.A.	N.A.	N.A.

N.A. = Not available.

This finish and dye plant is not meant to service all of Burma's needs. Its capacity is insufficient for this, of course, but large quantities of grey (unbleached) yarn and cloth that are both imported or manufactured in Burma can be processed here. Silk, rayon and wool goods can also be treated in some instances. Later, a second plant of the same size can be considered for the Mandalay district. The finishing process can often increase the value of the textile by 50% and only a relatively small expense is required by the processing.

(9a) Silk and Silk Products

(a) The market. During 1950–52 Burma imported silk products in the amounts and of values shown in the following table:

	Quantity	*Value - K*
1950–51		
Raw Silk	146,548 lbs.	11,78,134
Silk Thread and Yarn	239,103 lbs.	21,31,818
All Woven Silk Materials	108,660 yds.	2,71,874
		35,81,826
1951–52		
Raw Silk	96,180 lbs.	8,61,621
Silk Thread and Yarn	196,947 lbs.	4,62,300
All Woven Silk Materials	42,771 yds.	1,02,962
		14,26,883

The following table of silk imports for Burma and other countries shows that the volume of silk imported by Burma has exceeded that of Thailand, Indo-China and Indonesia, and is approximately half as much as the silk imported by India and Pakistan with their 450,000,000 people.

SILK TEXTILE IMPORTS
In metric tons

Year	*Burma*	*Thailand*	*Indo-China*	*Indonesia*	*India and Pakistan*	*Italy*
1936	—	20	47	56	910	288
1937	436	20	47	56	910	288
1938	436	20	47	56	910	288
1939–46	—	—	—	—	—	—
1947	*54	2	32	—	287	92
1948	*105	3	107	—	837	88
1949	133	6	6	6	52	145
1950	172	8	*14	*1	311	300

* Estimated figures.

There is a substantial domestic and foreign market for silk thread, yarn and fabrics, that can be supplied by the rehabilitation and expansion of the silk industry in Burma. The economic aspects of the industry are particularly favorable since it can be developed on a rather widespread cottage industry basis, with small capital outlay. It will provide employment for a large number of people in areas where employment opportunities are now limited. Steps in the rehabilitation of the silk industry have been undertaken.

(b) Possibility of domestic production.

(1) *General*

At the present time much of the silk yarn is imported from Japan, although Chinese silk is preferred. The climatic conditions in parts of Burma are favorable to the cultivation of mulberry trees and silk worms. One acre of mulberry will produce about 500 pounds of cocoons or 45 pounds of raw silk†.

The areas most suitable for the silk industry are the Myitkyina district, Chin Hills, Prome district, Toungoo district, Maymyo, Lashio, Kutkai, Kalaw, Taunggyi, Loikaw and Loilam. The Burma groups best suited to sericulture are the Yebeins, Karens, Kachins, Chins, Shan-Burmans and Nepalese. These people have been developing sericulture since prewar days. The various phases of the silk industry require many manual operations that cannot be accomplished entirely by machine. An inexpensive labor supply is therefore a pre-requisite to economical operations. The wages of the silk weaver usually are affected somewhat by the seasons. Wages for six months of the year are normal; for three months are good, and for the three remaining months are poor. During the three "poor" months, the weaver will weave about two yards of silk a day and will receive about K2.50 Each loom will weave about five viss of yarn a month, enough material for about 30 longyis. The labor involved is paid about K45 for weaving one viss of silk.

(2) *Phases of the silk industry*

(*a*) *Production and utilization.* The silk industry is divided into two main phases, production and utilization. "Production," or sericulture, includes the systematic cultivation of mulberry plants, bushes and trees, and the scientific rearing of silk worms. The second phase, "utilization", includes the reeling of cocoons, silk spinning, silk throwing, silk dyeing and silk weaving.

(*b*) *Silk Manufacture.* 1. *Quality of Cocoons.* The cocoons are divided into 4 qualities as follows: *a.* Cocoons clean and firm; *b.* Cocoons, otherwise good, but stained by crushed cocoons; *c.* Weak cocoons; *d.* Cocoons crushed and badly stained from within.

† About 9 lbs. silk per 100 lbs. of cocoons.

2. *Reeling*. Reeled silk is known as raw silk, and the object is to bring together two or more, generally from 5 to 20 cocoons and to form them into continuous, uniform, and regular strands, known as raw silk. Reeling is carried out in a "filature" which consists of 20 to 300 reeling basins. Female labor is usually required as the work is extremely delicate. Filatures are constructed to enable four, six, to eight skeins to be reeled by one reeler at a time. Thread breakage is not a problem as good silk will stretch one third of its own length before breaking.

3. *Throwing*. Throwing is the operation of twisting and doubling raw silk into more substantial yarn. This is the least skilled operation in the manufacture of silk and may be performed by inexpensive unskilled labor.

4. *Weaving*. The types of looms are similar to those used for other textiles. There are the three types; plain, box, and jacquard. The plain loom weaves flat fabrics such as taffetas and linings. The box loom weaves the crepes and novelties. The jacquard loom is an intricate mechanism and weaves elaborate designs for damasks, brocades and lamé.

5. *Degumming*. Degumming is done as part of the dyeing and finishing operation to remove the natural gum or coating of albuminous matter which is part of the filament spun from the cocoon.

6. *Spinning of silk waste*. Silk waste is silk unsuited for the throwing process. The silk "throwster" takes the perfect thread and the silk-waste spinner takes the imperfect thread.

(c) Recommendations. Such phases of the silk industry as the establishment of mulberry plantations, silk worm rearing, organization of cocoon markets and silk weaving are now being carried out under the direction of the Superintendent of Cottage Industries assisted by UN experts. The most important consideration along industrial lines is the need for a central filature or silk reeling mill. When reeling is done by the rearers themselves, the quality of the thread is usually poor, and a large portion of the silk is left as waste. A central filature will produce a high uniformity and continuity of each thread for the benefit of the rearer and of the trade. Crude home-made machines cannot do this.

Installation of a silk reeling mill with a capacity of 575 pounds silk output per day, or 172,500 pounds a year, is recommended. This is slightly less than the poundage of silk thread and yarn imports for 1951–52. A plant of this capacity will cost about K4,00,000 and is believed sufficiently large for the preliminary step in the industrialization of the silk industry.

(9b) Rayon and Rayon Products

(a) The market. Artificial silks are extensively used in Burma. The value of imported artificial silk manufacture reached the considerable amount of almost K3,00,00,000 for the year 1951–52. The import-export data do not differentiate between rayon and other artificial silks such as nylon. As rayon is the lower priced material and because the average cost per yard of all imported artificial silk manufactured was K1 per yard, it is evident that by far the greater proportion of imports were rayon.

Rayon is a strong competitor of cotton, silk and nylon. Some of its most popular uses are the following:

General Types of Finished Goods Using Rayon

(1) *General Uses*. (*a*) Rayon canvas for tennis shoes, rubber soled shoes. (*b*) Linings for trunks, suitcases, shoes. (*c*) Umbrellas, ribbons, fringes, braids, labels, bindings.

(2) *Industrial*. (*a*) Rayon cord for automobile tires, automobile upholstery.

(3) *Men's and boy's wear*. (*a*) Jackets, underclothes, sport shirts, shirts, socks, trousers, longyis. (*b*) Suit linings, coat linings, hats, gloves, ties.

(4) *Women's and children's apparel*. Longyis, dresses, underwear, hosiery, linings, sweaters.

(5) *Household uses*. Curtains, bedspreads, draperies, upholsteries, quilts, blankets.

The use of rayon has increased where it is used as a crossweave with cotton in weaving cloth. The Government cotton spinning and weaving factory would often prefer to use rayon to weave with indigenous cotton as it is 100% usable, whereas approximately 10% of imported cotton must be discarded as waste. For automobile tire cord bodies rayon is greatly superior to cotton due to its ability to increase in strength and elasticity with heat. If automobile tires are manufactured in Burma, the availability of rayon would be advantageous. Where rayon is used as a substitute for silk or nylon, its popularity is decreasing. Rayon will not stand repeated washings and wear like silk, nylon or cotton.

(b) Possibility of domestic production

(1) *Raw materials*

The essential raw materials required in the production of rayon are cellulose materials. Burma is in a favorable position insofar as most indigenous raw materials are concerned. Not only is cotton the purest form of cellulose available, but also other cellulose materials such as bamboo, bagasse, reeds, and hard and soft woods are available in abundance.

Much work has been done in India on the processing of these materials to provide a suitable rayon pulp. A pilot plant to test such materials and convert them into rayon pulp on a semi-commercial scale has been established.

The raw materials and amounts required per pound of viscose process rayon yarn are as follows:

Raw Materials Required per Pound of Viscose Rayon

1.	1·15 to 1·25 lbs.	Wood pulp and cotton
2.	1·4 lbs.	Caustic soda
3.	0·35 lbs.	Carbon bisulphide
4.	1·7 to 1·9 lbs.	Sulphuric acid
5.	0·5 lbs.	Glucose
6.	0·4 lbs.	All other chemicals
7.	100 to 200 gallons	Pure soft water

The above figures represent the gross consumption and do not show recovery of chemicals or materials.

The manufacture of carbon bisulphide should take place at the rayon plant site, as this chemical is highly inflammable and dangerous to transport. Sulphuric acid could be manufactured at the plant site, if it is not available within economical transportation distance of the plant. Caustic soda is an important chemical, and a rayon plant located near a caustic soda plant would be an advantage, as it could purchase its caustic soda in liquid form, thus saving the cost of concentrating, and later on, dissolving the caustic. The other chemicals required for the manufacture of viscose rayon are only of minor importance, as the quantities are small.

(2) *Cost of plant*

The table below shows the estimated cost of three sizes of plants for the manufacture of rayon yarn by the viscose process. The capacities of these plants are 750, 1,500 and 3,000 tons of yarn per year. The present imports of artificial silk products of all types are estimated at 1,250 tons per year. The estimate does not include a weaving plant to produce rayon cloth from the yarn. The costs are given in rupees (Indian) as they are based on the costs of an installation to be built in that country.

(c) Recommendations. While the present consumption of artificial silk products in Burma is large enough to justify the construction of a rayon plant of possibly 1,500 tons per year, this is not an essential industry, and should be deferred for inclusion in a long range plan, or until the basic industries are completed and are in successful operation.

(9c) Wool Textiles

Burma, prior to the World War II, produced a substantial quantity of raw wool, but exported most of it. The postwar production is far below the prewar rate, due to the loss of a large number of edible animals during the war. Some raw wool has been

ESTIMATED CONSTRUCTION COST
RAYON YARN MANUFACTURING PLANTS

I. Capitalization	*(750 tons/yr.)* *2·5 tons/day*	*(1,500 tons/yr.)* *5 tons/day*	*(3,000 tons/yr.)* *10 tons/day*
(*a*) Land and Buildings	Rs. 28,78,000	Rs. 28,78,000	Rs. 42,53,000
(*b*) Machinery and Equipment	89,50,000	1,59,80,000	2,95,81,000
(*c*) Erection and Starting	11,40,000	16,34,000	23,10,000
(*d*) Working Capital	6,30,000	12,60,000	25,20,000
Total Capitalization	1,35,98,000 (cost=35% of 10 ton/day plant)	2,17,52,000 (cost=56% of 10 ton/day plant)	3,86,64,000 (100%)
II. Production Cost	*2·5 tons/day*	*5 tons/day*	*10 tons/day*
	annas	annas	annas
(*a*) Raw Materials and Chemicals	10·18	10·18	10·18
(*b*) Labor and Supervision	1·81	1·37	1·02
(*c*) Power, Fuel, and Water	2·40	2·11	2·11
(*d*) Maintenance and Supplies	1·35	1·10	1·10
(*e*) Depreciation	4·70	4·11	3·98
(*f*) Miscellaneous	·20	·10	·10
Total Cost per lb. of Rayon Yarn	20·64 =Rs. 1/4/8	18·97 =Rs. 1/2/11	18·49 =Rs. 1/2/6

Above figures include the following items:
Land, Buildings and all Construction Work
Main Process Plant
Auxiliary Equipment
Steam-Power Plant
Water Plant
Carbon Bisulphide Plant
Sulphuric Acid Plant
Warehouses, Workshops, Garages, Office Buildings and Living Quarters for Engineers.

imported, but the quantity is very small, with none recorded in the last four years. The following table shows these figures.

RAW WOOL

Year	*Imports*			*Exports*		
	Quantity	*Value*		*Quantity*	*Value*	
	lbs.	*Per lb. K*	*Total K*	*lbs.*	*Per lb. K*	*Total K*
1936–37	179	3.07	551	297,121	0.29	88,460
1937–38	874	0.52	457	176,747	0.40	71,194
1938–39	1,140	0.26	300	244,857	0.24	60,855
1939–40	—		—	280,262	0.32	93,340
1940–41	—		—	189,006	0.59	1,13,223
1945–46	—	—	—	—	—	—
1946–47	41	6.46	265	20,160	0·26	5,400
1947–48	7	11.28	79	—		
1948–49	—		—	59,578	1.04	62,249
1949–50	—		—	N.A.		N.A.
1950–51	—		—	N.A.		N.A.
1951–52	—		—	N.A.		N.A.

N.A.=Not available.

Burma imports wool thread and exports none. These figures are shown below.

WOOL THREAD YARN

Year	Imports			Exports		
	Quantity	*Value*		*Quantity*	*Value*	
	lbs.	*Per lb. K*	*Total K*	*lbs.*	*Per lb. K*	*Total K*
1936–37	61,635	2.00	1,23,557			
1937–38	215,813	1.46	3,15,690			
1938–39	171,182	1.75	3,01,133			
1939–40	347,233	1.41	4,91,540			
1940–41	117,489	3.33	3,91,487			
1945–46	1,286	6.89	8,868			
1946–47	11,828	7.44	88,095			
1947–48	69,291	8.29	5,74,839			
1948–49	54,957	8.72	4,79,692			
1949–50	88,183	8.35	7,36,768	N.A.		N.A.
1950–51	133,109	11.91	15,86,553	N.A.		N.A.
1951–52	333,252	7.87	26,23,913	N.A.		N.A.

N.A.=Not available.

Burma also imports wool products, mostly in the form of wool carpets and rugs. She formerly exported some carpets and rugs but has not done so since the war. The following table shows these imports.

WOOL CARPETS AND FLOOR RUGS

Year	Imports			Exports		
	Quantity	*Value*		*Quantity*	*Value*	
	lbs.	*Per lb. K*	*Total K*	*lbs.*	*Per lb. K*	*Total K*
1936–37	50,659	1.97	99,954	237	1.48	351
1937–38	87,630	2.46	2,15,653	229	4.34	995
1938–39	83,179	1.66	1,38,130	—		—
1939–40	81,531	2.30	1,88,137	—		—
1940–41	84,173	1.73	1,46,338	400	0.60	240
1945–46	29,830	2.71	80,876	—		—
1946–47	132,770	2.99	3,97,024	—		—
1947–48	76,117	1.69	1,28,943	—		—
1948–49	39,952	0.48	19,352	—		—
1949–50	15,644	1.01	15,945	N.A.		N.A.
1950–51	5,480	6.47	35,497	N.A.		N.A.
1951–52	54,856	8.95	4,91,246	N.A.		N.A.

N.A.=Not available.

The wool products manufactured in Burma from imported wool thread are made in cottage-industry-sized plants. This is principally cloth for clothing. The Cottage Industry Division is considering establishing a new wool cloth weaving industry at Natmauk where wool is produced.

(a) Recommendation. The principal need seems to be for the establishment of raw wool processing plants to produce wool thread. Dyeing plants should be a part of this industry. For the near future this should be kept on a cottage industry basis. Rug and carpet weaving should follow to eliminate the importation of such products.

(10) Meat Packing

At the present time there is no organized meat packing industry in Burma. This is partially due to the eating habits of the people and partly due to World War II during which a large part of the nation's stock was lost. Burma also lacks the necessary facilities for storing and conserving meat products. Consequently, little slaughtering of cattle is done in Burma. Some pork and mutton are available.

The Government is conscious of the lack of cattle in the country and is taking steps to increase the quantity and quality. A cattle breeding center near Magwe has been established and is beginning to show results. The preferred breed of cattle in Burma is not primarily beef stock, but is work stock used for pulling carts and farm implements. Water buffalo are also used for these dual purposes.

Very little meat or meat products are imported. The prewar records disclose that the average prewar import of meat and meat products was only 35,000 cwt. Since the war, this has decreased. The 1951–52 year imports totaled only 1,400 cwt. There is therefore no need to build up a meat packing industry to eliminate imports. The principal need is to improve the diet of the people. As the people of Burma are not basically meat eaters the industry may never reach an important status.

However, the meat offered on the market is poorly prepared and poorly handled. Almost all meat sold is fresh slaughtered as there are no cold storage plants to preserve it properly. The need for a meat packing industry will depend on the growth of the demand for meat products, and the increase in meat animals available for sale. Following this, a refrigerated distribution system must be established. The nation had such a system at the end of the war, when the Allied Armies left complete operable refrigerated cars and barges. Through disuse these facilities deteriorated and were junked.

Any modern slaughter houses and packing plants should be located near the cattle raising areas. Any new plants should be small, but expandable, and should include one or more cold storage plants and refrigerated cars. A 50,000-pound-per-day meat processing and storage plant would handle 1,400 sheep, 119 cattle, and 140 hogs in eight hours. A 170-ton capacity cold storage plant is a necessary part of the unit. A complete plant of this type will cost approximately K91,55,000. Such a plant should be constructed when the meat animals become available.

(11) Dairy Products

The people of Burma consume little milk and dairy products. The climate is not favorable to the preservation of such products. Almost all nationally produced milk is consumed as produced and practically none is processed. No modern creameries exist.

The cattle bred in Burma are principally work animals and produce only a limited supply of milk. Cows' milk is supplemented by water buffalo and goat milk. Few of the milk animals are tubercular tested and no modern dairies exist. Recently however, the Government has established a modern dairy farm near Rangoon as a demonstration project to encourage dairy farming.

Because of the limited quantity of milk produced in Burma, means for collecting and processing it have not been developed. Imported milk in evaporated or powdered form is used to supplement the indigenous supply of fresh milk. Imports of these products total about 150,000 cwt. per year. The most recent declared import values of such products average K70·6 per cwt., so that the present annual expenditures of foreign exchange total approximately K1,06,35,000 per year. These figures do not include butter and cheese.

The estimated average consumption of milk per capita in Burma is about 8·18 kilograms (18 pounds). This is equivalent to less than four imperial quarts per year, an extremely low average. There is no reason why Burma cannot produce her entire requirements of milk and dairy products. The industry must begin with building up dairy herds near the larger cities and towns and growing suitable food for them. This step will require several years. With it must grow a modern milk collecting and processing system. Initially only pasteurizing, bottling and butter making facilities would be required in the processing plant, at least until the supply of fresh milk exceeds the demand. When a surplus of fresh milk becomes available, the processing plant should be expanded to include facilities for making evaporated and powdered milk for distribution to areas where refrigeration is not available. This industry would be especially suitable for private development. To save transportation costs, it would be most economical to have the farms and plants located near the urban centers in which they will have their markets. The most expeditious means of augmenting the present low milk production in Burma is to manufacture a milk substitute as outlined in the following paragraphs.

(11a) Soya Products

One of the valuable farm products that may be successfully and profitably grown in Burma is soya beans. Its value lies in the fact that it may be used directly as a food and that it may be processed into other food and industrial products.

One of the principal manufactured products is a milk substitute called Soyalac. Soyalac is a palatable product entirely free from any objectionable soya bean taste. This milk substitute has excellent keeping qualities and does not deteriorate if properly packed.

Its production in Burma is warranted for several reasons. One is that the Burmese diet is deficient in milk, being only about nine pounds per year per person (about four imperial quarts). A second reason is that Burma does not produce her requirements of milk, as the average annual imports total about 150,000 cwt. valued for import purposes at K1,06,35,000. A third reason is that the production of soya beans for soyalac would provide a new market for this agricultural crop that would increase the national income and employment. A plant or plants to manufacture Soyalac would meet the objectives of the development program in every respect. Milk from this source could be made available much quicker than from the long process of building up a dairy industry.

The analysis of Soyalac proves that it has the same relative quantities of protein, carbohydrates, fats, minerals and vitamins as natural milk. The process is simple, requiring only a few technicians. The powdered and evaporated milk imported is equivalent to 19,000,000 quarts of natural milk per year. There is therefore no doubt of a market outlet for any national milk produced.

A single initial plant having a daily capacity of 20,000 quarts per day would produce 6,000,000 imperial quarts per year on a 300-day year operation. Such a plant would displace about one third of the annual imports of these milk products. It is estimated that a Soyalac plant of this capacity would cost a total of K29,40,108.

The manufacturing cost is estimated to be as follows:

	Annual Cost	*Cost per Quart**	*Cost per Pint**
	K	*K*	*K*
Raw Materials	21,95,400		
Processing	9,39,000		
Packaging	18,00,000		
Distribution	72,000		
	50,06,400	0·8344	0·4172

* Imperial measure.

It is necessary to assume a selling price, as no sales of Soyalac have been made in Burma. For estimating purposes a price of K0.55 per imperial pint has been selected. This is a lower price than that of the milk equivalent of condensed milk sold in Burma and is much lower than that of other milk sold at retail.

On this basis, the profits on the investment of K29,40,108 would be as follows:

	K	*Per Quart K*	*Per Pint K*
Gross Sales	66,00,000	1·1000	0·5500
Cost of Sales	50,06,400	0·8344	0·4172
Gross Profit	15,93,600	0·2656	0·1328

Per cent Return on Investment:

On Gross Profit Basis 54·1%

The actual selling price will be dependent upon the prevailing prices of imported powdered and condensed milk as well as upon the price of natural milk. However, it is evident that there is a wide enough profit margin to absorb a considerable price reduction.

The company formed to construct and operate the proposed plant may be either a government corporation, a joint venture operation, or a private capital enterprise.

In the United States the average yield of soya beans is about 20 to 22 bushels per acre. Recent (1949) average prices received by the farmer for this product were $2.12 per bushel (K10.00). About 12,000,000 acres are regularly planted to soya beans.

In Burma there are no records of the actual production of soy beans. It is estimated that between 1,500 and 4,500 tons per year reach the Rangoon market. The proposed plant will require 1,150 long tons per year to support its operation. Sufficient acreage of soy beans required to support the plant can be developed during the period of its construction. Current prices are:

Domestic K530–725 per long ton
Imported: ex country of origin not including duty.
ex Hongkong K830 c.i.f./per L.T.
ex Manchuria K630 c.i.f./per L.T.
ex U.S.A. K565 f.a.s./per L.T.

The additional raw material requirements are (per year):

210 tons soya oil
277 tons dextrin-maltose (or glucose)
24 tons sugar
106 tons cane sugar
196 tons dextrose
17 tons salt
12 tons $\begin{cases}\text{Soda bicarbonate}\\ \text{Vitamin concentrates}\end{cases}$

All of these can be produced in Burma.

The plant would help both farm and national income, as its product is needed in Burma. It should be constructed as soon as possible after the first year plan has been financed. Additional plants would be justified when this milk substitute has been introduced and if public reception to it is favorable.

(12) Soap

Soap is manufactured in Burma, though a substantial part of it is substandard in quality and the production has been insufficient to meet the national demands. Most high grade laundry and toilet soaps are imported. Import figures for a number of prewar and postwar years are shown in the table below.

Year	*Household and Laundry*		*Toilet*		*Total*	
	Cwt.	*K*	*Cwt.*	*K*	*Cwt.*	*K*
1937–38	64,392	12,94,146	3,494	2,73,227	67,888	15,67,373
1938–39	70,213	13,27,072	3,097	2,60,486	73,310	15,87,558
1939–40	94,666	17,52,531	4,684	3,32,125	99,350	20,84,656
1940–41	87,156	17,01,152	4,228	3,40,985	91,384	20,42,137
Average Prewar	79,107		3,876		82,983	
1946–47	28,485	14,90,876	1,393	1,44,652	29,878	16,35,528
1947–48	30,927	18,14,653	356	68,171	31,283	18,82,824
1948–49					49,000	40,55,000
1949–50					31,000	26,07,000
1950–51					21,000	18,31,000
1951–52					33,000	32,13,000

The postwar imports have averaged only 59% of prewar, but the percentage of each type of soap imported remains constant at 95% and 5% for household and laundry soap and toilet soap respectively. As the declared import value of imported soap per cwt. is now approximately four times that of prewar, the foreign exchange requirement to purchase soap abroad is becoming greater each year.

Good soap in substantial quantities can be made in Burma. This will be particularly true when the pulp and paper factory is in operation with its supporting caustic chemical plant. From this source will come the soda ash required by a soap plant. The other raw materials will all be available from domestic sources. Oils are obtainable from sesamum, groundnuts or soy beans. While all of these are in short supply now, other oil will be made available from rice bran and/or cotton seed. A valuable by-product of a soap plant is glycerin which can be used in the manufacture of pharmaceuticals, and eventually dynamite.

A 10,000-ton soap plant was recently put into operation in Burma by private interests. This plant will contribute materially to the reduction of soap imports since the output will be considerably above prewar imports.

(a) Recommendation. It is recommended that the manufacture of soap be left to private enterprise. Present facilities, including the newly-built soap factory, and cottage industry production should be able to handle Burma's soap requirements without Government participation in this industry. Until soap of higher standard quality is produced in Burma, there will probably continue to be imported a small amount of high grade laundry, toilet and medicinal soap. The Government should establish and enforce minimum quality standards for protection of consumers.

(13) Vegetable Oils

(a) The market. Burma, although primarily an agricultural country, is critically deficient in vegetable oils and oilseeds. In these commodities import expenditures exceed export receipts by over K5,30,00,000 per year. This represents importation of almost 30,000 tons of oil and oilseeds.

The current consumption of oilseeds and oil is lower than that of the immediate prewar years because of the reduced level of income, but there is a definite upward trend and forecasts indicate that this will be maintained. Per capita consumption is presently very much below desirable standards.

Vegetable oils are an extremely important part of the Burmese diet, especially groundnut oil. The complete fat content of the diet, except for minor amounts obtained incidentally in the consumption of meat, fish, and milk, is derived from these oils. The WHO, and others, have indicated that the diet of the average Burman is more deficient in fats than any other single item.

(b) Domestic production of vegetable oils. Oilseeds can be produced domestically at a lower cost than imported seeds. The agricultural section of this Report discusses proposed targets for future output and the problems likely to be encountered in the cultivation of the various oilseed crops. The increased production of oilseeds will provide some additional materials for oil extraction, although another more readily available raw material, and one hitherto unused, is rice bran. Acreage given to rice, or any other exportable crop, will earn foreign exchange. Therefore the desirability of cultivating crops especially for their oil content should be evaluated against the availability of oil from rice bran, an inevitable by-product of Burma's major crop.

The extraction of oil from a widely available raw material, with which every Burman is well acquainted, accords with the general program for economic development. The individual plants give excellent returns on the capital invested, and, as the plants will be situated in various geographical locations, the benefits derived will be spread over a wide section of the population. Expressed in terms of oil equivalent, Burma in 1951–52 used 86,000 tons of oilseeds and oil, of which imports amounted to over 28,000 tons.* Prewar consumption approximated 110,000 tons of oil equivalent, of which 17–20,000 tons were imported.

Rice bran generally contains between 14% and 22% of oil. Bran from Burma rice averages 17% of oil. This oil is at present unused. Except for a small residue, almost all this oil can be extracted. Rice bran is commercially available. Current 1952–53 estimates indicate 179,000 tons, while 1959–60 forecasts show 272,000 tons.

(c) The plant. A solvent extraction plant to process bran at the rate of 100 tons per day would produce 14·25 tons per day of marketable rice bran oil, plus a small percentage of heavier residues. On normal 200-day operation this would amount to 2,850 tons of oil per year. The oil produced by this process is edible. It is also palatable being both odorless and tasteless, and besides being an edible oil, is suitable for many industrial uses including soap and cosmetics manufacturing.

This project has been presented in more detail in a project report previously submitted to Government. The estimated cost of producing rice bran oil is K683.55 per ton, due allowance having been made for the decreased quantity and lowered sales value of bran from which oil has been extracted. By comparison, imported groundnut oil costs K1,800.00 per ton and coconut oil K1,555.00 per ton on a c.i.f. basis. Using a weighted average, a price of K1,600.00 per ton is indicated for comparative purposes, the proposed extraction plant gives an estimated annual gross profit of K26,07,000. A plant of this size is estimated to cost K35,22,250; K5,06,000 in local currency and K30,16,250 in foreign exchange. This indicates that the plant can be paid for out of profits in less than eighteen months.

(d) Availability of management and labor. The project, although a simple chemical process, will require more technicians and management than it is possible to train in the time required to implement

* 1951 52 imports: groundnut oil 8,519 tons, coconut oil 2,076 tons, valued at K4,73,61,869.

this project. However, this deficiency can be overcome by means of a management contract with an appropriately qualified concern that could train Burmese counterparts to take over the complete operation within three to five years, or less if highly qualified persons become available.

The extraction of rice bran oil will be a new industry. Burma is an oil-deficient country. Therefore, as rice bran oil is intended to replace imported oils and not to supplant domestic oils such as sesamum and groundnut, it will create employment in the extraction or processing plants. Similarly, additional employment will result from raw material procurement and finished product distribution. As the product has a high sales value, it will increase the per capita income. Being produced at a low cost, the availability of the oil will tend to stabilize the market for domestic oils and thus prevent shortages which increase prices and the cost of living.

(e) National welfare. The project will make a substantial contribution to the national welfare as it moves towards making Burma self-sufficient in this commodity. As project implementation progresses and additional plants are installed, it will also reduce imports of vegetable oils required for industrial purposes. The benefits will not be restricted to any one group or class of people, as fats are required in every diet.

The proposed project in its earning capacity and elimination of imports will be of major importance to the economy. The above phase is a national step in the rehabilitation of existing industry without undue expenditures on obsolescent plants.

(f) Export of rice bran. The bran with oil extracted has a lower export value than the bran containing oil, but on the basis of United States export prices for the two types of bran, it is estimated that the difference does not exceed 10%. This loss in the export value of bran is much more than compensated for by the foreign exchange gain resulting from reduced imports of oil.

To illustrate this point, seven tons of bran will yield one ton of oil with a value of K1,600.00. Seven tons of unextracted bran, at an export price of K290.00 per ton, will bring foreign exchange receipts of K2,030.00. If the oil is extracted, 5·81 tons of bran will remain. At an export price of K261.00 per ton the 5·81 tons will earn K1,516.00 in foreign exchange. The effect of oil extraction on foreign exchange earnings may be tabulated as follows:

(1) Export value 7 tons of unextracted bran	K2,030.00
(2) Export value 5·81 tons of extracted bran	K1,516.00
(3) Loss in foreign exchange receipts (1 – 2)	K 514.00
(4) Savings of foreign exchange expenditures on 1 ton of oil	K1,600.00
(5) Net gain in foreign exchange (4 – 3)	K1,086.00

Furthermore, there is a foreign market for only a small fraction of Burma's bran at the present time. It would therefore be possible to extract oil from a very large quantity of bran without reducing exports of bran containing oil. The gain in foreign exchange so long as this circumstance continues would be the total value of the oil extracted, or K1,600.00 per ton. Thus it can be seen that the net effect on foreign exchange will be a saving of K31,00,000 to K46,00,000 annually for each plant put into operation.

(g) Recommendations. On the basis of imported oil for edible purposes Burma could absorb the output of ten such plants. This would require a long term program. Immediate benefits would be gained by constructing one plant now, followed by two additional plants at suitable outports as soon as operating experience has been gained.

It is recommended that a solvent extraction plant for the production of rice bran be constructed in the Rangoon area in the near future; that steps be taken to procure a suitable site; and that contract be made for the engineering design of the plant at the earliest possible date. The orders for equipment and materials should be placed as soon as the construction drawings have advanced sufficiently to permit. The construction of the plant and storage facilities should be performed by contract with a firm experienced in chemical plant construction.

(14) Rice Milling

Rice is the most important product of Burma. Its production furnishes most of the agricultural employment. It is the basic food of the nation and of neighboring countries. As it is always produced in excess of national requirements its export brings to Burma the greatest portion of the foreign exchange required to pay for imported commodities.

The 1953 yield is estimated to be 5,740,000 long tons of paddy and for 1959–60 it is expected to be 7,440,000 long tons. As the domestic consumption is not expected to increase greatly in this period, except for normal increases in population, the additional rice is primarily for export to increase the foreign exchange resources of the Government. The prewar rice acreage was 12,832,000 and the average crop 7,426,000 long tons per year. As the world price has increased greatly since the war, the revenue from the export of rice greatly exceeds the prewar income, even with a smaller crop.

As rice is such an important crop to Burma the milling of rice commands a correspondingly important place among the industries of Burma. Because rice is grown in practically every district in Burma the rice mills are well dispersed in seven principal groups. The number of mills and their locations are shown in Table XXII–3 along with the number employed.

TABLE XXII – 3

District	Rice Mills No. of Mills		No. of Workers		Capacity Tons
	1940	1952	1941	1952	
Arakan Division					
Akyab	22 – 5	17	5,499	3,316	675
Kyaukpyu	2 – 2		295		
Sandoway	1 – 1		32		
Pegu Division					
Rangoon Town	36	36	7,588	5,196	2,301
Pegu	67+10	77	2,682		
Tharrawaddy	43+22	65	2,442		
Hanthawaddy	40+ 3	43	3,575	1,126	1,100
Insein	29+12	41	2,240		
Prome	29 – 5	24	1,170		
Irrawaddy Division					
Bassein	56 – 4	52	3,904	4,069	2,161
Henzada	36 – 1	35	2,178	2,240	1,234
Myaungmya	68	68	2,090	2,170	2,008
Maubin	14+ 5	19	330	532	320
Pyapon	52 –19	33	1,936	1,612	920
Tenasserim Division					
Thaton	28 – 17	11	819	261	149
Amherst	34+12	46	1,899	1,372	1,118
Tavoy	7+ 3	10	236	205	269
Mergui	3 – 3		97		
Toungoo	22+ 5	27	848	1,065	1,085
Magwe Division					
Thayetmyo	1 – 1		32		
Minbu	18 –13	5	379	107	66
Magwe	—		—		
Pakokku	—		—		
Mandalay Division					
Mandalay	13+ 1	14	298	340	240
Kyaukse	7+ 5	12	160	237	234
Meiktila	—		—		
Myingyan	—		—		
Yamethin	9+ 3	12	169	265	161
Sagaing Division					
Myitkyina	7	7	187	143	94
Shwebo	17+12	29	319	556	384
Sagaing	—				
Katha	7 – 3	4	146	86	52
U. Chindwin	—				
L. Chindwin	5	5	76	84	30
Total	673 19	692	41,626	24,982	14,601

The existing milling capacity is well in excess of present production, and is in excess of any projected production in the foreseeable future. There is therefore no present need for new capacity as such. The principal interest now is in improving the process and in modernizing the existing mills to reduce milling costs and to improve the quality of the finished product.

The quality of the finished product is partially dependent upon the quality of the paddy grown. It has been reported that the milling of rice in Burma produces a greater per cent of broken rice than in any other rice milling country. This per cent of broken rice is much greater than in prewar years. The deterioration results from the fact that not all mills are in as good condition as before the war, and from a considerable reduction in the quality of the paddy.

An investigation of rice and the rice milling industry was made for the State Agricultural Marketing Board in November 1951 by ECA. This report stated that the present poor quality (variable grain sizes in the same varieties of rice) was caused by the interruption during the war, of an active program to improve quality and yields of all standard varieties and to improve grains for the European markets. The uneven grain sizes, unless carefully separated at the rice mill result in large breakage losses. The broken grain brings a lower export price and thus causes a large revenue loss to the Government. In addition, the export market for substandard rice is limited. The poor quality has already resulted in the loss of some of the large European markets to other countries offering superior grains.

The report stated that almost all of the mills should improve paddy storage and handling methods which result in serious losses and are too costly. It further stated that about 50% of the mills visited were found to be impractical to modernize, in that only a few machines, if any, could be used in modernization plans. On the other hand, it was interesting to note that about 50% of the mills could be modernized with a small investment and with very little installation time required. Generally, the mills were found to be either in a state of disrepair which precluded modernization, or in very good condition so that little extra equipment besides the rough rice classification machines is required to bring them into top condition. By classifying the rice initially and by other modifications the breakage can be held below 5%.

The production and recovery of by-products needs improvement. The report recommended the purchase and construction of a small modern American rice mill to demonstrate modern means of decreasing breakage. This mill is expected to be in operation in the near future.

The following definite recommendations were made to modernize the Burma mills:

(*a*) Paddy rice cleaners—usually only perforated oscillating screens—should be replaced by the S. Howe's "Eureka" cleaner, or equivalent, which does a more accurate job and salvages more by-products.

(*b*) Chaff separators—usually a huge machine composed of many fans which loses all the by-products—should be replaced by S. Howe's "Eureka" Chaff Separator, or equivalent, for reasons given in (*a*).

(*c*) Rough rice classification equipment should be added to decrease breakage; the reasons being outlined in discussion on "Modern Rice Milling."

(*d*) All under-runner shellers (called hullers in Far East) whose casings are of sheetmetal construction should be replaced by shellers using heavy gray iron castings. The Engelberg Huller Co.'s under-runner shellers are recommended for their quality of workmanship, large capacity, and adaptability for modernization plans (no extended shafts are used as with the older European machines).

(*e*) English type gyrating screen machines should be replaced by the more efficient standard paddy separators made in Germany, England, and the United States.

(*f*) Stone cones with no material handling equipment for bran should be replaced with those that have such material handling facilities. Before replacement of these machines, tests should be completed on the new American rice mill which has Engelberg Hullers and is believed by American millers to be more efficient and less troublesome than the cones.

(*g*) Perforated screening equipment or slow speed indented drum separators should be replaced using the modern disc separators (Hart-Carter Co.) or the high speed indented cylinder separators (Superior Separator Co.).

(*h*) Most of the wooden elevators in mills to be modernized will have to be replaced; this should be done using steel or cast iron heads and boots and native lumber trunkings or all steel elevators including steel trunking.

(*i*) Wooden aspirators should be replaced by more modern and efficient machines such as manufactured by the Hart-Carter Co. or the Superior Separator Co.

The ECA report covers the present situation. Its recommendations must be carried out if Burma is to sell rice in the export market in competition with countries offering superior rice.

One important process should be added to the rice milling process, that of rice enrichment. In producing white polished rice most of the valuable vitamins are retained in the bran. These vitamins may be replaced easily by treating one part in 200 and mixing the treated grains with the untreated grains. The process costs little and is an effective and simple way of enriching the diet of the people. Such enrichment programs are in effect in the Phillipines, in Puerto Rico and in Thailand. It has been started in Singapore. A plant to treat 120,000 pounds in six hours would cost only Malay $25,200. The treating cost, exclusive of the rice cost, is about M $1,044 per ton of treated rice which is ample for 120,000 pounds of mixed rice. The steps recommended are the following:

(*a*) Organize an intensive short and long range program to improve and standardize rice growing.

(*b*) Continue to offer a premium for less breakage to encourage the millers to modernize their mills along the lines recommended.

(*c*) After the pilot rice mill has established the best system of rice milling, the Burma mills should be modernized to incorporate the improvements found to be desirable, so that all mills will be raised to the same standard of efficiency.

(*d*) Gradually replace the obsolete mills by new and efficient modern mills.

A complete project report on rice milling, including costs, has been prepared and will be submitted.

(15) Flour Milling

The *Burma Labor Gazette*, September 1951, lists 80 flour mills in Burma. Burma produces wheat, rice, corn and soy beans from which flour and meal may be made. There are no important imports of flour. The diet of the Burmese does not include much food in the preparation of which flour is used. It may be presumed that the existing flour milling industry can supply all domestic demands. Therefore no new mills are recommended for the near future. The development of flour milling to meet the requirements of the nation during the foreseeable future can be met by private enterprise without the participation of Government.

(16) Starch

Starch is a standard food and household product that may be manufactured from either corn (maize) or rice, but preferably from corn, as the yield of starch is much greater. Both grains are normally grown in Burma in quantities great enough to support the operation of a moderate sized corn starch plant. The products can be consumed nationally, or be sold in export.

A single corn starch plant exists in the Rangoon area. When inspected, this plant had been idle for a long period. It was reported that not enough corn had been available since the war to support its operation and that permits to use rice had not been granted. An existing industry of this type should be encouraged to resume operations to provide both a standard food and employment. No new plants are required at this time.

(17) Sugar and Sugar Chemicals

(a) The market. (1) In a country where soil and climatic conditions are favorable for sugar cane growing, it is paradoxical that Burma has in the past imported and at present continues to import white sugar to supplement domestic production.

There have been two commercial sized white sugar factories in the country supplied by domestic cane. One of these, at Sahmaw, was so badly damaged during the war that it has not since been rehabilitated. An existing factory, at Zeyawaddy, is in operation with an annual capacity of about 15,000 tons of white sugar.

Prewar consumption of white sugar averaged about 40,000 tons. Sugar imports in recent years were:

Year	*Tons*	*Value/(Kyats)*
1947–48	3,356	21,80,263
1948–49	5,034	37,36,853
1950–51	6,527	60,57,644
1951–52	11,550	1,14,85,657

These figures show a rising consumption in excess of existing production which is indicative of a need for additional domestic production.

The 1953 first quarter average retail price for white sugar in Rangoon was K2.42 per viss (K0·673 per pound). In other localities the price reached a top of K3.00 per viss. Considering the quality, the market price is fairly high.

Sugar produced locally and imported into Burma is of substandard grades; the crystals are large and sometimes covered with syrup and, as sold, usually contain impurities and contaminants. Actually, there is not, and has not been in Burma, a sugar refinery as that term is accepted throughout the world. White sugar produced domestically is the type known in the Cuban, Phillipine and Hawaiian sugar trades as "plantation whites" and "Turbinado" sugar, a semi-refined co-product of raw sugar mills or "centrals." A perennial housewife's complaint in Rangoon is the poor quality of available sugar.

Conventional refining practice in Europe, United Kingdom, America and other countries starts with "raw" sugar. This material is produced in mills (centrals) located in or close to growing fields. After harvesting, cane is crushed and processed in these mills to a brown, crystalline sugar which contains molasses, syrup, mineral and other impurities. This sugar is imported into non-cane growing or cane deficient countries where it is refined to high purity by processes that use animal bone or vegetable char as filter, decolorant and decontamination agent.

(2) The "refined" sugar industry in the country at present is small scale in volume and seasonal in activity. The factories operate only during the harvesting season, a procedure that adds to capital cost.

The sugar refining industry proposed herein is based on the modern system of relatively small mills located in or adjacent to adequate growing areas crushing and processing cane to raw sugar during the harvest season. The sugar is then shipped to a refinery that operates on a year round basis (300 days). This system, which is conventional practice in western countries, permits low ratio of investment to output of the refinery, location of refinery close to finished sugar market center and dispersion of raw sugar mills in growing areas. Further, location of the refinery at a port, such as Rangoon, would permit importation of raw sugar and, conversely, export of raw or refined sugar.

(3) Since there are no refineries in southeast Asia, including Indonesia, an export market for high grade sugar in the area may be developed. Transportation costs on both raw and refined sugar would place European competitors at a disadvantage.

(b) Possibility of domestic production. (1) The industry proposed consists of a 30,000-ton refinery working 300 days per year and supplied with raw sugar from mills or "centrals" located within an economical transportation radius of growing areas. The capacity of the raw sugar mills would depend upon the productivity of an area; optimum capacity will probably be 10 to 12,000 tons of raw sugar per season of 100 to 120 days in which case three would be required to supply the refinery. The "centrals" will cost about 70% of the investment in the refinery or about £460,000. Total investment in refinery and centrals is estimated to be K1,16,04,000.

(2) An important aspect of the project, aside from the ready salability of its principle product, is the use of by-product molasses for the manufacture of alcohol. Molasses from refinery and raw sugar mills can be used for the purpose. Approximately 105,000 gallons annually will be available, enough to make 41,000 gallons of alcohol. Utilization of by-products is covered in a separate project report which will be submitted in the near future.

(3) The paramount criterion of the project is economy. Can a high quality product be produced at a cost that will find wide acceptance? Mill cost of packaged refined sugar is estimated at K1.23 per viss. Production costs of the usual substandard white sugar available in the market are not known but the retail price (first quarter 1953) in Rangoon of K2.42 per viss is indicative of a spread that would make the

high grade sugar competitive. Most certainly the retail price of the quality product would be no higher.

(4) It is estimated that approximately 70,000 acres suitable for cane cultivation arc dispersed among thc Myitkyina, Kyaukse, Yamethin, Pegu and Toungoo areas. On the basis of average yields, a potential 84,000 tons of raw sugar annually exists.

Actual cane production figures in past years have been:

Period	*Prewar*	*1938-39*	*46-47*	*47 48*	*48-49*	*49-50*	*50-51*	*51-52*	*52-53*
Tons (1,000)	840	780	534	515	534	450	455	540	575
Per cent of pre-war	100	93	64	61	63	54	54	64	69

Since the proposed refinery capacity is only 30,000 tons annually, on the basis of an 8% refined sugar yield, only 375,000 tons of cane are required, a volume well below present production figures. Of course, all cane produced would not find its way into refinery channels, jaggery and other products would continue to be produced.

(5) Other input materials will be imported until they are available locally. The annual requirements of these materials are:

Dry phosphoric acid	27 tons
Make-up bone char	10 tons
Coal	3,600 tons
Fuel oil (for char kiln)	425 tons

All of the above materials are available from several sources in the sterling area. Repair and maintenance supplies will be available from equipment manufacturers who supply the original installation.

(6) Direct production labor requirements are 20 men, three foremen, and one superintendent per shift or 72 men. In addition, maintenance, office and management staff will require about 30. A common labor force, handlers, cleaners and watchmen, of about 20 will be required, bringing the total personnel to about 122.

This project, by its character, should appeal to the local investor or businessman as it opens possibilities of a joint venture wholly owned within the country. Only a few foreign technicians (possibly six) will be required for the first few years of operation. Since the refinery proposed is for the production of a single grade of refined sugar, manufacturing routines are not complicated. There are several phases, however, that require considerable skill which is attained through experience. The employees will have to apply themselves assiduously to absorb the skill of the imported technician-instructors.

(c) Economic feasibility.

(1) *Description and cost of refinery*

The refinery proposed is for the production of 200,000 pounds of refined, granulated sugar per 24-hour day by the bone char process from 96° commercial raw sugar. The process is described below.

(*a*) *Cutting-in station.* Raw sugar shipped in gunny bags or in bulk is stocked in godowns. From the godown, bags are conveyed to the cutting-in station, and manually opened. After opening, the sugar is conveyed to a 60 short ton storage bin, a capacity which enables transfer from godown during daylight hours only. Raw sugar then passes through a sugar lump breaker, is elevated to the sugar mingler, mixed with hot saturated syrup, heated and mingled. From the mingler, the magma passes through Maisching rolls to insure that all lumps in the magma are crushed.

(*b*) *Affination centrifugal.* The magma is discharged from the Maisching rolls by gravity to the mixer of the affination centrifugal, where it is washed to a purity of not less than 98·5° Brix. The washed sugar is delivered by a scroll conveyor under the centrifugal to the sugar melter. Syrup runoff from the affination centrifugal is pumped to the vacuum pan supply tanks to be reboiled to produce raw sugar.

(*c*) *Sugar melter.* Liquor from the sugar melter is diluted to a density of about 58° Brix, heated to a temperature not exceeding 160° F. and delivered to the liquor screen. This screen eliminates all non-soluble foreign matter such as lint, straw, canvas or thread from the raw sugar bags or unmelted sugar lumps or gums. The screened liquor passes to the liquor treatment tanks and the trash is discharged to the filter press and tank.

(*d*) *Liquor treatment tanks.* The screened liquor is treated with milk of lime and phosphoric acid in the liquor treatment tanks and is pumped to the elevated feed tank above the clarifier.

(*e*) *Flotation type clarifier.* Liquor from the high level feed tank passes through an emulsifier and through liquor distribution pipes to the clarifier. Rising air bubbles, aided by the increased temperature of about 180° F. carry the impurities to the surface, where a blanket of scum is formed, the clear liquor remaining beneath the surface. This method of clarification eliminates a substantial portion of coloring matter, and reduces materially the quantity of bone charcoal subsequently required. The blanket of scum is continually removed to the scums gutter, clear liquor runoff is carried by overflow liquor pipes, the flow being regulated by adjustable level controls. Low pressure steam coils are provided in the clarifier to maintain desired temperature. Clear liquor from the clarifier is pumped to the char filters. The scums are discharged to the scum diluting tank, which is provided with blow-up coils, and diluted to 15° Brix, then pumped to subsiders. The clear liquor runoff goes to the affination melter and the bottoms to the filter press mud tank.

(*f*) *Filter press.* Bottoms from the scums subsiders are blown up in the filter press mud tank, heated to 200° F. and pumped to the plate and frame filter press. Clear liquor returns to the sugar melter. Mud from the filter press is discharged to a mud hopper and thence to discard. Filter cake is sweetened with hot water before discharging. Filter cloths are washed in cloth washing tank.

(*g*) *Char handling equipment.* Bone charcoal is used to eliminate the remaining coloring matter and most of the residual soluble impurities in the clarified sugar liquor.

The char is re-used in a continual cycle, passing in rotation through the char filters and the char revivifying kiln by means of char handling equipment. Char dust is eliminated by a char screen. The average life of the char is about five years of continuous service before replacement is necessary. The liquor from the clarifier is kept at a temperature of 180° F. by the liquor heater, and passes through the char filter. Filtered liquor from a freshly charged filter emerges almost water white, and the char filter may be used from 18 to 24 hours before traces of color again appear at the liquor runoff station. The liquor is then switched to a freshly charged filter, and the used filter washed with hot water, blown down with air pressure and the char discharged by gravity to the wet char chute and by char elevator to the wet char bin over the char dryer.

Dry char from the kiln is continuously discharged and elevated to the standby char filter as required.

(*h*) *Evaporator station.* In order to increase the fuel economy of the refinery a supplementary multiple effect evaporator is recommended to raise the density of the sweet wash water from the char filters and to concentrate the white liquors from 58° to 70° Brix or more as desired.

(*i*) *Boiling house.* Vacuum pans handling the refined sugar massecuites are intended to operate on a four-boiling-per-shift schedule. A separate installation of syrup supply tanks, vacuum pans, mixer, centrifugals, sugar conveyors and syrup blow-up tanks is provided for the refined sugar only. Remelts and low grade syrups are handled by a separate installation of tanks, vacuum pan, crystallizers, mixer, centrifugals and blow-up tanks. The raw sugar produced is washed in the centrifugal basket and is returned to the affination melter. Molasses is returned to the vacuum pan supply tanks for low grades, and the final molasses is discharged to the molasses scale for by-product conversion.

(*j*) *Refined sugar handling.* Moist sugar from the refined sugar centrifugal is handled by one conveyor, elevator, sugar bin and granulator. The massecuites from the vacuum pans are discharged to the centrifugal mixer in the pre-determined schedule of purities and each "strike" of sugar is segregated by the operator at the dry sugar storage bin which is divided into compartments for 1st, 2nd and 3rd, and 4th sugars. Separate discharge spouts are provided and adjusted to give a blended grade of commercial refined sugar to the bagging scales.

(2) *Capital cost*

The estimated capital cost is:

(*a*) *Machinery and equipment*

Cutting-in Station	Sheet Metal Work
Affination Station	Instruments
Clarification Equipment	Packaging Equipment
Char House Equipment	Heating Insulating Material
Boiling House Equipment	Electric Wiring, Steam and Water Piping
Sugar Handling (Bins and Conveyors)	Initial and one year make-up of House Char (400,000 lbs.)
Boiler House Equipment	One Year Supply Phosphoric acid (60,000 lbs.)
Power Plant Equipment (300 kW generator)	
Pumps	
Tanks	
Piping	

Total Machinery and Equipment f.a.s. K31,00,000

(*b*) *Buildings*

Affination House Clarification House Char Kiln and Filter House Boiling House Sugar Room Boiler and Power House Structural Steel Framing for above	K 6,04,000
Ocean Freight and Insurance for equipment and Structural Steel	3,08,000
Other building materials Brick, Cement, Re-inforcing Steel and Construction Labor for entire Refinery	10,22,000

Raw and Refined Sugar godowns including material and construction	2,00,000	
Total Building Cost	K21,34,000	
Land and Site Preparation Railroad siding and Roads	5,00,000	
Contingencies	5,00,000	
Engineering and Drafting	6,00,000	
	16,00,000	
Total Capital Cost		K68,34,000

Of the total cost approximately 70% or K47,83,000 will be required in foreign exchange.

(3) *Production cost*

The estimated production cost on a per ton (2,000 lb.) basis is:

(*a*) *Materials*

Raw Sugar	K417.00	
Make-up Char, Phosphoric Acid, Lime, and Fuel (this item includes Power, Steam and Water)	212.00	
Labor	29.30	
	K658.30	K658.30

(*b*) *Fixed Charges*

Equipment and Buildings—20-year life foreign exchange purchase K47,93,000 at 8·024%=K3,83,000	12.80	
Equipment and Buildings—20-year life domestic currency purchase K20,51,000 at 7·36%=K1,51,000	5.03	
Insurance and Taxes at 1% of K68,34,000=K68,340	2.05	
	K 19.88	K 19.88
Total Production Cost per ton		K678.18
Total Production Cost per viss		K 1.23

Transportation, distribution cost and retails profit must be added to mill cost to ascertain retail price. The average retail price of sugar in Rangoon shops for the first quarter of 1953, as an example, was K2.42 per viss. The spread between mill cost and market price then is K1.19 per viss, an amount estimated to amply provide for transportation, distribution and profit.

Packaging in individual 1 or ½ viss paperboard cartons would add about 10% to mill cost but would add to the attractiveness of the product. This merchandising feature should be considered when finalizing the project.

(d) Recommendations. The spread between estimated mill cost and retail prices is evidence that sugar cane growing has exceeded existing mill capacity and is justification for initiation of the subject project. Implementation will add to the food supply, will introduce a high grade product in the economy that will sell for the same or a very little more than the present substandard product, and will provide incentive for cultivators to increase their crops.

It is recommended that designs and firm proposals be obtained for both refinery and raw sugar mills and investigation be carried further to determine optimum location of elements of the entire scheme.

(1) *Implementation schedule*

Equipment deliveries vary according to country of manufacture. A United States firm quotes initial delivery in eight and completion in about eighteen months. If comparable deliveries obtain generally, the factories could go into production in about 2½ years by following the suggested schedules:

(*a*) Fiscal year 1953–54	
Site Surveys and Purchases	K 5,00,000
Engineering and Design	K 3,00,000
Payment with order on principal equipment and building material	K30,00,000
(*b*) Fiscal year 1954–55	
Engineering and Design balance	K 3,00,000
Balance of payments on equipment and material	K10,00,000
Payments on construction cost	K15,00,000
(*c*) Fiscal year 1955–56	
Final payments on construction	K 2,34,000

Construction schedule will closely parallel expenditures.

(18) Bagasse Pulp and Paper

Attention has for some years been given to the use of bagasse (sugar cane stalks after the juice has been extracted) for pulp and paper making. Use of the material is motivated by two reasons; to reduce the cost of sugar through by-product utilization, and to supplement cellulose materials in those countries where the consumption of pulping woods is outstripping new growth. Since more efficient sugar refinery design and operation has reduced fuel consumption, for which bagasse is used, the large excess of the material has further spurred research in its use as paper-making material.

Commercial mills now in operation use bagasse pulp with admixtures of other pulps for heavy papers for containers. There have been recent reports of a patented process for making newsprint, but it is too early to seriously consider such an operation for Burma.

While emphasis should be placed on carrying out the bamboo pulp and paper operation, the possibilities of bagasse should be explored in the future as another element in the pulp and paper products industry with particular reference to boxboards, heavy papers and wall boards of the Cellotex type.

Increase in sugar production may open possibilities of obtaining a cheap pulping material if the mill is located in the vicinity of a raw sugar mill to save transportation.

(19) Timber and Timber Products

(a) Sawmills

This section dealing with the processing of raw logs assumes a "normal" flow of new teak log supplies to mills of from 400,000 to 500,000 cubic tons annually. The present flow is equivalent to about 80,000 tons. It is obvious therefore that the implementation of some of the recommendations pertaining to sawmilling and in particular to the erection of a new sawmill capable of converting 130,000 cubic tons of logs annually, may not be of immediate urgency. Of much greater urgency is action with respect to the assurance of a continuance of an increased flow of teak logs from the forests to mills, as pointed out in Chapter XXIV. In the meantime, the plans for additional milling capacity to supplement existing operative and idle capacity and the mill that is in the process of erection should be prepared. Actual erection should be timed to coincide with the hoped for increase in new supplies.

(1) *Existing plants*

A survey of the location and capacity of all the sawmills in Burma was made to determine the country's present capacity for the production of lumber. A condensed summary of the survey is given in Table XXII–4.

It was reported that during 1951–52 these sawmills produced 243,405 cubic tons of converted lumber, approximately 50% of the reported capacities of the sawmills. The three most important sawmilling districts are:

Moulmein	28 mills	72,750 c.t. round logs
Mandalay	18 mills	106,550 c.t. round logs
Rangoon	51 mills	372,055 c.t. round logs
	97 mills	551,355 c.t. round logs

These mills produced at about 55% of their rated capacities in 1951–52. These districts, with 28·8% of the sawmills of Burma, are capable of sawing 58% of the lumber produced in the country.

TABLE XXII – 4

ANNUAL PRODUCTION CAPACITIES OF SAWMILLS IN BURMA

Circle	*Number of Mills*	*Principal Locations*	*Production Capacity Round Logs Tons per yr.*
Maritime	79	Bassein, Nyaunglebin, Moulmein, Akyab	111,357
Sittang	36	Pyinmana, Toungoo, Pyawbwe, Pegu	91,581
Northern	71	Mandalay, Katha, Shwebo, Myitkyina	200,256
Chindwin	32	Monywa, Meiktila, Kyaukse, Thazi	103,320
Utilization	51	Rangoon Area	372,055
Hlaing	41	Hlegu, Minhla, Nattalin, Paungde	53,837
Shan States	26	Namtu, Mamahkaw, Lashio, Loikaw	17,220
Totals	336		949,626

(2) *The market*

(*a*) *Exports.* Export data show the postwar sales abroad for teak and other hardwoods have dropped materially below those of prewar. These data in terms of cubic tons of converted timber are as follows:

Teak			
	1937–41	average,	213,000 cubic tons
	1946–52	average,	55,000 cubic tons
	1947–48	high year,	91,000 cubic tons
	1949–50	low year	16,000 cubic tons
	1953	estimate,	80,000 cubic tons
Hardwoods			
	1937–41	average,	41,000 cubic tons
	1946–51	average,	15,000 cubic tons
	1947–48	high year,	32,000 cubic tons

With the return of security in the forest areas it is safe to assume that export of teak and hardwoods may be brought up to 200,000 and 40,000 cubic tons of converted timber respectively each year. The milling of teak and other hardwoods for export would require about 40% of the capacity of the existing mills if all exports were in the form of converted timber.

(*b*) *Domestic demand.* Estimates were made of the probable growth of demand for timber and lumber products in Burma giving consideration to the requirements of the housing and economic development program from 1952–53 through 1959–60. A summary of these estimates in cubic tons of round logs and of finished lumber is given in Tables XXII–5 and XXII–6 (*see next page*).

The domestic lumber requirements for 1952–53 are estimated to be 507,250 and for 1959–60 995,500

TABLE XXII – 5

ESTIMATED LUMBER REQUIREMENTS 1952–53

Use	*Teak Cubic Tons*		*Durables* Cubic Tons*		*Semi-Durables* Cubic Tons*			*Non-Durables* Cubic Tons*	
	Round Logs	*Finished Lumber*	*Round Logs*	*Finished Lumber*	*Round Logs*	*Finished Lumber*	*For use as Round Logs*	*Round Logs*	*Finished Lumber*
Housing	16,000	8,000	24,000	13,400	283,000	184,000	—	3,000	2,000
Plywood	—	—	—	—	—	—	—	—	—
Furniture, etc.	8,000	4,000	834	500	—	—	—	—	—
Engineering Construction	2,000	1,000	13,333	8,000	15,385	10,000	—	3,750	3,000
Transportation	16,000	8,000	33,333	20,000	30,765	20,000	—	12,500	10,000
Telephone, Telegraph and Electric Communication	—	—	—	—	—	—	4,000	—	—
Industry	1,000	500	5,000	3,000	12,300	8,000	5,000	12,500	10,000
Agriculture and Piscatorial	—	—	1,666	1,000	3,010	2,000	—	5,000	4,000
Miscellaneous	—	—	834	500	1,540	1,000	—	2,500	2,000
Exports	160,000	80,000	50,000	30,000	—	—	—	—	—
Totals	203,000	101,500	129,000	76,400	346,000	225,000	9,000	39,250	31,000

* Note: These three headings are classifications that were established by the Forest Department in 1948 and are as follows:
Durables (Pyinkado, Padauk, Thitya–Ingyin).
Semi-durables (Pyinma-In-Kanyin and 50% of others).
Non-durables (General utility woods).

TABLE XXII – 6

ESTIMATED LUMBER REQUIREMENTS 1959–60

Use	*Teak Cubic Tons*		*Durables* Cubic Tons*		*Semi-Durables* Cubic Tons*			*Non-Durables* Cubic Tons*	
	Round Logs	*Finished Lumber*	*Round Logs*	*Finished Lumber*	*Round Logs*	*Finished Lumber*	*For use as Round Logs*	*Round Logs*	*Finished Lumber*
Housing	54,000	27,000	96,666	58,000	646,155	420,000	—	12,500	10,000
Plywood	—	—	—	—	—	—	12,000	—	—
Furniture, etc.	16,000	8,000	1,667	1,000	—	—	—	—	—
Engineering Construction	2,000	1,000	16,667	10,000	15,385	10,000	—	6,250	5,000
Transportation	6,000	3,000	33,334	20,000	30,769	20,000	—	12,500	10,000
Telephone, Telegraph and Electric Communication	—	—	—	—	—	—	6,000	—	—
Industry	2,000	1,000	6,666	4,000	12,308	8,000	2,000	10,000	8,000
Agriculture and Piscatorial	—	—	3,333	2,000	3,077	2,000	—	2,500	2,000
Miscellaneous	—	—	1,667	1,000	1,539	1,000	—	2,500	2,000
Exports	400,000	200,000	66,667	40,000	—	—	—	—	—
Totals	480,000	240,000	226,667	136,000	709,233	461,000	20,000	46,250	37,000

* Note: These three headings are classifications that were established by the Forest Department in 1948 and are as follows:
Durables (Pyinkado, Padauk, Thitya–Ingyin).
Semi-durables (Pyinma-In-Kanyin and 50% of others).
Non-durables (General utility woods).

cubic tons of round logs. Since the total capacity of existing sawmills in Burma is approximately 950,000 cubic tons of round logs annually it is evident that serious consideration must be given to increasing this milling capacity in the near future in order to produce the export and domestic demand for lumber.

(3) *Increasing production*

There are several ways by which the increase in lumber production may be accomplished:

(*a*) By the improvement and modernization of existing mills, both government and privately owned.

(*b*) By opening the way for privately owned mills that are now lying idle to resume operations and to improve their plants.

(*c*) By constructing a new modern mill of capacity adequate to meet the nation's requirements after implementation of (*a*) and (*b*) above has been accomplished.

(*d*) Inspection of sawmills representing about 65% of production capacity of the country was made. It was found that in many of the mills the equipment was arranged in the form of a "U," presumably to limit the length of the mill, and save line shafting. This arrangement entails considerable manual shifting and turning the lumber as it proceeds from the head saw through the resaws and cutoff saws to the finishing operation or yard. The capacity of these mills can be increased by the re-arrangement of the equipment to provide for straight-line operation from the log decks through the saws. This arrangement will permit the mills to increase output by limiting the equipment time now lost while manual shifting of slabs and lumber is underway.

The capacities may be increased in the larger mills by the introduction of live rolls and power-operated conveyors. Where the mills are operated with electric energy the installation of individual motors on each unit of equipment will save power, increase efficiency and provide safer working conditions. The Government should encourage and aid sawmill owners in making improvements to mills to increase their production.

(*e*) Improvements can be made to the two European-owned sawmills in Rangoon so that their present rated capacities can be doubled. Increased production can be accomplished by the addition of another head saw (space has been provided) and other improvements. The addition of overhead cranes and live rolls would break an existing "bottle-neck" in the re-sawing operations.

(*f*) The remaining 334 sawmills of Burma can be made more productive by an estimated average of 15% which within three years would increase the capacity about 150,000 cubic tons of round logs.

(*g*) The State Timber Board is in the process of constructing a new sawmill at Singan Yard, Ahlone, with a rated capacity of approximately 50,000 to 60,000 cubic tons of round logs annually. Completion of this mill is scheduled for June 1954.

(*h*) The estimated sawmilling capacity available to meet the country's needs after the general improvements suggested above are:

Existing Mills	950,000 c.t.
Two European Owned Mills (increase)	120,000 c.t.
Other Existing Mills (increase)	150,000 c.t.
New STB Sawmill No. 3	50,000 c.t.
Total	1,270,000 c.t.

To meet the estimated lumber milling requirements for 1959–60 of approximately 1,400,000 cubic tons of round longs, additional capacity of 130,000 cubic tons should be planned. A single mill is recommended to be operated as the central plant of an integrated forest products industry. The general requirements of such a plant and estimates of capital and operating costs follow:

(4) *The plant*

The plant should be constructed in the Rangoon area where power, transportation, markets, and the advantages of integration with other allied industries may be realized. An integrated development of industries based on forest products would result in substantial savings in construction and operation costs. The plant should be on the same site with other projects for milling forest products recommended herein in order to facilitate the interchange of products between plants.

The site of the proposed State Timber Board Sawmill No. 3 (now under construction) is on property leased from the Port Commissioners, and should be reserved for future port development for the shipment of rice. The integrated lumber industries should be located further north in the Kemmendine area where there is suitable and sufficient land available to accommodate a completely integrated forest products industry development. The area surrounding the present State Timber Board Sawmill No. 1 should be acquired, thus making this mill a part of the integrated development. The site should be approximately 35 acres in area to accommodate all of the proposed wood industries. In the over-all development, State Timber Board Sawmill No. 3 and the proposed additional sawmill recommended herein could be coordinated in operations, with one plant specializing in milling teak and the other in milling non-teak hardwoods.

This sawmill will require approximately 900 boiler horsepower of steam per hour, and will occupy an area of about four acres. The main building will require approximately 15,000 square feet. The storage space and covered areas will require about 5,300 square feet, while the office will need 1,800 square feet of building. The main building would be of light steel frame with corrugated asbestos roof and siding, while the other building could be of frame with siding. It is assumed that the choice of site will be such that no foundation piles will be required, if possible. The complete development should be located along the river and be accessible to both railroad and highway transportation. For location and plant layout see Plates No. 6 and No. 7.

The estimated costs of the sawmill are as follows:

COST ESTIMATE FOR NEW SAWMILL

Cost of sawmill equipment, delivered Rangoon	K28,65,060
Transportation and insurance, from US.	2,28,140
Erection of equipment	2,88,800
Steam plant and electrical installation	3,80,000
Miscellaneous items (not enumerated)	1,42,500
Buildings	6,10,000
Concrete equipment foundations	85,500
Total cost of plant	K46,00,000
Land costs and site improvements	2,30,000
Total	K48,30,000

Equipment costs for this sawmill are based on specific quotations for every equipment item of modern sawmill equipment. The expenditures required for this plant will be approximately K31,00,000 for equipment to be purchased with dollar exchange and about K4,00,000 for equipment that can be purchased with sterling. The balance of K11,00,000 will be local currency.

(5) *Production costs.*

In estimating production costs, many variables were considered, and average weighted prices used to arrive at such cost data. Manpower requirements for the proposed sawmill were calculated from actual personnel needs of a local mill (see Table XXII–7).

Assuming an arbitrary mixed production and present-day market prices of these woods, Table XXII–8 presents a computation of the gross annual profits that may be expected.

(6) *Raw materials*

(*a*) *Requirements.* The raw material requirements for this sawmill are estimated at approximately 130,000 cubic tons of round logs annually. The mill will be capable of converting any of many species of woods of Burma.

TABLE XXII – 7

ESTIMATED ANNUAL MILL OPERATION COSTS

	K	K
Interest and Amortization (20 yrs. at ·07358)		3,39,000
Electric Power Costs at ·20 ps./kWh.		4,20,000
Steam Costs		2,85,000
Operating Personnel		
Supervisory	3,48,000	
Operations	11,94,000	
General Office	1,63,200	
Stock and Shipping	1,90,800	
Miscellaneous	4,32,600	23,28,600
Stores		6,50,000
Maintenance and Repairs		6,50,000
General Office Expense		2,27,500
Miscellaneous Expense		1,30,000
Total		50,30,100

(*b*) *Present costs of raw materials.* Present prices of teak logs delivered in Rangoon vary widely, according to the quality of the logs (which are variously designated from four-star, the best, to one-star). Current prices range from K240.00 to K340.00 per cubic ton, with an average price of about K280.00 per cubic ton. The non-teak hardwoods delivered in Rangoon average: durables, K220.00; semi-durables, K180.00; non-durables, K110.00 per cubic ton, all on a round log basis.

(7) *Personnel requirements*

In general, experienced sawmill operating labor, skilled and unskilled, is available in Burma. There appears to be a considerable difference in the use of labor and efficiency of the mill as is indicated in the comparison on the next page between a privately owned plant of 60,000 cubic tons of round logs annually and the State Timber Board Mill No. 2, which is rated at 18,000 cubic tons annually.

TABLE XXII – 8

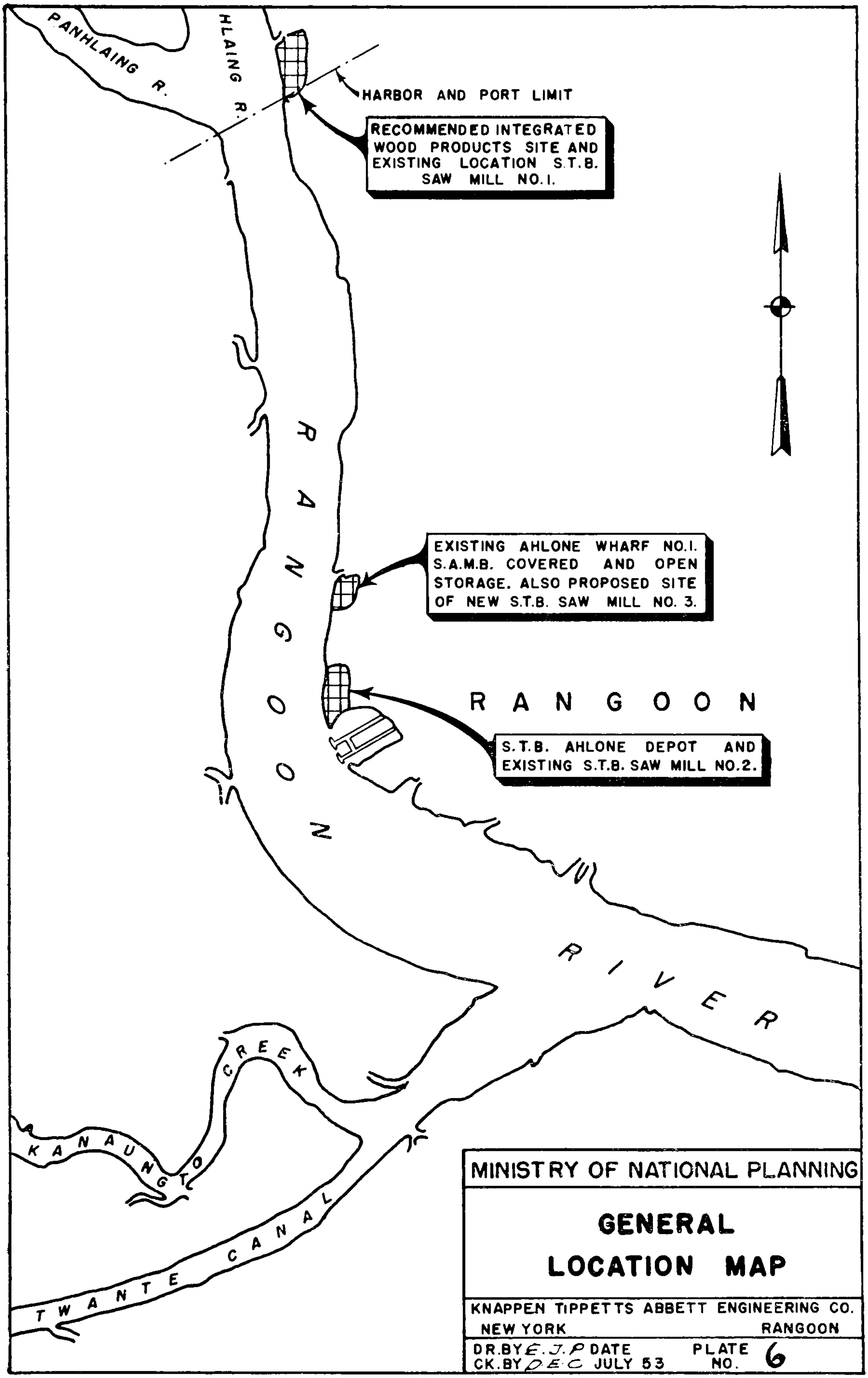
ESTIMATE OF GROSS ANNUAL PROFIT

Conversion of Round Logs into Lumber

	Input		Output
20% Teak	26,000 c.t. rd. logs × 50%	conversion	13,000 c.t.
40% Durable Hardwoods	52,000 c.t. rd. logs × 60%	conversion	31,200 c.t.
30% Semi-durables	39,000 c.t. rd. logs × 65%	conversion	25,350 c.t.
10% Non-durables	13,000 c.t. rd. logs × 80%	conversion	10,400 c.t.
Round Logs Total	130,000 c.t.	Converted Lumber Total	79,950 c.t.

Total Operational costs K50,30,100 — 79,950 c.t.=K63.00/c.t.

	Converted Lumber Value	K
Teak	13,000 c.t. at K750	97,50,000
Durable Hardwoods	31,200 c.t. at K475	1,48,20,000
Semi-durable	25,350 c.t. at K400	1,01,40,000
Non-durable	10,400 c.t. at K200	20,80,000
Total converted	79,950 c.t. Value	K3,67,90,000


PANHLAING R.
HLAING R.
HARBOR AND PORT LIMIT
RECOMMENDED INTEGRATED WOOD PRODUCTS SITE AND EXISTING LOCATION S.T.B. SAW MILL NO.1.
RANGOON
EXISTING AHLONE WHARF NO.1. S.A.M.B. COVERED AND OPEN STORAGE. ALSO PROPOSED SITE OF NEW S.T.B. SAW MILL NO. 3.
RANGOON
S.T.B. AHLONE DEPOT AND EXISTING S.T.B. SAW MILL NO.2.
RIVER
CREEK
KANAUNGTO
TWANTE CANAL
MINISTRY OF NATIONAL PLANNING
GENERAL LOCATION MAP
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK
RANGOON
DR.BY E.J.P DATE
CK.BY D.E.C JULY 53
PLATE NO. 6

Round Log Costs

Round Log Costs Teak	26,000 c.t. at K280	K72,80,000
Round Log Costs Durables	52,000 c.t. at K220	K1,14,40,000
Round Log Costs Semi-durables	39,000 c.t. at K180	K70,20,000
Round Log Costs Non-durables	13,000 c.t. at K110	K14,30,000
Total Round Log Costs	130,000 c.t. Value	K2,71,70,000

Summary

Total Production Value	K3,67,90,000
Total Round Log Costs	K2,71,70,000
Difference	K96,20,000
Total Production Costs	K50,30,100
Gross Annual Profit	K45,89,900

LABOR COMPARISON BETWEEN PRIVATE MILL AND S.T.B. MILL No. 2.

	Number of Employees	
	60,000 Ton Sawmill	*S.T.B. Mill No. 2*
Supervisory Force	47	45
Operating Labor	634	435
General Office Force	26	14
Round Log Men	75	28
Subtotal	782	522
Shipping and Sales	24	12
Total	806	534
Men per 1,000 Cubic Tons Conversion only	13·0	29·0
Men per 1,000 Cubic Tons Total	13·4	29·7

The State Timber Board Mill No. 2 is an older mill and less efficient than the 60,000 ton mill. In newly established mills, equipped with modern machinery, top supervisory personnel should be employed from abroad to operate the plant until it is well established and Burmese counterparts are trained to fill these positions. It will also be advisable to import operators for special equipment for limited periods to train local operators.

(8) *Recommendations*

(*a*) That a program of improvement in efficiency in existing Government-owned mills be undertaken at once. The program should include re-arrangement of equipment, new units of equipment where needed, and training programs to improve the efficiency of labor.

(*b*) That two European owned mills each having a capacity for converting 60,000 cubic tons of round logs per year be encouraged to reopen operations and to increase the capacities of the mills as the demand for lumber increases.

(*c*) That State Timber Board Sawmill No. 3 be completed, but that no additional facilities be built on this site with the view that the mill will be moved when the requirements of the Port of Rangoon necessitate the use of this area for port development.

(*d*) That plans be made for the construction of a new modern mill of 130,000 cubic tons of round logs per year capacity as the central plant of an integrated forest industry. The site to be selected to provide ample room for the sawmill, joinery works, wallboard mill, veneer and plywood mill, and furniture factory. The construction of the sawmill should be geared to bring in additional capacity as additional supplies become available. The general site plan for the integrated forest products industry must be developed to permit the construction of the joinery, veneer and plywood plant, and lumber treatment before the sawmill is built, since these facilities will be needed prior to the sawmill.

(b) Joinery or woodworking plant. A joinery in which the mass production of wood mill work items such as doors, windows, frames, finishing lumber and other similar units of woodwork may be accomplished, is a necessity for expediting the housing program. This plant should be constructed as a unit of an integrated forest products industry. These materials are now fabricated by hand.

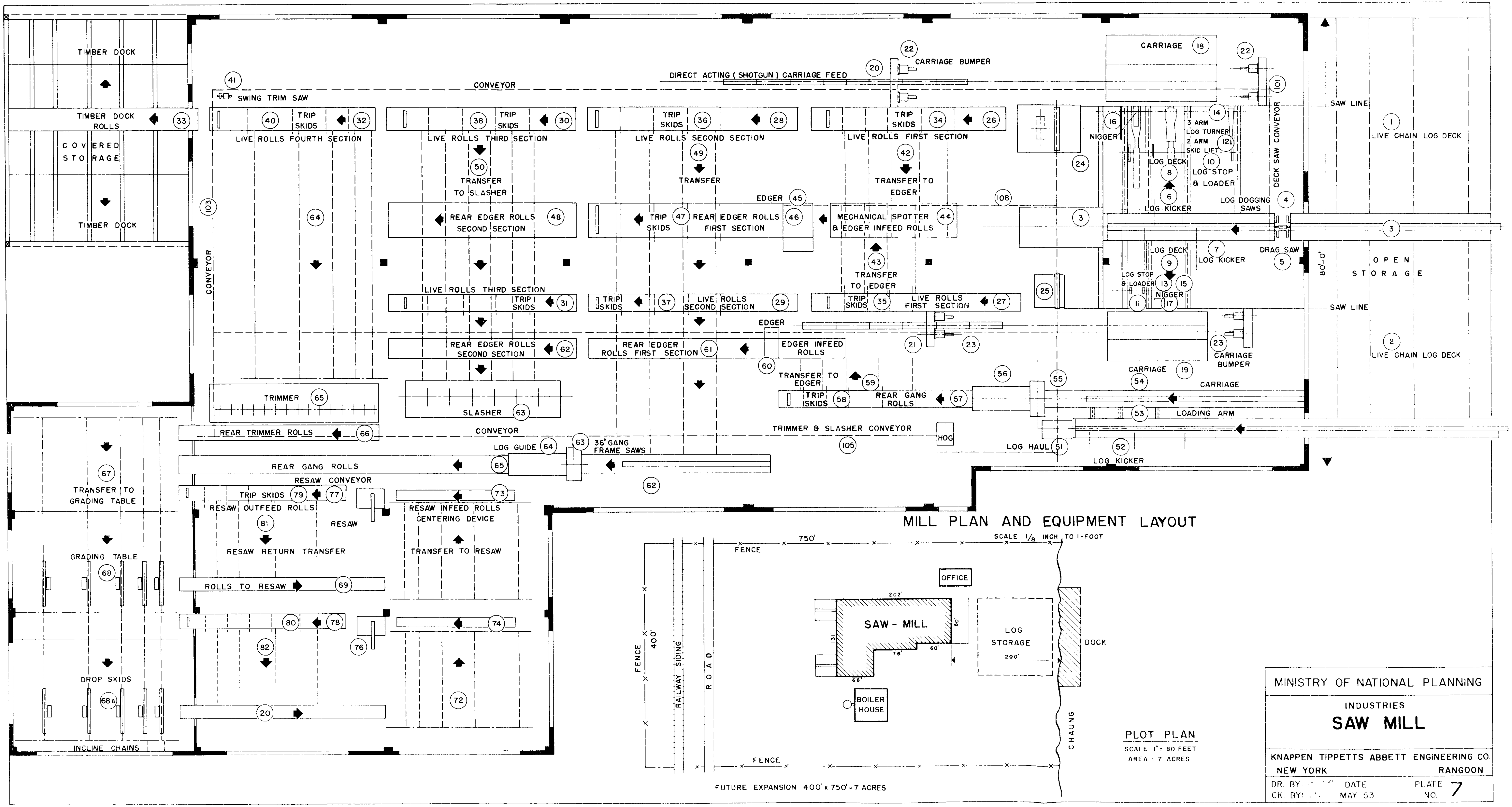
(1) *The market*

Adequate markets will be available in the housing program. Appreciable savings in the mass production of these items over the present hand method of fabrication will decrease building costs and release skilled labor for the expansion of housing construction.

(2) *Standardization*

There is an obvious need for standardization of many units of building construction. In planning housing units, standard sizes and design of doors, window frames, sash and louvered openings should be established and used throughout the different buildings.

The establishment of such standards should not be difficult to accomplish. The National Housing Board and other boards or departments that have buildings to design and construct could determine the sizes and details of types of mill work items that could be used in any one or all of the buildings. These details when established could be printed on sheets of convenient size with all measurements clearly shown and distributed to architects, designers and the wood working industries. Specifications should be given and tolerances of measurements well defined.



MILL PLAN AND EQUIPMENT LAYOUT
SCALE 1/8 INCH TO 1-FOOT
TIMBER DOCK
TIMBER DOCK ROLLS
COVERED STORAGE
CONVEYOR
SWING TRIM SAW
DIRECT ACTING (SHOTGUN) CARRIAGE FEED
CARRIAGE BUMPER
CARRIAGE
TRIP SKIDS
LIVE ROLLS FOURTH SECTION
LIVE ROLLS THIRD SECTION
LIVE ROLLS SECOND SECTION
LIVE ROLLS FIRST SECTION
TRANSFER TO SLASHER
TRANSFER
TRANSFER TO EDGER
EDGER
REAR EDGER ROLLS SECOND SECTION
REAR EDGER ROLLS FIRST SECTION
MECHANICAL SPOTTER & EDGER INFEED ROLLS
EDGER INFEED ROLLS
NIGGER
3 ARM LOG TURNER
2 ARM SKID LIFT
LOG DECK
LOG STOP & LOADER
LOG KICKER
LOG DOGGING SAWS
DECK SAW CONVEYOR
DRAG SAW
SAW LINE
LIVE CHAIN LOG DECK
OPEN STORAGE
80'-0"
TRIMMER
SLASHER
REAR GANG ROLLS
LOADING ARM
LOG HAUL
TRIMMER & SLASHER CONVEYOR
HOG
REAR TRIMMER ROLLS
LOG GUIDE
36" GANG FRAME SAWS
RESAW CONVEYOR
TRANSFER TO GRADING TABLE
GRADING TABLE
DROP SKIDS
INCLINE CHAINS
RESAW OUTFEED ROLLS
RESAW
RESAW INFEED ROLLS
CENTERING DEVICE
RESAW RETURN TRANSFER
TRANSFER TO RESAW
ROLLS TO RESAW
FENCE
750'
400'
RAILWAY SIDING
ROAD
OFFICE
SAW-MILL
LOG STORAGE
DOCK
BOILER HOUSE
CHAUNG
PLOT PLAN
SCALE 1" = 80 FEET
AREA = 7 ACRES
FUTURE EXPANSION 400' x 750' = 7 ACRES
MINISTRY OF NATIONAL PLANNING
INDUSTRIES
SAW MILL
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK
RANGOON
DR. BY
CK BY:
DATE
MAY 53
PLATE NO 7

Standardization of mass production would result in saving of materials. Machine made woodwork can make these units to closer tolerances than present hand methods with the result that the members can be of smaller size and stronger. With properly selected machines and equipment, millwork units can be fabricated on a mass production basis at low cost.

The prevailing price of this type of handmade carpentry work averages approximately K5.00 per sq. ft., whereas from the proposed plant the price should average K2.18. There is at present a small amount of machine produced millwork that averages K2.77 per sq. ft. of finished area.

(3) *Raw material requirements*

Converted lumber will be the chief raw material required for this plant. Semi-durable non-teak hardwoods, chemically pretreated to resist deterioration can be used to meet the bulk of the plant's raw material requirements.

For maximum annual production this plant will require approximately 4,500 c.t. of teak, 6,500 c.t. of durable hardwoods, 16,000 c.t. of semi-durable hardwoods, and 3,600,000 sq. ft. of $\frac{3}{16}$-inch plywood. All of these requirements would be supplied from the adjoining plants of the integrated timber industries.

(4) *Cost of raw materials*

In the estimate of production costs, the following prices of converted lumber delivered to the woodworking plant were used: teak K700 per c.t., durables K450 per c.t., and semi-durables K375 per c.t. Plywood costs, as indicated in the project report on the subject, would average K332.74 plus K16.26 for handling and transport, or a total of approximately K349.00 per 1,000 sq. ft. The prices of converted lumber were obtained from marketing sources in Rangoon.

(5) *Description and cost of plant*

The plant should be constructed on the site and adjacent to other recommended lumber and wood products industries, such as sawmills, plywood and furniture plants, so that the whole would be an integrated working unit. The integrated development would result in a substantial saving in construction and operation costs, as the plants would depend on one another for materials. The Rangoon area is proposed because of the availability of power, transportation and markets, and because integration with other allied industries would be possible.

The initial plant layout would require an area of five acres, but an area of ten acres should be provided to allow for expansion. This area would provide:

30,000 sq. ft. for the mill building;
2,600 sq. ft. for lumber storage;
5,000 sq. ft. for covered storage for finished millwork;
20,000 sq. ft. for a railroad siding, roads, and truck loading platforms;
1,600 sq. ft. for boiler and kilns; and
1,500 sq. ft. for the mill office.

Location and plant layout are shown on Plates 6 and 8.

TABLE XXII – 9

COST ESTIMATE FOR WOODWORKING PLANT

Cost of equipment, delivered Rangoon	K10,92,500
Erection of Plant	1,18,750
Kilns for wood preparation	71,250
Equipment foundations	64,125
Buildings	12,90,000
Total costs	K26,36,625
Land cost and site improvement 5%	1,31,875
Total	K27,68,500

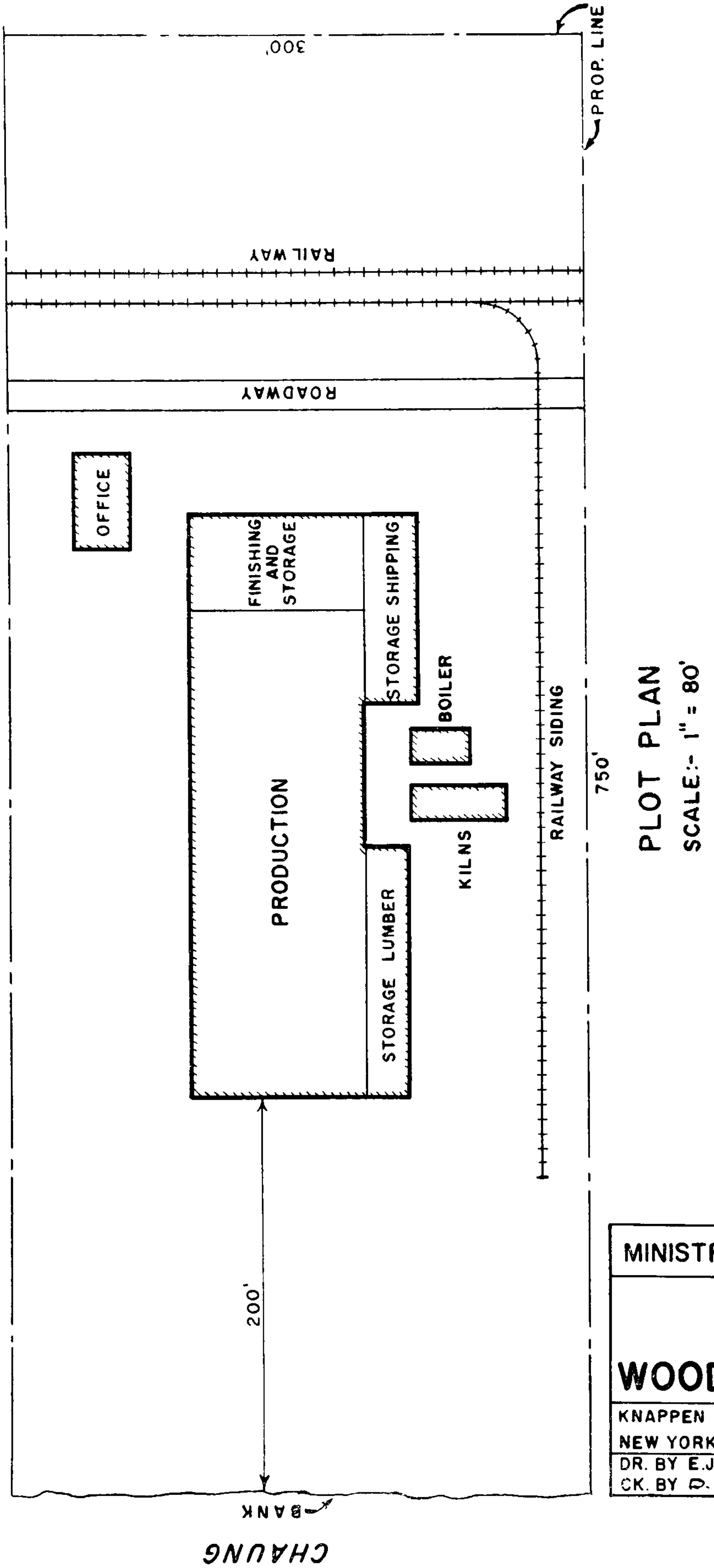
The estimate is based on proposals and recommendations received from US equipment manufacturers who are designers and builders of specialized woodworking machinery. The estimate assumes that all equipment will be purchased in United States dollars, but similar equipment may be procured from sterling areas. The buildings are of light steel-frame construction with corrugated asbestos sides and roof, and may be purchased in sterling currency.

Approximately K11·0 lakhs of purchases will be in dollars and about K5·0 lakhs in sterling currency. The balance of K10·4 lakhs is in kyats. Dollar costs could be reduced by purchasing part of the equipment from the sterling area, if it is available from that source.

(6) *Costs of production*

The estimated annual operational costs for the production of millwork items (Table XXII–10, *see p. 743*) have been based on the quantities shown in Table XXII–11 (*see p. 743*). The output of the plant was estimated at approximately 50% of the equipment capacity as stated by the manufacturers. This conservative estimate of production is made for a period of the first year to allow for the training of local personnel. These production costs are based on operating the plant one shift a day. The employees required to operate the plant are:

Management and superintendence	5
Supervisory	14
Skilled workmen	40
Office, shipping and stores	20
Unskilled workmen	150
Total	229



MINISTRY OF NATIONAL PLANNING

INDUSTRIES

JOINERY OR WOODWORKING PLANT

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK. RANGOON.

DR. BY E.J.P. DATE PLATE
CK. BY D.C. JUNE '53. NO. 8

Adequate skilled and unskilled labor is available in the Rangoon area. A very limited management group from abroad would be required to manage and operate the mill during the first five years of operation.

TABLE XXII - 10

ESTIMATED ANNUAL PRODUCTION COSTS

Interest and Amortization on Buildings				K
(20 yrs. at ·07358) 15·4 lakhs				1,13,300
Interest and Amortization on equipment				
(15 yrs. at ·08994) 11·0 lakhs				99,000
Power costs 600,000 kWh at K0.20				1,20,000
Kiln operations (fuel costs) 570 at 300 days				1,71,000
Material costs (Timber)			K	
Teak	4,500 c.t.	at K700	31,50,000	
Durables	6,500 c.t.	at K450	29,25,000	
Semi-durables	16,000 c.t.	at K375	60,00,000	
Plywoods	3,600 m.s.f.	at K344	12,56,400	
				1,33,31,400
Material costs (imported)				
Nails	250 cwt.	at K50	12,500	
Metal fittings	200 cwt.	at K70	14,000	
Glue	212,000 lbs.	at K2	4,24,000	
Glass	5,000 boxes	at K60	3,00,000	
Pretreatment	16,000 c.t.	at K13	2,08,000	
				9,58,500
General Office expense 8,000 m.s.f. at K 2.00				16,000
Workshop and Stores 8,000 m.s.f. at K10.00				80,000
Labor costs				
Supervisory			1,39,740	
Office			2,37,680	
Operations			4,97,520	
Miscellaneous			74,400	
				9,49,340
Plant maintenance 5% of K12,82,500				64,160
Operational contingencies 10%				15,07,300
Total				1,74,10,000

The estimated annual production of the plant and its value, based on prevailing selling prices for machine made products are given in Table XXII-11.

TABLE XXII - 11

		K
Glazed sash	1,500,000 s.f. at K3.00	45,00,000
Louvered openings	2,500,000 s.f. at K2.80	70,00,000
Panelled doors	1,350,000 s.f. at K3.20	43,20,000
Millwork items		
(Partitions, cupboards, etc.)	2,650,000 s.f. at K2.40	63,60,000
	Total value	2,21,80,000
	Total operational costs	1,74,10,000
	Gross annual profit	47,70,000

(7) *Recommendations*

The preliminary planning, selection of site, and placing of purchase orders for the equipment could be completed by October 1, 1953. Detailed design and drawings, could be completed and ready for tenders for construction by December 1953. Manufacturers have stated there should be no delay in shipment of machinery. Delivery of equipment to Rangoon can be made by March 1954. Expenditures would have to be appropriated for local payrolls and development of the project locally. An initial K1·0 lakh would be sufficient. By June 1954, the remainder of K9·4 lakhs should be available. Construction of the buildings and installation of equipment can be completed by August 1954.

(c) Veneer and plywood plant. The advantages of using plywood over other types of construction material are many. Properly made plywood has greater strength and rigidity than any other building or construction material of equal weight and thickness. Some of the versatile features of this product are: ready workability, large panel sizes, light weight, dimensional stability, exceptional strength, resistance to splitting, resistance to puncture.

(1) *The market*

(*a*) Adequate markets are available for the annual 20,000,000-square-foot output (on a two-shift, 300-days-per-year basis) of the proposed plant. Manufacture of doors, interior partitions, and panelling for the housing program will require an estimated 20,500,000 sq. ft. of plywood annually. The present demand for tea chests is approximately 450,000 sq. ft. annually, and is expected to increase within the next few years to about 750,000 sq. ft. There will be a market for additional quantities of plywood for furniture and other purposes.

(*b*) The proposed plant could produce another specialized veneer by rotary cutting of logs into veneer for manufacturing baskets, boxes and other containers suitable for packing fruits, vegetables and similar commodities. Because of comparatively greater thickness at which veneer for this purpose is produced, it is usually referred to as "rotary-cut lumber."

(2) *Domestic production of plywood*

Plywood can be produced in Burma at less than the cost of the imported product. The estimated production cost of $\frac{3}{16}$-in. plywood is approximately K333 per 1,000 sq. ft., compared with imported $\frac{3}{16}$-in. plywood delivered in Rangoon at K704.80 per 1,000 sq. ft. Much of the imported plywood is not well suited to tropical conditions, while plywood to be manufactured in the proposed plant will be cemented with waterproof urea or phenol glues. The indigenous product will therefore be superior in quality.

There are many items that can be made of plywood in whole or in part and which will eontribute materially to the nation's eeonomy. They inelude:

(*a*) Housing; wall sheeting and panelling, subfloors, partitions, doors;

(*b*) Furniture, cabinets;

(*c*) Industrials; packing and display cases, counters, filing cabinets, instrument panels, drafting tables;

(*d*) General construction; concrete forms, structurals, temporary walls and fences, temporary roofing and work tables;

(*e*) Transportation, railroad cars, truck lining and sheathing;

(*f*) Tea chests, boats, toys, recessed lighting, parade floats.

(3) *Raw material requirements*

Some of the less valuable merchantable woods can be used for the manufacture of veneers and plywoods. Taungthayet and kanyin woods have been found suitable. There is an abundanee of these and other woods in Burma that are suitable for the manufacture of plywoods. Their use would result in a better utilization of the timber resources of the country. It is estimated that this plant, under maximum production, will require about 17,000 cubic tons of round logs annually. The estimated eost of these logs delivered Rangoon is K125 per cubic ton.

(4) *The plant*

The plywood plant should be constructed on the same site and adjacent to a modern joinery plant, which is proposed herein in a separate report. The joint use of such facilities as drying kilns, railroad sidings and storage areas would permit appreciable economy in both construction and operation. The woodworking plant would use a substantial amount of plywood for fabricating doors and cabinets; eonsequently, the joint use of the site would minimize plywood handling costs. The location is proposed for the Rangoon area because of the availability of power, transportation and markets.

As recommended in other reports, a site should be chosen in an area that would be large enough (approximately 35 acres) to accommodate the complete development of an integrated wood products industry. At this site an area of at least 7½ acres should be provided for the plywood plant; a 15-acre site would be preferable to providc for future expansion.

Most of the equipment for a plywood plant is immediately available from storage in Singapore and can be purehased at 1946 prices. The equipment is primarily for a veneer and cutting plant, and an additional drier and press would be needed for the mass production of plywood. For location and plant layout, see Plates 6 and 9.

(*a*) *Estimated costs.* The estimated eosts for this plant, which is rated at 20,000,000 sq. ft., annually, are given in Table XXII–12.

TABLE XXII - 12

COST ESTIMATE FOR PLYWOOD PLANT

	K
Cost of equipment f.o.b., Singapore	9,55,000
Cost of handling and shipping to Rangoon	50,000
Cost of equipment erection, Rangoon	4,50,000
Cost of additional drier and press	3,00,000
Cost of erection drier and press	1,20,000
Cost of equipment foundations	65,000
Cost of buildings	6,90,000
Total cost of plant	26,30,000
Land costs and site improvements 5%	1,31,500
Total	27,61,500

The above figures of the cost of the plant f.o.b., Singapore, are negotiating figures as quoted by the owner. All of the above costs can be paid in kyats with the exception of K3,00,000 for the additional drier and press and some eonstruction materials, to be purchased in sterling. All of the equipment was originally purchased in the United States and it is therefore advisable to purchase the new drier (3 lakhs) from the same souree so that the plant will be uniform in operation. Construction materials, such as steel frame buildings and corrugated eement-asbestos sheets, can be purehased in sterling for approximately K4,50,000.

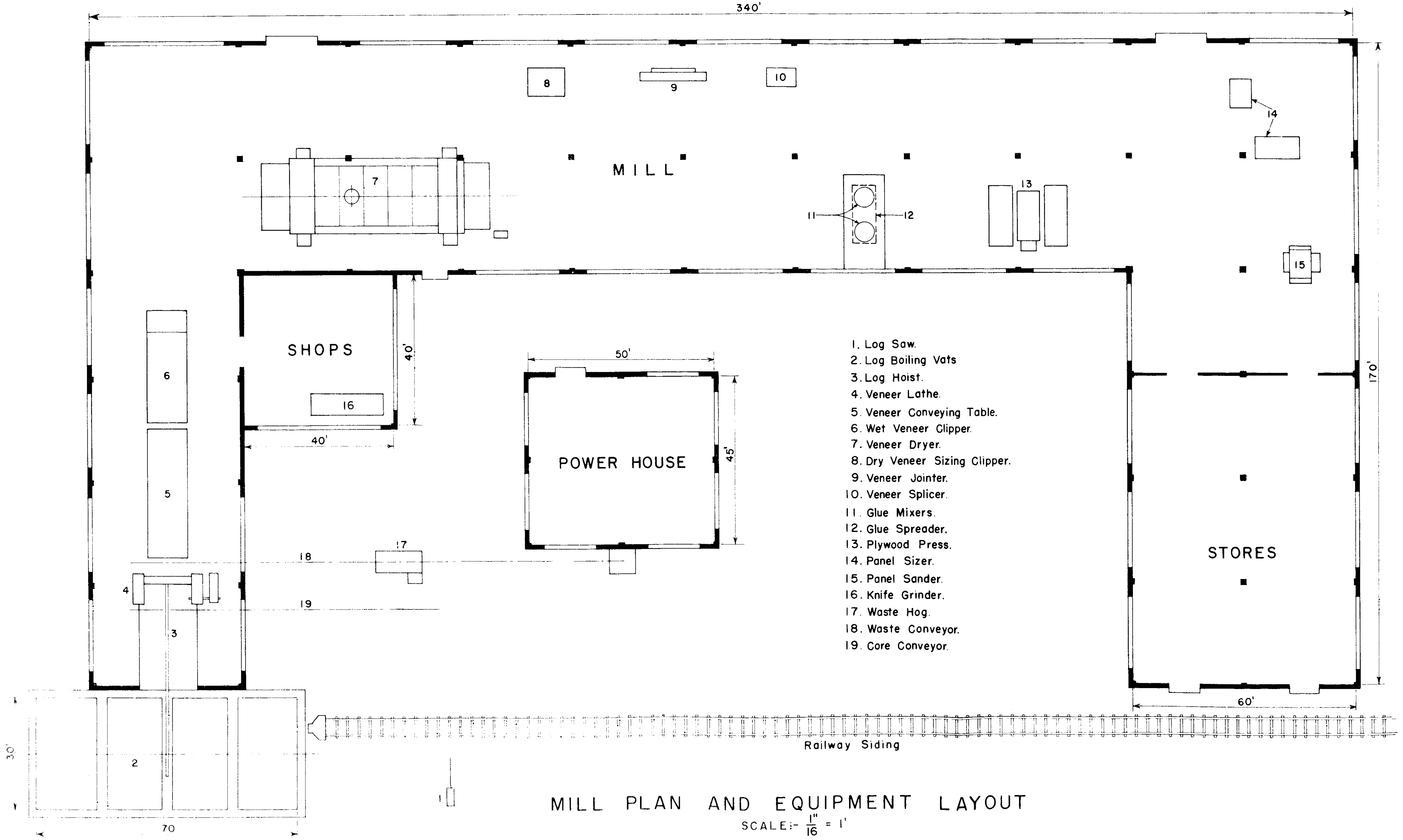
(*b*) *Personnel requirements.* The operation of this plant will require approximately 197 employees, distributed as indicated in Table XXII–13.

TABLE XXII - 13

PLYWOOD PLANT PERSONNEL

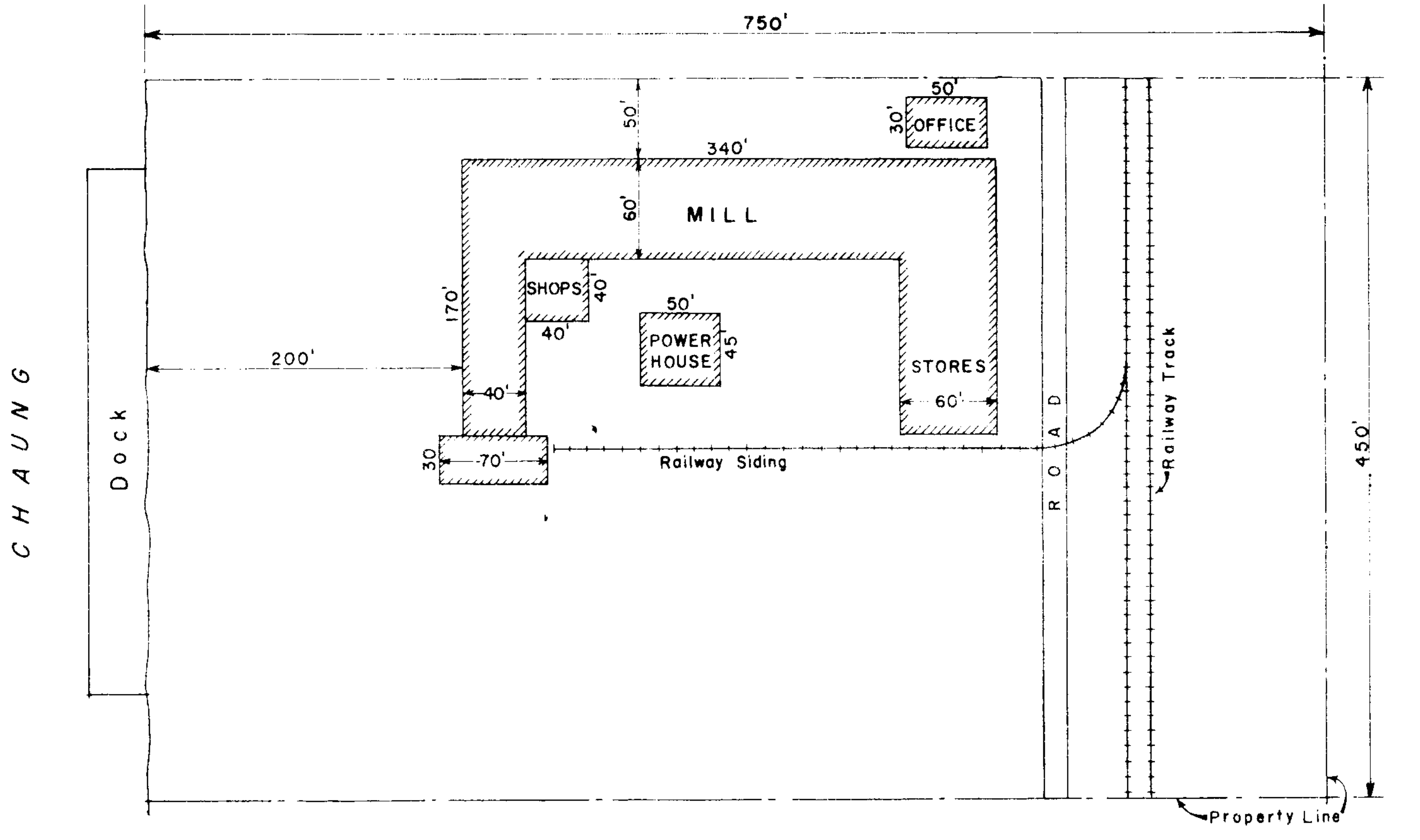
Plant manager and supervisory force	10
Office supervisory, accountants, clerks and stenographers	40
Skilled workmen	52
Semi-skilled workmen	35
Unskilled workmen	60
	197

Adequate skilled and ordinary labor to operate the plant are available in Rangoon. A small management group from abroad would be required to manage and operate the plant during the first five years of operation.



MILL PLAN AND EQUIPMENT LAYOUT

SCALE:- $\frac{1''}{16} = 1'$



PLOT PLAN

SCALE:- 1" = 80'

MINISTRY OF NATIONAL PLANNING

INDUSTRIES

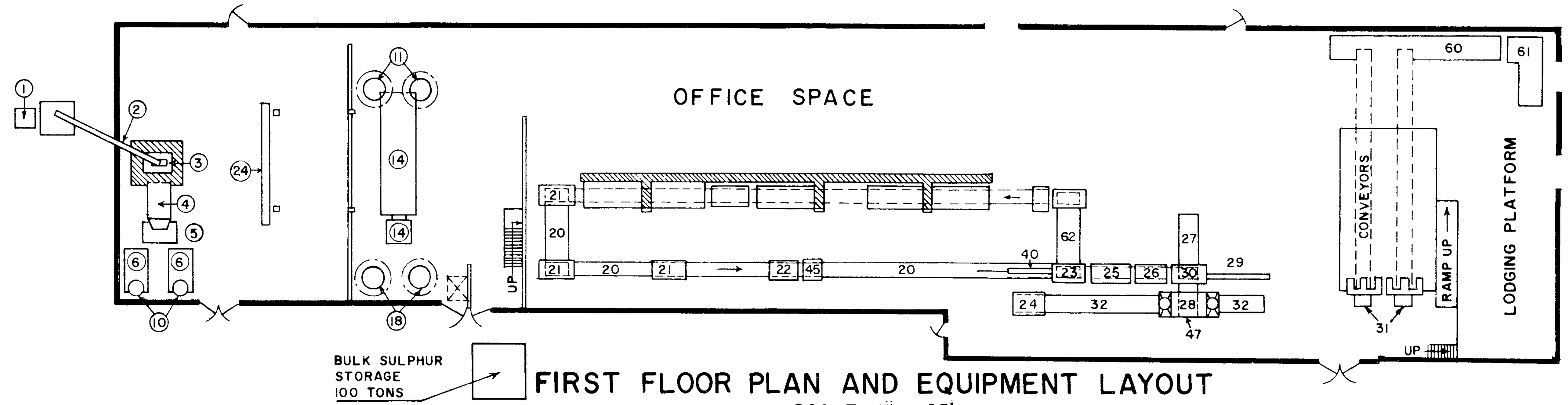
PLYWOOD PLANT

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.,
NEW YORK RANGOON

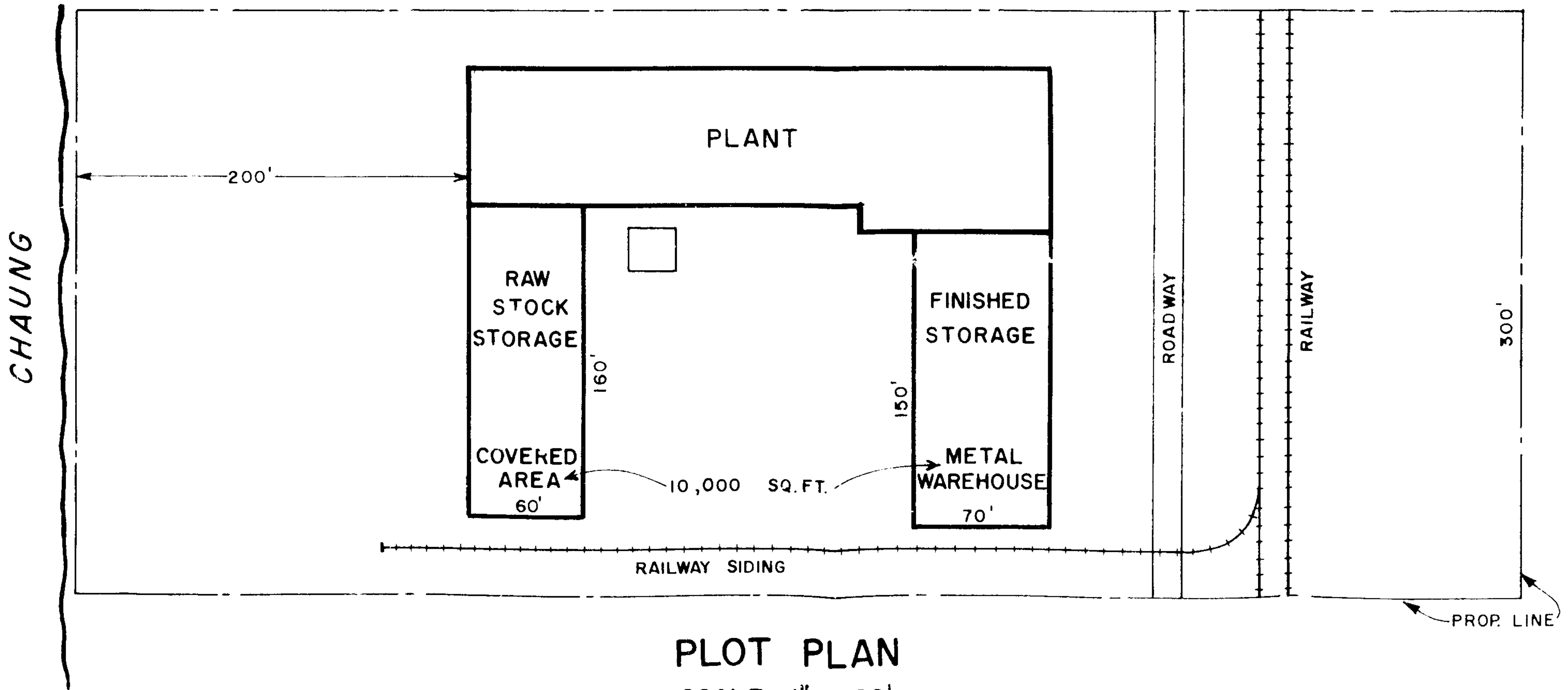
DR. BY E.J.P.	DATE	PLATE
CK. BY D.C.	MAY 1953	NO. 9

MACHINERY AND EQUIPMENT LIST

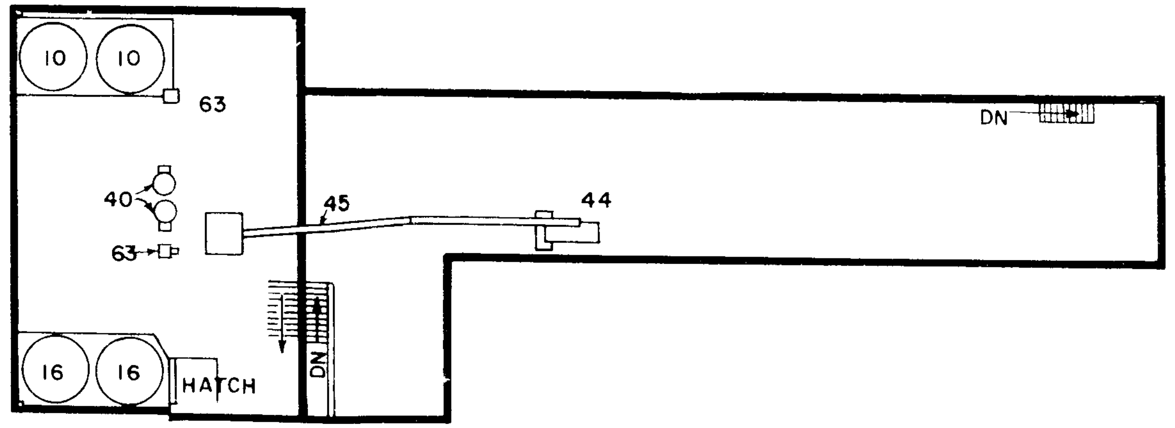
ITEM NO	DESCRIPTION
1	CONVEYOR FOR PNEUMATIC BLOWER FOR CARRYING SAWDUST TO STORAGE BINS; TRACTORS AND TRAILERS FOR WOOD YARD; BARKER, IF REQUIRED, FOR GREEN WASTE.
2	MITTS AND MERRILL NO.7 HOG WITH 20 HP MOTOR.
3	FEED TROUGH WITH GEARED MOTOR, 1/2 HP, 60 RPM TO FEED SECOND GRINDER.
4	36 INCH BAVER BROS. ATTRITION MILL WITH ALL ACCESSORIES.
5	SUCTION BLOWER FOR GROUND MATERIAL AND CYCLONE.
6	VIBRATING SCREENS, FOR ASSURING CONSTANT MESH MATERIAL.
10	DRYER, CAPACITY 6,000 POUNDS OF SAWDUST PER HOUR, REMOVING 2,000 POUNDS OF WATER PER HOUR.
11	BLOWER AND SILO FOR DRY GROUND WOOD.
14	ONE WOOD CHEMICAL BIN AND DISCHARGE MECHANISM.
16	GRAVIMETRIC WEIGHTOMETER FOR GROUND WOOD.
18	MIXING MACHINE.
20	AUTOMATIC SCALE FOR FILLING PANS.
21	SPREADER AND PAN FILLING MACHINE.
22	40 SURFACE PLATES (COLD ROLL STEEL)
23	50 TRANSPORT PLATES, 21 WEAR PLATES.
24	COMPLETE AUTOMATIC PAN CONVEYOR SYSTEM.
25	440 GALVANIZED IRON SCREENS.
26	2 WASHING TANKS FOR SURFACE PLATES AND SCREENS.
27	POLISHING MACHINE FOR SURFACE PLATES.
28	VENTILATORS.
29	HYDRAULIC PRESS, 20 OPENING.
30	PLATE COOLING CAR.
31	PLATE COOLING ROOM.
32	SHEET CAR AND LIFT TRUCK.
40	2 GEARED MOTORS, 3HP, 50RPM.
44	ELECTRICAL SWITCH BOARD.
45	SUCTION FAN FOR SAWDUST COMPLETE WITH PIPING AND CYCLONE.
47	AUTOMATIC GRINDING MACHINE (HAMMER MILL)
60	FIVE THICKNESS GAGES.
61	STOP WATCH.
62	SMALL CIRCULAR SAW.
63	DRYING OVEN.



FIRST FLOOR PLAN AND EQUIPMENT LAYOUT
SCALE 1" = 25'



PLOT PLAN
SCALE 1" = 80'



SECOND FLOOR PLAN
SCALE 1" = 25'

MINISTRY OF NATIONAL PLANNING
INDUSTRIES
WALLBOARD PLANT
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK RANGOON
DR. BY F.J.P. DATE
CK. BY D.E.C. MAY 53.
PLATE NO 10

(c) *Cost of production.* The estimated costs of manufacturing plywood per 1,000 sq. ft. of panels $\frac{3}{16}$-in. in thickness are indicated in Table XXII–14.

TABLE XXII – 14

ESTIMATED PRODUCTION COSTS—PLYWOOD

	K
Interest and amortization (based on 20 years at ·07358)	9.68
Timber costs at K125 per cubic ton	106.88
Direct labor	18.00
Supervision	6.00
General office expense	0.50
Workshop, stores, etc.	3.50
Power costs (electrical)	14.73
Boiler costs	3.20
Glue (best urea or phenol)	140.00
Operational costs, contingencies 10%	30.25
Total cost per 1,000 sq. ft.	332.74

Using the present imported costs of $\frac{3}{16}$-in. plywood the average gross saving to the economy of Burma will be approximately as follows:

Imported plywood 20,000 m.s.f. at K704.80	=K1,40,96,000
Plywood from this plant 20,000 m.s.f. at K332.74	K66,54,800
Difference	K74,41,200
Customs charges on imported plywood	K35,34,000
Gross profit	K39,07,200

(5) *Recommendations*

The objective of this project is the establishment of a manufacturing plant as a unit of an integrated program to produce a product from otherwise unmerchantable indigenous woods. Plywood has become one of the most diversified construction materials developed in recent years. Waterproof adhesives and methods of manufacture have expanded its usefulness many times. Its use results in a great saving in wood. For many of its uses there is no substitute. It is recommended that this project be approved and implemented in the near future.

(d) Wallboard plant. In the study of an integrated wood products industry, the implementation of a wallboard manufacturing plant is of prime importance to reduce timber conversion losses by transferring mill wastes and non-merchantable indigenous woods into a useful product immune to fungus and insect attack.

(1) *The market*

Wallboard is used in housing construction for ceilings, partitions, backing for cabinets, and many other purposes. Other products that are competitive in some respects are covered in other sections of this Report, namely, plywood and asbestos-cement board. The use of these other products has been established in Burma and it is possible that a promotional program would have to be undertaken to demonstrate the practicability of wallboard. The expanded housing program will eventually be able to use the output of all the proposed plants.

(2) *The process*

Boards can be made from many species of hard and soft woods, from wood waste in the form of sawdust, shavings, slabs (both with and without bark), and from bagasse, coconut fibers, and other vegetative wastes. The operation requires no pre-treatment, wet treatment, or processing outside the press. The fibers or granules in the form of sawdust or ground material are simply dry-mixed with a few per cent of a readily available and common chemical material which has as its function the "activation" of the lignin in the wood to make it serve as a binder again as it did in the original wood. This chemical is not a binder or resin in itself; and its cost is not more than a small fraction of a cent per square foot of board produced. This dry mixture is spread by automatic machinery onto a plant which is charged into a hydraulic press having multiple heated platens. The time of pressing is approximately ten minutes, more or less, depending on the thickness of the board to be made. The chemical reaction occurs between the added chemical and the lignin present in the wood to form a hard, strong, water-resistant board. The entire processing time from the raw wood waste to the finished board may be only a matter of minutes, and it is no more complicated than sawmilling or other lumbering operations. No chemical or technical supervision is required.

(3) *The plant*

The wallboard plant should be constructed on the site proposed for other units of the integrated forest products plant such as sawmill, joinery, furniture and plywood, so that the wastes from these plants could be utilized in the production in this plant. For location and plant layout see Plates 6 and 10.

The estimated costs for this plant, which is rated at approximately 25,000,000 sq. ft. annually, are given below:

	K
Cost of machinery—f.o.b., United States	22,13,500
Packing, freight, insurance, etc., to Rangoon	3,51,500
Erection of equipment in Rangoon	4,27,500
Equipment foundations	64,125
Buildings and storage areas	13,50,000
Miscellaneous items and contingencies	6,61,675
Total Costs	50,68,300
Land costs and site improvements 5%	2,51,700
Total	53,20,000

The estimate is based on proposals and recommendations received from United States equipment manufacturers who are designers and builders of such specialized production machinery, and on purchase in dollars. The buildings, which are of light steel frame construction with corrugated asbestos sides and roofs, can be purchased in sterling currency. The foreign exchange will amount to approximately 27·0 lakhs of purchases in US dollars and about 9·0 lakhs in sterling currency. The balance of 14·7 lakhs is in kyats. Dollar costs could be reduced somewhat by purchasing part of the equipment from the sterling area, if it is available from that source.

The estimated costs of manufacturing wallboard per 1,000 sq. ft. are given below:

	K
Interest and amortization (20 yrs. at ·07358)	15.00
Electrical power	65.55
Steam power	9.03
Water	0.48
Maintenance and supplies	24.50
Supervision	19.48
Labor	38.57
Wood waste	6.70
Added materials	15.20
Operating contingency	17.49
Total	212.00

The estimated annual production of the plant and its value, based on prevailing selling prices of wallboard imported in Rangoon is as follows:

	K
Wallboard at K500×25,000 sq. ft.	1,25,00,000
Custom charges on imported wallboard	37,50,000
Difference	87,50,000
Wallboard produced in this plant 25,000 m. sq. ft. at K212	53,60,000
Gross Profit	33,90,000

(4) *Raw materials*

The raw material requirements for this plant are estimated at approximately 7,200 tons of saw dust and wood waste annually. The sources of supply are from the rejected wood wastes of other wood processing plants in the Rangoon area. Present price of saw dust waste is K14 per ton, and the wood price (now usually used as firewood) is K25 per ton. These prices are quoted as f.o.b. their source.

(5) *Employment*

The project would directly create additional employment. Indirectly, in its effect on cabinet work and housing construction, it would also probably lead to a net increase in employment. The operation of this plant would require approximately 118 employees, distributed as indicated below:

Plant manager and supervisory force	20
Office supervisory, accountant, clerks and stenographers	10
Skilled workmen	36
Semi-skilled workmen	20
Unskilled workmen	32
Total	118

Adequate skilled and ordinary labor to operate the plant are available in Rangoon. One qualified manager from abroad would be required to manage, operate and train local personnel during the first two years of operation.

(6) *Recommendations*

Wallboard, at present, has a small domestic market. Plywood, gypsum, and asbestos-cement sheets are used instead of wallboard. It is recommended that the construction of the proposed board plant be deferred until such time as a ready market for wallboard is definitely established. However, general plans for the proposed mill should be incorporated into the over-all program for an integrated forest products industry. It is estimated that two and one-half years would be required to design the plant, procure equipment, and build and put it into operation. The demand for the output of the plant should be anticipated by that length of time.

(e) Furniture factory. To balance the integrated forest products industry, it appears advisable to establish a small plant to manufacture furniture. Aside from the domestic furniture market there is a possible export market. In 1947, 1948, and 1949, K8,00,000 to K9,00,000 worth of furniture was exported. Such furniture was sold "knocked-down" to be assembled at destination. No exports have been made in recent years. Little wood furniture is imported, as it can be produced economically in Burma.

The plant should be built to supply the domestic market primarily, as an export market is not reliable. No statistics exist regarding the domestic market, but it is believed that Burma can absorb the output of the proposed plant. Most of the furniture now built in Burma is made by hand in small cabinet shops. There are no furniture plants in operation comparable to the one proposed for mass production with motorized woodworking machines. The products would include household, office, restaurant, store, hotel, public building, hospital and professional furniture. Using indigenous woods the plant would add to the integration of the wood products industry and help to expand the economy of Burma.

(1) The plant should be a separate building constructed adjacent to the joinery works. All of the advantages of locating the plant as an integrated part of the other phases of the wood processing program are equally applicable to the establishment of this plant. The recommended site is discussed in a project report on this subject. For location and layout see Plates 6 and 11.

The estimated cost of the furniture factory is as follows:

	K
Cost of equipment, delivered, Rangoon	6,70,000
Erection of plant	71,300
Equipment foundations	32,300
Buildings	5,80,000
Total costs	13,53,600
Land costs and site improvement 5%	64,400
Total	14,18,000

These estimates are based on United States equipment with buildings purchased from the sterling area. This will require approximately 7·0 lakhs of purchases in dollars and about 2·3 lakhs in sterling currency. The balance of 4·3 lakhs is in kyats. Dollar costs could be reduced somewhat by purchasing part of the equipment from the sterling area, if it is available from that source.

(2) *Production costs*

The estimated production costs of items of furniture have been based on an estimated number of pieces that could be produced under operating conditions prevailing in Rangoon. A complete list of personnel capable of manning all operations of the plant was set up to facilitate making this estimate. The output of the plant was estimated at approximately 70% of the equipment capacity. This conservative estimate of production is made for a period of the first year, to allow for the training of local personnel. These production costs are based on operating the plant one shift a day.

PRODUCTION COSTS

		K	*K*
Interest and amortization on buildings (20 yrs. at ·07358) 6·0 lakhs			44,000
Interest and amortization on equipment (15 yrs. at ·08994) 7·5 lakhs			67,500
Power costs 300,000 kWh at K0.20			60,000
carried forward			1,71,500
Material costs (Lumber)			
Teak	1,600 c.t. at K700	11,20,000	
Durable	1,600 c.t. at K450	7,20,000	
Semi-durables	800 c.t. at K375	3,00,000	
Plywood	600 m sq. ft. at K 349	2,29,400	
			23,69,400
Material imported			
Nails	100 cwt. at K50	5,000	
Metal fittings and hardware	200 cwt. at K70	14,000	
Glue	80,000 lbs. at K2	160,000	
Pretreatment	1,800 c.t. at K13	23,400	
Finish materials		1,100	
			2,03,500
General office expenses 300 days at K30			9,000
Workshop and stores 300 days at K50			15,000
Labor Costs			
Supervision		60,000	
Office		1,10,000	
Operations		2,15,000	
Miscellaneous		20,000	
			4,05,000
Plant maintenance 5% of K7,40,000			37,000
Operational contingency			2,12,600
Total			34,23,000

The annual production of the plant and its value based on an estimated export price of selected pieces of furniture that would be manufactured is as follows:

CURRENT SELLING PRICES

		K
9,000 Desks	K125	11,24,000
9,000 Cabinets	K225	20,25,000
7,500 Tables	K130	9,75,000
7,500 Chairs	K 45	3,37,500
Total Value		44,61,500
Total Operational Costs		34,23,000
Gross Annual Profit		10,38,500

(3) *Raw materials*

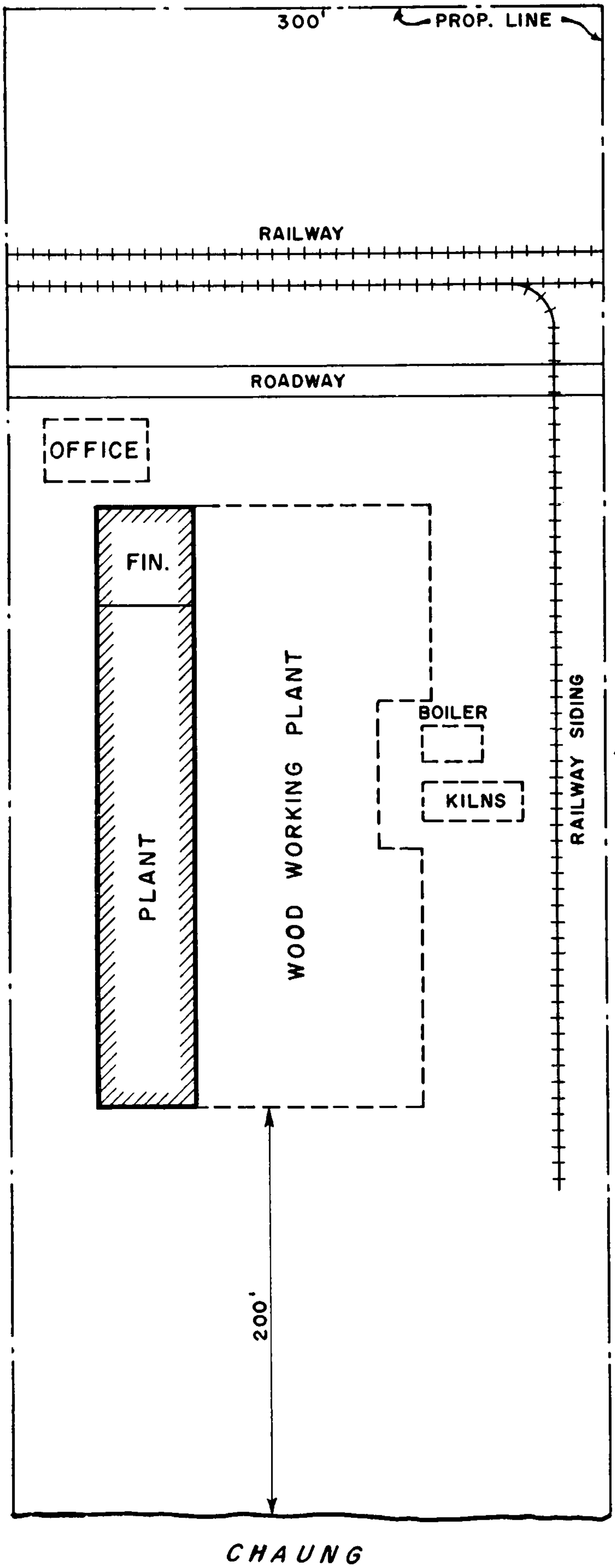
Converted lumber will be the chief raw material required for the manufacture of furniture. It is recommended that durable and semi-durable hardwoods be used insofar as possible. The semi-durable and non-durable woods can be chemically treated so that they can be utilized.

(4) *Employment*

Adequate skilled and unskilled labor is available in the Rangoon area. Capable personnel should be available locally to manage and supervise this plant. Approximately 120 employees are required to operate the plant, distributed as indicated below:

PERSONNEL

Management and superintendents	3
Supervisory	7
Skilled workmen	30
Office, shipping and stores	10
Unskilled workmen	70
	120



PLOT PLAN
SCALE 1" = 80'

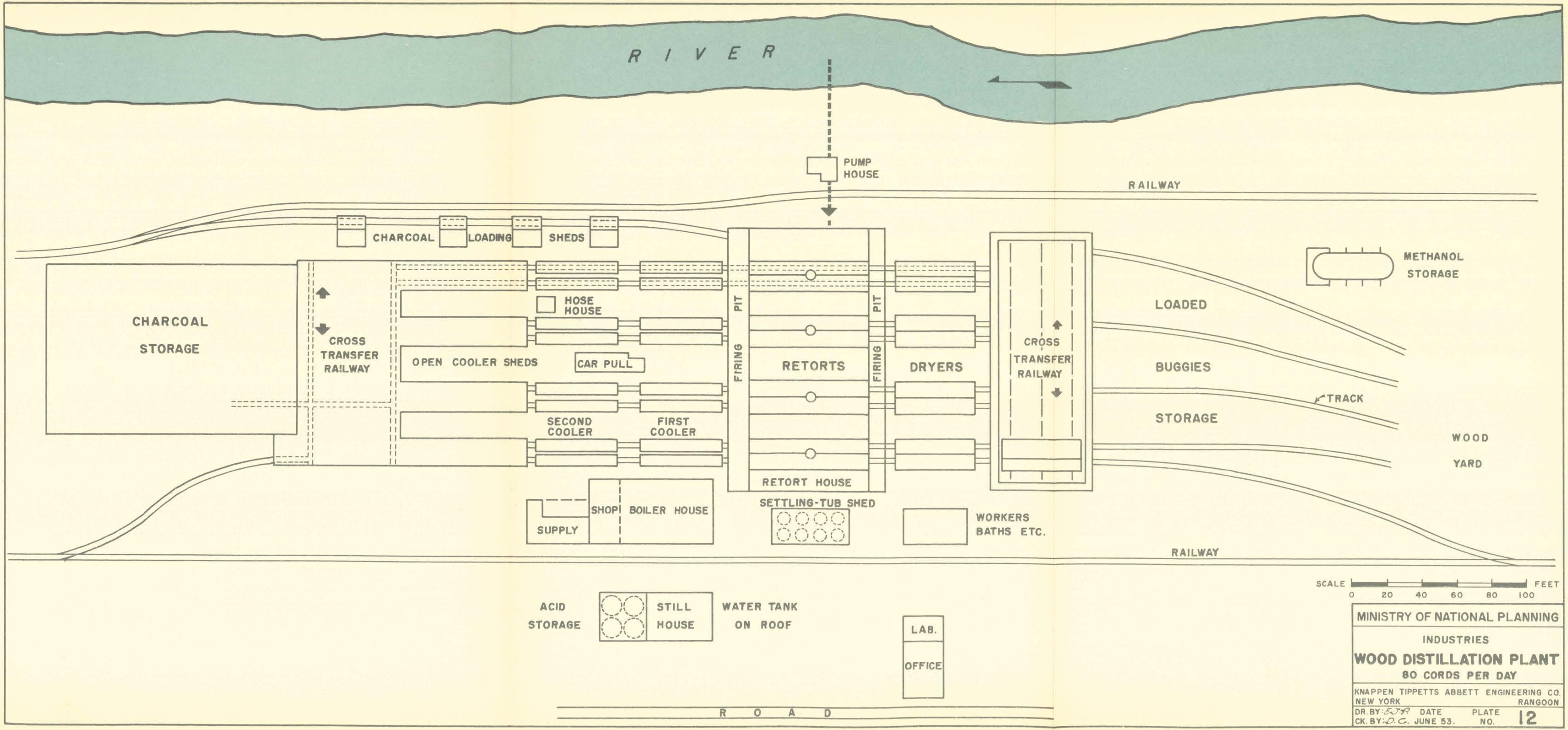
MINISTRY OF NATIONAL PLANNING

INDUSTRIES

FURNITURE PLANT

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK RANGOON

DR. BY E.J.P. DATE PLATE
CK. BY D.E.C. JUNE 53 NO. 11


RIVER
PUMP HOUSE
RAILWAY
CHARCOAL LOADING SHEDS
METHANOL STORAGE
CHARCOAL STORAGE
CROSS TRANSFER RAILWAY
HOSE HOUSE
PIT
FIRING
RETORTS
PIT
FIRING
DRYERS
CROSS TRANSFER RAILWAY
LOADED
BUGGIES
STORAGE
TRACK
WOOD YARD
OPEN COOLER SHEDS
CAR PULL
SECOND COOLER
FIRST COOLER
RETORT HOUSE
SETTLING-TUB SHED
SHOP
BOILER HOUSE
SUPPLY
WORKERS BATHS ETC.
RAILWAY
SCALE
0 20 40 60 80 100
FEET
ACID STORAGE
STILL HOUSE
WATER TANK ON ROOF
LAB.
OFFICE
ROAD
MINISTRY OF NATIONAL PLANNING
INDUSTRIES
WOOD DISTILLATION PLANT
80 CORDS PER DAY
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK
RANGOON
DR. BY:
CK. BY: D.C.
DATE JUNE 53.
PLATE NO. 12

(5) *Recommendations*

The economics are favorable, as the plant would be profitable. If a further study of the market discloses that Burma can absorb its output, the plant should be built as a part of the intermediate plant.

(f) Wood distillation plant. Burma uses a large amount of charcoal for domestic and a minor amount for industrial purposes. In many smelting operations charcoal can be used as a substitute for coke. Present production of charcoal is largely by primitive methods and a considerable amount of valuable by-products is lost. These by-products include: acetic acid which is used in the manufacture of cellulose acetate and acetate plastics, acetic anhydride, ester solvent, metallic acetates, and various metal compounds such as calcium compounds, white lead, Paris green, acetamide, aspirin, and other pharmaceuticals, and artificial vinegars; methanol which is used in the manufacture of formaldehyde, denaturants, solvents and for other miscellaneous purposes; insoluble tars which have many domestic uses such as treatment of rope and fish nets; combustible wood gases that can be burned under the retorts or under the boilers to produce steam; and tannin extract from mangrove bark which has a domestic use in the tanning of leather and has a very wide world market (see plate 12).

As the demand for these industrial chemicals increases in Burma, or export markets can be developed, serious consideration should be given to the construction of a wood distillation plant.

(1) *The market*

The present demand for charcoal is being met by local carbonizing enterprises which do not attempt to save the by-products. Such chemicals as might be produced in a modern wood distillation plant are, at present, imported. It is expected that this market will increase within the next decade to justify producing these chemicals in Burma where an ample supply of raw materials is available.

(2) *The plant*

Jungle wood, the raw material, is piled in storage piles to dry some distance from the plant as a precaution against fire. The wood is cut into four-foot lengths for convenience in handling. For carbonizing, the wood is piled into 12-foot long buggies holding approximately five cubic tons each. Four buggies are coupled together as a unit for handling through the plant. The tracks (4 ft. $8\frac{1}{2}$ in. gauge) are arranged to permit the loaded cars to pass through the plant to the charcoal storage shed in a straight line. This straight line arrangement minimizes equipment and labor costs, and increases the yields by minimizing loss of charcoal.

The plant itself is designed to carbonize 160 c.t. of wood per day. There are four batteries of two pre-driers, each 52 feet long by 8 feet high. Following these are the retorts in four batteries of two each, 52 feet long, 6 ft. 3 in. wide, by 8 ft. 4 in. high. First and second day coolers follow on the same trackage.

The retorts are housed in a steel retort house or shed approximately 160 ft. by 60 ft., having two firing tunnels running full length under the oven doors. There are 16 cooling chambers; four banks of two each for first coolers, and four banks of two each for second coolers.

Five days are required to process the wood. However, production is continuous and 160 cubic tons of wood are turned out daily. At least 200 buggies would be required to accommodate the several operations and to allow a reasonable number of spares.

The still house, located adjacent to the retort house, would be approximately 24 ft. by 40 ft. in floor area with a height of about 70 ft. There would be, besides the ground floor level, an operating floor level and a condenser floor level. A heavy steel frame would support a water tank on the roof. Sidewalls would probably not be necessary. This structure would accommodate the recovery of the liquor from the retorts after settling in outdoor settling tanks for tar removal, and there would be a de-methanolizing system, an ageotropic recovery system for the acetic acid, refining systems for the methanol and the acetic acid.

A storage shed is necessary for the acetic acid tanks. The methanol will be stored in large tanks in the open. A pump house for cooling water from the river, a large charcoal storage building with suitable facilities for bagging, a machine shop about 24 ft. by 48 ft., and an office and a small laboratory for chemical control complete the plant.

(3) *Estimated cost of the plant*

The following is an estimate of costs of the proposed plant erected in Burma for the installation of 160 c.t. (round log) of mangrove or similar wood per day. This estimate includes the cost of the installed plant ready for operation including all equipment, buildings, boiler house, a small electric generator, plant water supply, railroad trackage for wood yard, and necessary storage capacities.

Cost of equipment, delivered, Rangoon		K 45,50,000
Erection of plant		11,87,500
Equipment foundations		38,000
Buildings		14,82,000
Miscellaneous trackage—tanks boilers		1,42,500
Total costs		74,00,000
Land costs and site improvements	5%	3,70,000
Total		77,70,000

The estimate is based on United States equipment and on buildings purchased in the sterling market. The expenditures will require approximately K48 lakhs of purchases in dollars and about K15 lakhs in sterling currency. The balance of K11 lakhs is in kyats.

(4) *Cost of production*

The three principal products are charcoal, acetic acid and methanol. Charcoal is the largest (by volume) single product that will be produced from this wood distillation plant and it is recommended that this be produced so that in the future, commercial use be made of this produce in industry as a substitute for coke. Acetic acid has many uses as mentioned earlier in this Report. Methanol has a wide use and markets for this product should be readily available in Burma.

PRODUCTION COSTS
Based on 160 c.t. Capacity Plant

	K
Interest and amortization based on 20 yrs. at ·07358	5,60,000
Maintenance and repairs	1,92,000
Workshop and stores	1,29,600
Electrical power	1,44,000
Fuel (for carbonization)	2,59,200
Management and supervisory	1,53,600
Operational labor	1,39,200
Wood raw materials	3,36,000
Total annual operational costs	19,13,600

The estimated annual production of the plant and its value based on imported prices for these products, are as follows:

		K
Methanol	600 tons at K1,200	7,20,000
Acetone	48 tons at K1,800	86,400
Acetic Acid	1,440 tons at K2,100	30,24,000
Charcoal	7,500 tons at K 70	5,25,000
Total annual revenue		43,55,400
Total annual operational costs		19,13,600
Gross annual profit		24,41,800

The above production figures are based on 2,000 lbs. per ton and the unit costs in kyats c.i.f. Rangoon.

(5) *Raw materials*

The raw material required for the operation of the plant could be any one of the "jungle" or non-durable woods. However, mangrove will be the most profitable in conjunction with another plant that would utilize the bark for tannin as a paste or powder. It is estimated that a plant of 160 c.t. a day capacity under maximum production will require 48,000 c.t. of round logs annually. The estimated cost of these logs delivered to the plant is K7 per c.t.

(6) *Personnel requirements*

The operation of this plant will require approximately 187 employees, distributed as follows:

Wood Distillation Plant Personnel

Plant manager and supervisory force	7
Office supervisory, accountants, clerks, etc.	20
Supervisory	10
Skilled workmen	65
Unskilled workmen	85
	187

Adequate skilled and unskilled labor is available in the Rangoon area. A plant manager from abroad would be required to manage the plant during the first two years of operation during which time local personnel would be trained in its operation.

(7) *Recommendations*

It is recommended that the general plans for this proposed mill should be incorporated into the over-all program for Burma's industrialization. The engineering should be done in the United States where large wood distillation plants are in operation and where modern processes have been developed. Much of the equipment, particularly the heavy steel fabrications, could be obtained in the sterling area.

Approximately two years and six months will be required to design, build and put the plant into operation. It is estimated that markets will develop to use the output of chemicals by 1959 if the industrial program proceeds as scheduled. It would therefore be necessary to start design of the plant in 1956.

The location recommended for the plant is in the Bassein or Moulmein area where adequate supplies of mangrove wood are available.

(g) Tannin and cutch extraction plant

(1) *The market*

The domestic market for tannin is limited and is confined to the leather tanning industry which has not been fully developed. There is a moderate world market, the United States alone having imported 168,000 metric tons in 1951. The principal use of tannin is for tanning leather. Minor uses include the manufacture of pharmaceuticals and others. Cutch is used for the preservation of fishing lines and in salt water nets, and to a limited extent in the manufacture of dyes. Prior to World War II approximately 3,500 tons were exported annually. The domestic consumption for the same period is estimated at about 5,000 tons per year.

(2) *The plant*

A plant for the extraction of both tannin and cutch should be considered for the ultimate development of the integrated forest industries. The plant would consist of a one-story steel building, 50 ft. by 170 ft. in area, and a covered storage area about 50 ft. by 100 ft. A small office building would also be required. The equipment would consist of the following:

2 Bark cutting machines	1 Collecting wood vat
2 Vibrating screens	5 Vacuum evaporators
2 Hammer mills	3 Centrifugal pumps
1Collecting worm	1 Water supply pump
1 Clesstor	1 W.I. container for cold water
1 Distributing worm	1 Steam boiler plant
7 Feeding hoppers	1 3 Plunger pump
7 Extractors	1 Steam engine
7 Calorizers	1 Electric generator for cutch extraction
1 Pre-heater	1 Chipper for chipping cutch heartwood
3 Duplex steam pump	Necessary conveying equipment
Copper piping	
1 Collecting container	
2 Clarifying wood vats	
1 Mud fitter vat	

The estimated cost of the plant erected in Burma is as follows:

	K
Cost of equipment, f.o.b., Europe	8,50,000
Cost of packing, freight, insurance, etc.	1,05,000
Erection of equipment	3,75,000
Equipment foundations	75,000
Buildings and storage areas	4,15,000
Miscellaneous items and contingencies	1,80,000
Total Costs	20,00,000
Land and site improvements 5%	1,00,000
Total	21,00,000

The estimate is based on proposals and recommendations received from European equipment manufacturers and assumes that all equipment and most of the buildings, of light steel frame construction, will be purchased in sterling exchange. The installation of the equipment and construction of the plant can be in kyats. The expenditure will require approximately K13,00,000 in sterling exchange and the balance about K7,00,000 in local currency.

(3) *Cost of production*

The cost of production is based on the extraction of tannin only and the sale of this produce on the world market. Although the plant will be designed so that cutch can be extracted, this market is not well defined at this time. It is assumed that the cost of production for cutch can be made competitive in the world market. Cost of production based on 1,800 tons per year are:

	K
Interest and Amortization based on 20 years at ·07358	1,47,200
Maintenance and Repairs (30·00 c.t. × 6,000 t)	1,80,000
Workshop and Stores (K20 c.t × 6,000 t)	1,20,000
Electrical Power 650,000 kWh at K0.20	1,30,000
Fuel for boilers (K50 c.t. × 6,000 t)	3,00,000
Management and Supervisory K20 (c.t. × 6,000)	1,20,000
Operational Labor (K25 c.t. × 6,000 t)	1,50,000
Raw Materials (20t/day × 300 days 6,000 t at K200)	12,00,000
Packaging 1,800 t at K25	45,000
Exporting costs 1,800 t at K2.00	3,60,000
Total Annual Production Costs	27,52,200

The estimated annual production of tannin extract and its value based on prices on the world market are as follows:

Tannin Extract 1,800 t at K2,000	36,00,000
Total Annual Production Costs	27,52,200
Gross Annual Profit	K 8,47,800

(4) *Raw materials*

Ample raw materials are available in Burma; for tannin, the bark of trees from the coastal swamps, and cutch from the dry forests. Both have been exploited in the past on a small scale. Mangrove bark is now sold in Rangoon for approximately K180 per ton. It is harvested as a by-product of jungle wood which is sold for fuel.

(5) *Employment*

The harvesting of mangrove and cutch will create part-time employment in the coastal and hill villages.

The operation of the plant will require approximately 113 employees, as indicated below:

Personnel	
Plant manager and supervisory force	18
Office supervisory, accountants, clerks, stenographers	12
Skilled workmen	30
Semi-skilled workmen	18
Unskilled workmen	35
Total	113

Adequate skilled and unskilled labor to operate the plant is available. One qualified manager from abroad would be required to manage, operate and train local personnel during the first two years of operation.

(6) *Recommendations*

It is recommended that the general plans for this project be incorporated into the over-all program for an integrated forest products industry. The scheduling of implementation can be coordinated with other recommended industries that are to be deferred for future consideration.

(20) Paint and Varnish Factory

(a) The market. The current volume of paint and related products used in Burma is approximately 400,000 gallons annually. Most of these products are imported. The requirements for paints can be expected to increase materially with the implementation of the development program. The existing and future demand provide an ample market to justify the implementation of a paint and varnish industry.

(b) The plant. The plant should be designed for a capacity of 10,000 gallons per week, of paint, varnish, lacquer and rubber latex. It should be located in Rangoon since that will be the largest market and is the most advantageous location for procurement of raw materials and the distribution of the finished products.

The plant will consist of a single building with a floor area of 8,000 sq. ft. on the ground and 2,500 sq. ft. each on a first and second floor. The equipment proposed is sufficiently flexible to accommodate major variation in demand as to type of products and output (see Plate 13).

The estimated cost is as follows :

	K
Equipment delivered Rangoon	12,85,000
Installation of Equipment	3,00,000
Buildings	4,74,000
Equipment Foundations	33,750
Contingency	1,00,250
Total costs	21,93,000
Land Costs and Site Improvement 5%	1,10,000
Total	23,03,000

Equipment costs are based on comparable equipment for similar plants in the United States. The necessary construction materials that must be imported can be obtained in the sterling area. The expenditures required for this plant will be approximately K13,00,000 for equipment to be purchased with dollar exchange and about K3,00,000 in sterling currency. The balance of K6,00,000 is in local currency. Dollar costs can be reduced somewhat by purchasing part of the equipment from the sterling area.

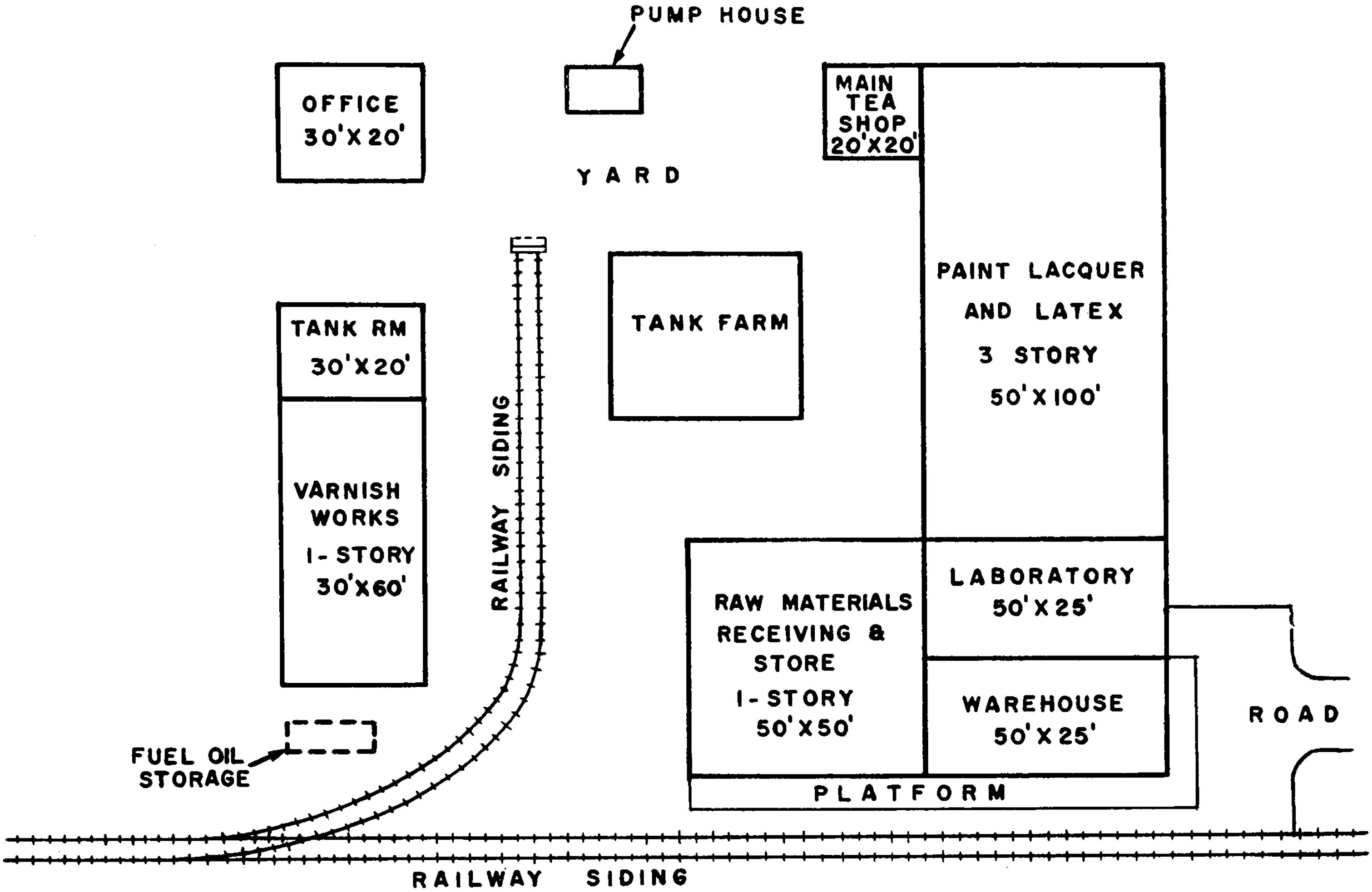
(c) Cost of production. Formulations for the various products differ considerably, the number of constitutents varying from one or two to as many as twenty. Therefore, the raw materials and manufacturing cost of individual products will differ considerably.

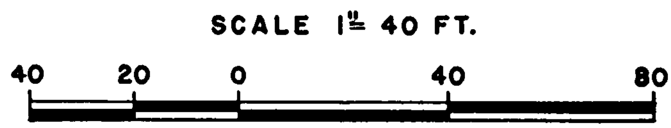
For purposes of setting up an estimated production cost, several typical latex formulations have been investigated and one is set forth as an example. A careful study of each individual product must be made before a final sales price is set. The raw materials cost of this formulation has been used as an average cost in the estimate, although some prices will of course be higher and others considerably less.

Present day latex manufacturers produce paints with from 2·8 to 3·5 lbs. pigment mix per gallon of paint. Therefore, it has been assumed that for all paint produced, in any color, the average of 3·25 lb./gal. pigment mix was used.

Any estimate of the relative quantity of each color sold in any one year is at best a hazarded guess, since human tastes and whims have much to do with the color chosen. However, six basic colors were chosen and an estimate of the raw materials costs per gallon was made and the average of these six is used as a basis for analysis. The following production costs are based on the operation of this plant on a 43-week annual operating schedule.

	K
Interest and Amortization (20 year basis at ·07358)	1,62,000
Raw Materials at K7.32/gal.	31,47,600
Packaging Costs at K0.62/gal.	2,66,600
Steam Costs at K0.02/gal.	8,600
Electricity at K0.05/gal.	21,500
Water at K0·005 gal.	2,200
Maintenance at K0.14/gal.	60,200
Laboratory at K0.11/gal.	47,300
Misc. Supplies at K0.03/gal.	13,000
General Office Supplies at K0.10/gal.	43,000
Labor at K0.70/gal.	3,02,000
Supervisory at K0.10/gal.	43,000
Marketing Exp. at K0.60/gal.	2,58,000
Contingency	4,25,000
Total Manufacturing Costs	48,00,000





MINISTRY OF NATIONAL PLANNING.

PLANT LAYOUT

10,000 GALLONS PER WEEK

PAINT, VARNISH, LACQUER AND LATEX.

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK. RANGOON.

DR. BY. EJP DATE JULY 53. PLATE NO. 13
CK. BY. DEC

These production costs are based on the manufacture of one kind of paint and it is assumed that other types can be produced with corresponding margins of profit.

Using a conservative selling price in Burma of K14 a gallon (which may be compared to the same paint in the United States selling for approximately $3.50 (K16.63) a gallon), the nearest comparable paint now imported into Burma sells for about K16 c.i.f. per gallon.

Annual Revenue 430,000 gal. at K14.00	K60,20,000
Annual Manufacturing Costs	K48,00,000
Gross Annual Profit	K12,20,000

(d) Raw materials. Most of the raw materials are found in Burma with the exception of linseed oil. It is understood that 30,000 acres of land along the Sittang and Irrawaddy Rivers are suitable and available for the cultivation of flax as second crop after paddy. Turpentine, resins and lac are found in Burma and are collected and extracted to some extent on a cottage industry scale. The methods used for collection and extraction have not been profitable. Steps are now being taken in the Shan States to increase the quantity and the efficiency of the extraction and collection of turpentine, resins and lac. The estimate of manufacturing costs was based on imported raw materials because no established prices of indigenous materials were available. The development and expansion of the mineral and chemical resources of Burma will provide raw materials for the implementation of a paint manufacturing plant.

(e) Employment. The project would create employment at the plant as indicated below and indirectly in the procurement of raw materials needed for the products manufactured.

Plant Manufacture Personnel

Plant Manager and Supervisory Force	8
Office Supervisory, Accountants, Clerks, etc.	22
Supervisory	14
Skilled Workmen	72
Unskilled	70
	186

Adequate skilled and unskilled labor is available in the Rangoon area. A plant manager from abroad would be required to manage and operate the plant during the first two years of operation during which time local personnel would be in training to take over.

(f) Recommendations. General plans for this proposed paint manufacturing plant should be included in the program for industrial development of Burma. The project could be developed as a government enterprise, a joint venture, or a private enterprise. It is recommended that its implementation be deferred until the more essential industrial projects are implemented, unless it is undertaken as a private venture which would not impose this additional load on governmental implementing agencies.

(21) Rubber and Rubber Products

(a) The market. The incongruity of the Burma rubber market is the peculiar proportion between the value and volume of rubber goods imported and indigenous raw rubber produced. The value of rubber goods imported is about the same as the value of the

TABLE XXII – 15

RUBBER IMPORTS, VALUE AND ESTIMATED WEIGHT, 1951–52

Commodity	*Total Value*	*Total Quantity*	*Average Value per unit*	*Estimated Weight of Rubber only, per unit*	*Estimated Weight of Rubber only, Total*	*Weight percentage of Total, all Commodities*
	Kyats	*Number*	*Kyats*	*Pounds*	*Pounds*	%
Rubber Soled Footwear with Canvas Uppers	1,80,264	39,827 pr.	4.52	0·5	19,913	1·4
All-Rubber Footwear, No Canvas	49,799	9,359 pr.	5.31	1·5	14,038	1·0
Pneumatic Rubber Tires for Autos	1,50,54,118	74,274	202.68	12	891,288	62·9
Pneumatic Rubber Tubes for Autos	15,67,018	64,929	24.13	3	194,787	13·5
Pneumatic Rubber Tires for Bicycles	12,30,894	198,645	6.19	1	198,645	13·9
Pneumatic Rubber Tubes for Bicycles	4,31,073	180,895	2.38	0·25	45,223	3·2
Solid Rubber Tires for Motor Vehicles	18,705	1,283	14.57	6	7,698	0·5
Other Rubber Manufactures	15,86,050	—	—	@ K30 to 1 lb.	52,800	3·6
Total	2,01,17,901	—	14.10	—	1,424,392	100

raw rubber produced in Burma, but the quantity of pure rubber in the imports is equal to only 5% of the quantity of the raw rubber indigenously produced. The remaining 95% of the value goes to foreign countries for profit, service, labor, and other materials which consist mainly of cotton cord and binder materials.

At the present time, Burma imports over K2,00,00,000 of rubber goods a year.* A total of 94% of these imports are rubber tires and tubes. There are tire plants located in almost every country. The consumption of rubber by vehicular transport dwarfs every other requirement for rubber. For the year 1951–52, Burma imports of tires and tubes alone amounted to K1,83,01,808. The only remaining item of single importance is rubber footwear in which the rubber content amounted to only 2·4% of total rubber imports. Table XXII–15 (*p.* 754) gives a classified list of the total rubber-goods imports for the year 1951–52.

The various types of rubber products are extremely diversified. Next to pneumatic rubber tires and tubes in volume of consumption for industrialized countries is the rapidly expanding field of rubber conveyor and power transmission belting. Burma's present industrial requirements are limited but this may be expected to increase in the next 15 years. A listing of the most common rubber products in the order of their general volume of consumption is :

- Tires and tubes for automobiles, buses, trucks, motorcycles, bicycles, tractors
- Rubber soled canvas shoes
- All-rubber shoes, boots, galoshes
- Rubber slippers, sandals
- Rubber heels, soles
- Rubber hose, industrial and domestic
- Rubber mats
- Rubber belting, conveyor and power transmission
- Rubber cushions, pillows, mattresses, upholstery
- Solid rubber blocks for rice mills
- Rubber raincoats, waterproof clothing
- Rubber sports goods, golf balls, tennis balls, rubber balls, padding, clothing, tents
- Surgical manufactures of rubber
- Rubber balloons
- Rubber toys, animals, dolls
- Rubber bands
- Rubber swimming tubes
- Rubber molded industrial products
- Auto battery cases
- Fountain pens, hard rubber products
- Rubber insulated wires and cables.

* K2,01,17,901 rubber-goods imports for 1951–52.

The proportion of pure rubber utilized in forming many of these products is deceptively small. In many cases the bulk of the article is formed of cotton cord, bead wire, accelerator and stabilizing chemicals. The average automobile tire has an actual rubber content of only 54%. The automobile tire is ordinarily composed of three types of rubber : natural rubber, synthetic rubber, and reclaimed rubber, which are mixed together. Natural rubber tends to lend toughness, elasticity and wearing quality to the tire. Synthetic rubber imparts an ability to withstand higher road temperatures, but it is also often less costly and easier to obtain than natural rubber. Reclaimed rubber is used because of its low cost and also because it completes the rubber blend more satisfactorily than chemicals or any other one type of rubber. The ratio of synthetic and reclaimed rubber is not rigidly static and natural rubber can replace them to a great extent. The general specification weights of passenger car and truck tires are as follows (see Table XXII–16).

TABLE XXII – 16

COMPOSITION SPECIFICATION OF AUTOMOBILE AND TRUCK TIRES

Material	*Specification Weights*					
	Average Passenger Car Sizes: 6·00–16, 6·50–16, 6·70–15, 7·10–15, 7·60–15			*Average Truck Sizes: 6·00–16, 6·50–16, 7·50 × 20–10, 8·25 × 20–10, 10·00 × 20–12*		
			lbs.			lbs.
Natural Rubber	53·8%	9·1%	2·08	47·6%	26·9%	17·0
Synthetic Rubber	(12·28	35·0%	8·0	(30·1	17·8%	11·3
Reclaimed Rubber	lbs.)	9·7%	2·2	lbs.)	2·9%	1·8
Green Cotton Sugar Woven			0·12			0·86
Green Rayon			2·9			9·7
Bead Wire			0·64			2·3
Chemicals			7·5			18·3
Total Materials Weight			23·44			61·26
Deduct Shrinkage and Trim			—·56			—1·90
Net Tire Weight			22·88			59·36
Flap			—			4·10
Total Weight			22·88			63·46

The recommendation that consideration be given to construction of facilities for the manufacture of automobile tires does not stem from the quantity of rubber to be utilized by their production. The weight volume of pure rubber for an annual production of 50,000 automobile tires would be about 500,000 lbs., or 1·6% of Burma's 1952–53 production of rubber

(31,322,500 lbs.). The basic reason for production consideration is the large sum represented by the import of these finished articles. If the tire is manufactured in Burma, the greater part of its labor and production cost will remain in the country. The following table shows the necessity of limiting the totals of rubber-goods imports which have been steadily increasing in volume and ratio until their total value has exceeded that of the export of all raw rubber for the years of 1946 to the present.

(b) Possibility of domestic production

(1) *Input materials and utilities*

Of raw rubber there is naturally an abundance. The input materials that are not presently produced in Burma are cotton and rayon fabric used in tires, rubber footwear, rubber ply hose, and industrial rubber belting. Other imported basic materials are chemicals such as carbon black, caustic soda, lithopone, sulphur and zinc oxide.

The utilities consumed consist of a modest amount of electrical power for the operation of mixers, grinders and presses. Coal is used to produce steam for the necessary vulcanizing and heating of rubber for molding and extruding operations.

(2) *Justification*

The production of automobile tires in Burma will tend to contribute directly toward the improvement of transport which is a basic condition toward the trade and welfare of villagers and rural people alike. A large portion of outgoing expenditure for the purchase of rubber imports will be eliminated with facilities for the indigenous production of rubber in Burma. If the amount of vehicular transport and service is increased through both the availability and economy of local tire production, then the economic level of the entire country will benefit. The resulting increase in direct and indirect employment produces a decided effect toward improved per capita output. The degree of skill for the majority of employees in a rubber plant is not great and there is no large number of skilled specialists who must be imported from other countries.

(c) Economic feasibility

(1) *Description and cost of plant*

In reference to rubber import table XXII–15, it is noted that the import of automobile tires is 74,274 for 1951–52. With approximately 28,000 motor vehicles listed for 1953, a tire plant with a production of approximately 50,000 automobile tires per year is recommended. The total cost of this plant is estimated at K62,40,000 as follows:

K40,00,000	Machinery and equipment for the production of 50,000 auto tires per year.
K10,00,000	Estimated installation cost of equipment.
K4,00,000	Transportation of machinery and equipment to Rangoon.
K6,00,000	Cost of all buildings.
K2,40,000	Engineering service including design, purchase, installation, and initial operation of entire plant.
K62,40,000	Total cost installed at Rangoon.

(2) *Production cost*

The production cost for automobile tires is estimated as follows, for both passenger and truck tires:

TIRE MANUFACTURING COST

Operation	*Average Passenger Sizes: 6·00–16, 6·50–16, 6·70–15, 7·10–15, 7·60–15 (All 4 ply)*	*Average Truck Sizes: 6·00–16, 6·50–16, 7·50×20–10, 8·25×20–10, 10·00×20–12 (All standard ply)*
	K	*K*
Material, including Rubber, Cord, Chemicals	27.70	83.80
Flap	—	5.08
Total Material	27.70	88.88
Direct Labor	2.94	9.60
Indirect Labor	0.76	1.99
Factory Burden	5.93	17.25
Curing	0.52	1.48
Waste Loss	0.57	2.23
Seconds Loss	0.29	0.67
Receiving and Handling	0.48	1.05
Wrapping	—	—
Total Direct Cost	11.49	34.27
Total Factory Cost	39.19	123.15
Warehouse, Shipping and Administration	2.75	8.08
Total	41.94	131.23

The current retail selling price of automobile tires in Rangoon is as tabulated on the following page.

Of secondary importance, next to the manufacture of automobile tires, is the production of camelback or tire recapping strips. Provision for the production of camelback would be included as a part of the tire plant. This will provide facilities for the production of 20,000 strips per year of automobile tire camelback.

(d) Recommendation. It is recommended that steps be taken by Government to implement the building of a factory for the manufacture of motor car, truck, and bicycle tires of selected sizes in most common use in Burma. The factory should also provide for the manufacture of camelback for tire recapping. It is

AUTOMOBILE TIRE PRICES

Passenger Car

Stock Sizes	Tires 6 ply	Tires 4 ply	Tubes
	K	K	K
Passenger			
5·50–15	117.75	91.50	13.00
6·00–15	125.25	96.50	14.00
6·50–15	152.50	117.50	17.25
4·50/4·75–16	—	69.50	13.00
5·00–16	99.25	79.25	13.75
5·25–16	104.75	83.75	13.75
5·50–16	123.75	94.75	13.75
5·75–16	124.50	96.00	13.75
6·00–16	126.25	97.50	14.25
6·00–16 (Jeep Type)	139.50	—	14.25
6·25/6·50–16	156.00	120.00	15.50
7·00–16	181.00	—	15.50
4·50–17	92.00	73.50	14.00
5·25/5·50–18	126.00	—	14.00
Super Balloon			
5·90–13	108.00	82.50	13.00
6·40–13	123.00	94.00	13.00
6·70–15	138.25	106.75	17.25
7·10–15	153.75	—	17.25
7·60–15	167.75	—	17.25
6·70–16	133.75	—	15.50
7·60–16	171.75	—	15.50

Note.—White sidewall single and double available in all 15-inch and 16-inch passenger car tires. Single 20% and double 25% above black sidewall tires.

TRUCK AND BUS TIRE PRICES

Stock Sizes	Tires No. Ply	Tires BS/TPT	Tires AT/HT	Tubes
		K	K	K
Truck and Bus				
6·00–16 Delivery	6	139.50		14.25
6·50–16 „	6			
9·00–16	10	414.25		34.75
10·50/11·00–16	12	592.00		39.25
7·00–17	8	227.00		22.00
7·00–20/32×6	10	283.50	297.80	23.00
7·50–20/34×7	10	342.25	359.25	29.25
7·50–20/34×7	12	376.50		29.25
8·25–20	10	377.50		39.75
8·25–20	12	415.00		39.75
9·00–20	10	467.00		39.75
9·00–20	12	513.50		39.75
10·00–20	12	621.50		45.50
11·00–20	12	709.00		53.50

further recommended that the project be included in the intermediate plan to be started between 1956 and 1958. Before deciding on the specific capacity of the plant a careful study of the market should be made for sizes of tires and the feasibility of export.

(22) Clay and Shale Products

Except for a limited number of crude clay building-brick kilns, and a number of pottery plants of cottage industry size, there is no real clay products or ceramics industry in Burma.

Even in the important Rangoon area, where a greater number of higher type buildings exist than in any other city in Burma, there are no modern brick plants. Almost all building-bricks are manufactured in crude kilns owned and operated by the principal building contractors. The quality, size and shapes are uncertain and uneven.

(a) Tile. Clay roofing tile is not manufactured in the country although this type of roofing is commonly used on most permanent and semi-permanent building. It is all imported. Yet clays suitable for the manufacture of clay products are generally found in abundance in most countries, and particularly in alluvial delta areas, and are known to exist in abundance in Burma.

The imports of clay tile and brick into Burma have been recorded as follows:

Years	Number *	Declared Import Value in Kyats
Prewar		
1938–39	1,872,082	1,47,642
1939–40	2,441,804	1,88,853
1940–41	2,924,466	2,30,099
Prewar Average	2,412,784	—
1941–46	No records	
Postwar		
1946–47	1,573,269	3,30,906
1947–48	734,725	1,88,988
1948–49	1,977,518	5,70,867
1949–50	820,618	2,23,273
1950–51	635,451	2,17,878
1951–52	2,595,638	10,22,830
Postwar Average	1,389,369	

* Includes roofing tile, wall tile, and non-fire brick. Roofing tile made up 90% of declared value of 1951–52 imports.

The Government of the Union of Burma is implementing a large-scale housing program. It is estimated that approximately 240,000 new houses of the non-basha type will be built in the next ten years. It is also estimated that each of these will require an average of 2,000 sq. ft. of roofing. As other types of roofing will be used on many of these, all cannot be considered potential outlets for the sale of clay roofing tile. Assuming one fourth use clay roofing tile, a total of 120,000,000 sq. ft. of laid tile will be required. Each tile covers 0·90 sq. ft., thus a total of 133,333,000 roofing tile will be required, or an average of 13,333,000 per year, for this purpose alone.

In addition, large public and private buildings will increase this quantity. In general, it has been estimated that all construction material requirements will be 344% of the prewar requirements by 1959–60. On this basis the use of roofing tile should increase to 8,300,000 pieces per year by that date.

While these estimates do not check with each other, the latter figure is believed to be conservative, and the first one possible. Certainly if these tile were to be made in Burma, where they could be manufactured and sold cheaper than the imported product, their use would increase.

(b) Building-brick. No statistics are available regarding the use of common clay building-brick in Burma. However, statistics of brick manufactured in some other countries indicate an average annual use of 20 brick per capita. As Burma is ranked very low in comparison to the international average use of other basic building materials, the average use per capita for Burma would probably not exceed 25% of the international figure. Thus, on the basis of a per capita use of five brick per year, the estimated total use in Burma would be 93,720,000 brick per year.

The new housing program will require a tremendous number of building-brick. The rebuilding of the Pagoda at Pegu alone will require millions of brick; and many of the projected factory buildings for the development program will require millions more. The estimates previously made are therefore believed to be conservative.

Common clay building-brick, because they can normally be manufactured everywhere, cannot usually be shipped far. Thus no single brick plant can hope to supply all of Burma. It is not believed that more than 50% of the brick used will be sold in the Rangoon area. This would reduce the Rangoon market to about 45,000,000 per year. As there are a number of local brick plants, no single plant, however modern, would expect to make and sell more than 30–40% of the brick required in this market, or 18,000,000 per year.

(c) Government clay products plant. The Government of the Union of Burma has recognized the necessity for a modern clay products plant in the Rangoon area, and has purchased the machinery and equipment for this purpose. This plant will have the capacity to produce 6,000,000 roofing tile, and 4,000,000 building-brick per year.

As the building program develops a modern brick and tile plant should be built in the vicinity of each of the larger cities.

(d) Light-weight aggregate. The Rangoon area is entirely an alluvial delta area, and is therefore entirely devoid of proper aggregates for concrete use. Aggregate is shipped from the limestone deposits near Moulmein, or from the granite deposits near Mokpalin. Gravel obtainable is not suitable for good concrete, being of a narrow size range, and too fine. The only other aggregate in use in this area is broken brick-bats. These are of poor quality and are not comparable to good gravel or stone.

Sand used in Rangoon is of poor quality, being almost all one size, and very fine.

The Rangoon area has abundant deposits of clays suitable for the manufacture of clay brick and tile. Such clays are also ideal for the manufacture of light-weight aggregates. The use of light-weight aggregates manufactured from clays and other common materials has become important in the construction industry, particularly in the United States, where it is made and sold profitably in areas where good stone and gravel aggregates are readily available at normal prices.

Such manufactured clay aggregates are freely used in building construction and in concrete products. Being light in weight and of normal strength, their use permits smaller columns and beams, which reduces construction costs sharply. The concrete products made with such aggregates are lighter in weight and are more easily handled.

The principal advantage of using such aggregates in the Rangoon area would be that of supplying a better and graded aggregate at less cost. Its use would reduce the amount of Portland cement required, because it would be of a proper size gradation, permitting the design of concrete of higher strengths. The use of common building brick-bats is a crude substitute for the same type of product.

The manufacture of light-weight aggregates from clays is a simple procedure. It consists of working the clay, sizing it, and burning it in a small rotary kiln. The cost of such a plant would be small, compared with other industries, as the machinery should not cost more than K10,00,000. A plant of this type should be constructed as a part of the new clay tile and brick plant.

(e) Rock wool insulation. Another product needed in Burma, and which can easily be made in this country, is rock wool insulation. Aside from the basha thatched roofs used, all other types of roofing require insulation to prevent undue heat transmission.

Rock wool insulation is manufactured from shales or low-grade limestones. The process consists of melting the raw material and then spraying it into the air. The resulting solidified material is an excellent insulator that is permanent, cheap, and fireproof.

Such a plant could be made a part of the brick and tile plant being constructed. The cost of the equipment would be comparatively very small, probably not over K2,50,000.

(f) Clay drain tile. No clay drain tile is manufactured in Burma, yet an important quantity is required. There are two types needed, the common baked tile, and the glazed tile. These can be made as easily as roofing tile or building-brick, and with the same equipment. The glazed tile requires the use of salt.

These products are commonly used for water drainage, and for sewage lines.

(g) Hollow building-tile. Clay tiles of this type are made and used in two ways. One is for interior partitions. These are light in weight and have good structural properties.

Another use is for exterior walls. In this case the exposed exterior surface is given a special treatment to make it more pleasing to the eye. Its use is economical and results in a wall having good insulating qualities due to the air spaces.

(h) Ceramics. There are numerous clay pottery and glazed pottery plants in Burma. None of these are large, and many are of cottage industry size. No statistics exist regarding the total output. None manufacture vitreous china, at least of the type required for bathroom and kitchen use.

Good kaolin has been found in commercial deposits in upper Burma. A modern ceramics plant to manufacture tiles, flat tableware, art pottery, and industrial shapes would cost K1,23,94,720. Further study is recommended to develop this project and to determine its economic aspects.

(23) Glass Products Plant

(a) The market. Currently there are no facilities in the Union of Burma for the manufacture of flat glass, and only limited facilities for the manufacture of other glass products. Consequently most of such products are imported. This requires the allocation of a considerable block of foreign exchange, and the resulting arbitrary costs and selling prices restrict the use of glass products.

The volume of imports of glass products has reached a sustained level that is great enough to warrant the establishment of a national glass products industry. The demand for all glass products is certain to increase by normal growth as well as from the large-scale housing and building program now being started.

The past and present use of glass is shown in the table of glass products imports, Table XXII-17.

The housing program alone will account for a great deal of the demand for flat glass products. While many homes in Burma are of the type that do not use glass, the new Pucca and all-timber houses to be constructed will require glass. The estimated number of these to be built is as follows:

Year	*Pucca*	*All-timber*
1952 53	1,828	22,832
1953–54	2,335	23,930
1954–55	2,842	25,028
1955 56	3,349	26,126
1956–57	3,856	27,224
1957–58	4,364	28,336
1958–59	4,871	29,430
1959–60	5,378	29,532
Total	28,823	212,438
Average	3,603	26,555

For each new house built it is estimated that 150 sq. ft. of glass will be used. This would require 4,523,700 sq. ft. or 2,343 long tons per year. Normal replacements, remodeling older houses, office, factory and public building construction and maintenance would require an approximately equal amount.

Import figures for flat glass, and estimates of new future needs, indicate that a flat glass plant to manufacture 5,000 long tons per year should be built.

(b) Raw materials. The principal raw materials required for the manufacture of glass products are the following:

Silica Sand	40%
Soda Ash	15%
Cullet	35%
Dolomitic Limestone	8%
Various	2%
	100%

The 2% of "various" ingredients shown above consists of the various chemicals utilized in each batch to insure desired physical and chemical qualities in the finished glass. The quantity of each is so small that their use has little effect upon the manufacturing costs.

(1) *Sand*

Deposits of sands for use in the manufacture of glass products have been located in the Mergui district, both on the mainland and on islands nearby. This area is approximately 330 miles south by east from Rangoon.

An investigation of some of these glass sand deposits was made in May 1952. A summary of the results of this investigation with respect to quantity of the sand deposits is as follows:

Reference	*Deposit*	*Estimated Quantity (cubic yards)*
A	Thegon and Panoyo	272,000
D	Selengyi Sakan	13,000
F	Thedangyi	6,000
G	Tatange Island	13,000
	Total	304,000
		or 366,000 long tons

At an annual rate of use of 5,000 long tons per year for 10,000 long tons of glass, these deposits would last 73 years.

(2) *Soda ash*

Soda ash will be manufactured near Akyab, which is about 500 sea miles from Rangoon.

(3) *Cullet*

Cullet (broken glass) will originate in or near Rangoon.

(4) *Dolomite*

Dolomite is available in Burma in several locations, but none is near Rangoon. The Department of Geology reports a 3,000-foot thick deposit in the deep gorge of Namtu, near Lema, north Shan States, and a second deposit of the same thickness at the south end of Great Scuff, south of Kyaukkyan, north Shan States. The average analysis of this dolomite is:

$CaCO_3$	55·84%
$MgCO_3$	43·05%
Fe_2O_3 and Al_2	0·54%
Insolubles	0·57%
	100·00%

A third deposit is in the neighborhood of Loian, near Kalaw, in the southern Shan States, about 360 miles from Rangoon, by rail. High calcium limestone

TABLE XXII - 17

IMPORTS OF GLASS AND GLASS PRODUCTS

Fiscal Year	*Sheet and Plate Glass*		*Phials and Sodawater Bottles*	*Other Bottles*	*Tableware including Tumblers, Decanters*	*Funnels, Globes, Glass Lamp Parts*	*Hardware Lamps and Glass*
	Long Tons	*Sq. Ft.*	*Gross*	*Gross*	*Kyats*	*Kyats*	*No.*
1936–37	1,163	2,132,438	2,895	58,919	1,13,136	88,014	268,901
1937–38	1,504	2,847,447	5,399	89,583	60,212	1,08,258	223,593
1938–39	862	1,564,385	2,924	63,488	54,000	1,08,197	105,356
1939–40	1,250	2,453,519	3,618	81,099	49,160	1,23,432	186,759
1940–41	841	1,392,868	5,994	65,820	36,427	1,22,399	53,702
Prewar Total	5,620	10,390,657	20,830	358,909	3,12,935	5,50,300	838,311
Prewar Average	1,124	2,078,131	4,166	71,782	62,587	1,10,060	167,662
1945–46	Nil	Nil	208	7,627	1,30,633	66,855	Nil
1946–47	656	1,033,195	179	40,879	3,34,616	2,01,836	9,702
1947–48	3,498	3,765,260	635	39,349	3,23,849	1,94,226	931
1948–49	303	472,658	Nil	27,464	1,15,892	41,276	4,914
Postwar Total	4,457	5,271,113	1,022	115,319	9,04,990	5,04,193	15,547
Postwar Average	1,114	1,317,778	255	28,829	2,26,248	1,26,048	3,887
1949–50*	400						
1950–51	600						
1951–52	800						
1952–53	1,000						
1953–54	1,200						
1954–55	1,500						
1955–56	1,600						
1956–57	1,700						
1957–58	1,800						
1958–59	1,900						
1959–60	2,000						

* Estimated.

can be obtained from deposits near Moulmein, about 80 miles from Rangoon.

(5) *Fuel*

Good natural gas is the most desirable fuel but will not be available. Oil has the next most desirable characteristics, but while the tank furnace may be fired on heavy oil of the Bunker C type, light oil of the diesel type will be required for the debiteuse kiln in the sheet glass plant and for the lehrs in the container plant, and is greatly preferred for the feeders in both types of glass manufacturing plants. If any of the various types of coal are to be employed, then a producer gas installation is required. Raw producer gas may be employed for the tank furnace, but the lehrs and debiteuse kilns require scrubbed clean gas. Imported coal generally originates in India. No data are available concerning the producer-gas qualities of this coal.

Kalewa coal, when the mine is developed, can be delivered at Rangoon below the cost of imported coal. Therefore if coal is to be used, a quantity should be shipped to a testing plant to determine its gassing characteristics, as the design of the tank furnace, as well as the lehrs and debiteuse kiln, is dependent upon the analysis and characteristics of the producer gas.

(c) **Glass manufacturing plant location factors**. As no existing glass plant facilities are to be incorporated in the proposed new glass products plant, there are no restrictions to prevent the establishment of thc plant in the most favorable location that will result in the lowest manufacturing and distribution costs.

The factors influencing the selection of this ideal site are:

Purchase cost of materials and fuel.
Cost of transportation of raw materials and fucl from point of purchase to plant site.
Cost of transportation from point of manufacture to major market areas.
Availability of labor.
Cost of site and its improvement.

A preliminary check indicates that it would be cheaper to bring all of the necessary materials together at Rangoon than it would be to collect them at Mergui. The freight and breakage in shipping the finished products to Rangoon, the major Burma market, would be eliminated. The proposed plant should be located at Rangoon.

Because the silica sand, the soda ash, the lime, and the fuel must be brought in by water transport, the plant site should be on the north or east bank of the Rangoon or Hlaing River. Such a site would also permit railway and truck transport, as well as water transport, without having to cross the river.

(d) **Products.** Burma imports almost all types of glass products and while all of these are needed, it is doubtful that there is sufficient demand for each one to warrant the expense of installing the special equipment required to manufacture all of them initially.

These products classified by processes are:

Flat Glass
Bottles and Containers
Pressed Ware
Paste Mold Ware
Glass Tube Ware
Insulation Products
Vitreous Enamcl Products.

The proposed plant has been restricted to the manufacture of flat glass and bottles and containers. The equipment for manufacturing the other products is not included in the proposed plant but may be added as the demand for these products justifies.

(1) *Thin glass*

This includes glass weighing less than 16 ounces per square foot, i.e., less than one twelfth inch in thickness, and includes watch-crystal glass (one thirtieth inch to one twelfth inch), lantern-slide glass (one twentieth inch), microscope-slide glass (one twenty-fifth inch), photographic dry-plate glass (one fifteenth inch), X-ray and picture glass (one thirteenth inch).

(2) *Common sheet (window) glass*

This type represents the great bulk of production and includes principally single-strength glass, weighing from 16 to 19 ounces per square foot (one twelfth inch to one tenth inch), and double-strength glass, weighing from 24 to 26 ounces per square foot (one ninth inch to one eighth inch). Such glass is used largely for glazing windows and doors of dwelling houses, for hot beds, cold frames, skylights, conservatories and greenhouses.

(3) *Heavy (crystal) sheet glass*

This type includes glass weighing over 26 ounces per square foot (over one eighth inch thick). The most common types in this glass are three fifteenth inch, seven thirty-seconds inch, and one quarter inch in thickness. This glass is used in automobiles, in showcase windows, for table tops, and elsewhere.

Not included in the sheet glass production are the many forms of structural sheet glass, such as wired glass and polished plate glass, both of which are produced by entirely different processes and equipment.

(4) *Flat glass weights*

The following are the weight, area, thickness ratios:

Thickness	*Ounces per square foot*
Single Strength	
($\frac{1}{12}$ in. to $\frac{1}{10}$ in. thick)	16–19
Double Strength	
($\frac{1}{9}$ in. to $\frac{1}{8}$ in. thick)	24–26

One square foot of single strength sheet glass (2 to 2½ mm. thick) approximates 1·16 pounds. One metric ton is approximately equivalent to 170 square meters, or 1,900 sq. ft.; 1,700 sq. ft. to a 2,000-pound ton, and 1,930 sq. ft. to a long ton of 2,240 pounds.

The following table shows the maximum production of three standard Fourcaults drawing standard size sheets. These figures are based on good glass and continuous operation. The use of 300 operating days per year provides an 18 % margin from estimated maximum production for the annual production.

(5) *Bottles and containers*

The bottles and containers will be produced in two machines having a combined capacity of about 120,000 gross per year of assorted sizes and shapes. One unit will be capable of manufacturing containers in sizes from half ounce to 64 ounce capacity including wide-mouth screwtop jars. The second unit will form containers of from quarter ounce to 8 ounce capacities, including narrow neck and slim wide-mouth bottles.

If large containers are required, a third unit will be needed, but the cost of this unit is not included in the initial plant.

(6) *Pressed ware production*

The manufacture of pressed glassware can be included in the proposed glass plant, although such a division is not included in the estimate of costs. This would include hollow glass building-blocks.

(7) *Paste mold ware*

The manufacture of paste glassware can also be included in the proposed glass plant, but is not being included in the initial estimate.

(8) *Glass tubing and rods*

The manufacture of glass tubing and rods can be done in the proposed glass plant if additional equipment is included. At present this can be delayed, so the necessary equipment is not included in the estimates of cost.

PRODUCTION PER MACHINE
(*Square feet*)

Daily Figures Based on 24 Hours

Annual Figures Based on 300 Days

	60-in. Machine	*84-in. Machine*	*100-in. Machine*
	48 in. Trimmed Width	*72 in. Trimmed Width*	*88 in. Trimmed Width*
·091 in. Thickness			
Speed, in./min.	42 in.	42 in.	42 in.
Hourly Production	840 sq. ft.	1,260 sq. ft.	1,540 sq. ft.
Daily Production	20,160 ,, ,,	30,240 ,, ,,	36,960 ,, ,,
Annual Production	6,048,000 ,, ,,	9,072,000 ,, ,,	11,088,000 ,, ,,
⅛ in. Thickness			
Speed in./min.	27 in.	27 in.	27 in.
Hourly Production	560 sq. ft.	740 sq. ft.	904 sq. ft.
Daily Production	13,440 ,, ,,	17,760 ,, ,,	21,696 ,, ,,
Annual Production	4,032,000 ,, ,,	5,328,000 ,, ,,	6,508,800 ,, ,,
¼ in. Thickness			
Speed in./min.	12 in.	12 in.	12 in.
Hourly Production	240 sq. ft.	360 sq. ft.	440 sq. ft.
Daily Production	5,760 ,, ,,	8,640 ,, ,,	10,560 ,, ,,
Annual Production	1,728,000 ,, ,,	2,592,000 ,, ,,	3,168,000 ,, ,,
Daily Pull (full width sheet)	15 tons	21 tons	25 tons

(9) *Other products*

(*a*) *Insulation products*
Glass Wool
Rock Wool
Foam Glass.

(*b*) *Vitreous enamel products*
Glazed Building-tile
Sewer and Drain Pipe
Ceramic Tableware
Vitreous Enameling Plants
Building-brick
Silicate of Soda.

It is not intended to include the manufacture of these products in the initial plant, so the cost of the equipment is not included in the estimates.

(e) **Description of process.** The principal raw materials, silica sand, soda ash, lime, and broken glass (commonly called cullet) are ground or pulverized and thoroughly mixed together in accurately maintained proportions. The batch mixture is fed automatically to the glass-melting tank furnace to maintain the level of the molten mixture in the tank within one tenth of an inch, in good operating practice.

In the tank furnace the batch is melted, refined and conditioned in a continuous operation during which the material passes from the charging end to the exit, or machine feeding end.

From the feeding end the glass is drawn vertically in a sheet six to eight feet wide and solidifies in the process. The drawing equipment is known as the "Fourcault machine" after its Belgian inventor.

The continuously rising sheet is cut transversely near the top of its travel and is then sent to the cutting room for trimming and cutting to the desired dimensions.

The process described is called "the Fourcault system" which produces most of the world's sheet glass.

(1) *Glass-melting tank furnace*

The batch materials are charged into one end of a large "tank" built of refractory blocks. Rectangular in shape, the tank usually contains from 500 to 1,500 tons or more of molten glass. The tank is somewhat similar to an open hearth steel furnace.

At operating temperatures of 2,800° F. the demand on the refractory materials is great. The quality of the glass and the life of the furnace depend upon the quality of the refractory materials. The tank blocks are continuously subject to corrosion, erosion and chemical decomposition. The life of the tank blocks varies greatly with the skill with which the furnace is operated and the furnace design. Good design and good operating practice may multiply the life of the furnace by a factor of four or an even larger figure.

(2) *Sheet glass cutting*

There is available some automatic equipment for cutting and packing sheet glass, but a large percentage of sheet glass is cut and packed by hand. It must be determined in individual circumstances whether the possible salvage of sheet glass by selective hand cutting outweighs the advantages of the lower operating cost of semi-automatic equipment. Hand cutting requires a great deal of space for the individual cutting tables on which this operation is usually accomplished.

(f) **Estimated costs.** It is estimated that the capital required to establish a plant to manufacture 5,000 long tons of flat glass, and 120,000 gross of assorted containers, per year, will be as follows:

Flat Glass and Bottle Plant	*Estimated Cost (K)*
Raw Material Storage Equipment	2,83,200
Raw Material Preparation Equipment	3,54,000
Batch Mixing Equipment	3,54,000
Flat Glass Furnace Equipment	9,44,000
Container Glass Furnace Equipment	4,72,000
Flat Glass Drawing Equipment	3,77,600
Container Glass Molding Equipment	3,77,600
Debiteuse and Floater Kiln	70,800
Lehr Machine and Equipment	2,26,560
Cutting Tables	94,400
Mold Cleaning Equipment	23,600
Elevating and Conveying Equipment	94,400
Compressed Air System	1,88,800
Vacuum System	47,200
Fuel Oil System	1,41,600
Water Cooling Tower and Water System	1,41,600
Standby Power Plant Equipment	4,00,000
Electrical Distribution Equipment	2,36,000
Laboratory Equipment	70,800
Office and Stores Equipment	70,800
Shop Equipment and Tools	3,54,000
Box Making Equipment	70,800
Sewage and Sanitary Equipment	94,400
Automotive Equipment	1,18,000
Total Equipment	56,06,160
Buildings and Structures Material	11,80,000
Ocean Freight	7,08,000
Insurance	1,32,160
Duty	—
Rental on Construction Equipment	3,54,000
Living—Travelling Expense of Foreign Experts	3,54,000
Construction Overhead	3,30,400
Contingencies	7,20,000
Engineering-Erection-Construction	23,60,000
Total Cost except Real Estate	1,17,44,720
Real Estate—Plant Site and Raw Materials	5,87,280
Total Erected Cost	1,23,32,000
Working Capital	23,60,000
Total Capital Required	1,46,92,000

(g) Construction and expenditure schedule. It is estimated that it will take about 20 months to complete the proposed plant from the time the preliminary design has been completed, the raw materials and fuels checked. The machinery can be shipped from six to eight months after the order is placed.

(1) *Procedure*

A consultant should be employed to make the preliminary design, test the raw materials, select the plant site, and to prepare machinery specifications. This should require about four months.

The plant site should then be purchased and grading started. Upon completion of general drawings and foundations drawings, construction can start.

(2) *Expenditure schedule*

Of the estimated cost of K1,46,92,000, approximately K93,17,000 will be required in foreign currency and K53,75,000 in local currency.

(3) *First year expense*

The principal first year expenditures will be for engineering, material testing, acquisition, and improving plant site and raw material deposits, and for advance payments on machinery and materials. These are estimated to be K77,88,000 of which K59,00,000 will be in foreign currency and K18,88,000 in local currency.

(4) *Second year expense*

The expenditures for the second year will be K34,17,000 in foreign currency and K34,87,000 in local currency.

(h) Manufacturing costs. The manufacturing costs have been estimated as shown on the following table XXII–18.

TABLE XXII - 18

ESTIMATED COST OF SALES AND PROFIT

Sheet and Container Glass

	Flat Glass	*Per L.T.*	*Container Glass*	*Per L.T.*	*Per Gross*
	K	K	K	K	K
1. Operating and Repair Labor	2,00,000		3,57,000		
2. Operating and Repair Supplies	60,000		40,000		
3. Silica Sand	1,50,000		60,000		
4. Soda Ash	1,80,000		72,000		
5. Cullet	42,000		16,800		
6. Dolomite	24,000		9,600		
7. Miscellaneous	24,000		9,600		
8. Fuel	3,42,500		1,37,000		
9. Power	5,00,000		2,00,000		
10. Water	15,000		6,000		
11. Boxing and Packaging Materials	75,000		30,000		
12. General Works Expense	3,75,000		1,50,000		
13. Administration and Sales	3,75,000		1,50,000		
14. Amortization of Capital Loan	6,00,000		4,05,095		
15. Insurance	75,000		30,000		
16. Cost of Sales	30,37,500	606.25	16,73,095	836.55	13.94
Quantity	(5,000 L.T.)			(2,000 L.T.)	(120,000 Gr.)
17. Gross Sales	25,71,650	514.33	18,00,000*	900.00	15.00
18. Add for Breakage	2,57,165	51.43	—	—	—
19. Total	28,28,815	565.76	18,00,000	900.00	15.00
20. Stevedoring and Warehousing	2,26,305	45.26	—	—	—
21. Gross Total Sales	30,55,120	611.02	18,00,000	900.00	15.00
22. Less Cost of Sales	30,37,500	606.25	16,73,095	836.55	13.94
23. Gross Profit	17,620	4·77	1,26,905	63.45	1.06

*Estimated. No data available from import records for containers alone.

The estimated cost of flat glass is very close to the estimated ex-warehouse cost of UK and Belgian imported glass, less duty and profit to dealer. Japanese prices are below the UK and Belgian prices checked, for flat glass. No accurate costs of imported bottles could be obtained from the import figures available.

The distances it is necessary to transport the silica sand, soda ash and dolomite make the manufacturing costs higher than normal.

(i) **Recommendation.** This project is marginal from the viewpoint of financial return but justifies consideration from the viewpoint of self-sufficiency in an essential commodity. It is recommended that the project be considered for implementation in the intermediate plan. Improvement in transportation facilities and lower costs of transportation services and electric energy will enhance the economic feasibility of the project.

(24) Sand and Gravel

Sand and gravel are elemental construction materials. Sands are used in all concrete and are required for many other purposes such as surfacing macadam and black top roads and streets.

Sands are generally available in every area and their recovery is normally a simple operation. Because of its general abundance, construction sand is usually not shipped far.

The sands in the Rangoon area are not of the best grade as they are too fine and the size is too uniform. The best sands for concrete use are graded, all of them passing a quarter inch screen, and 95% passing a 100-mesh screen. Such graded sands are normally not found in slow moving rivers or on sea shores as the water grades the sand by size and deposits only one size in any one spot.

The demand for construction sand in the Rangoon area is great enough to warrant the construction of a suitable plant. At present about 80% of all Portland cement used in Burma is sold in the Rangoon area. This amounted to approximately 60,000 long tons for the year 1951–52. This is sufficient to produce about 240,000 cubic yards of rammed concrete. As each cubic yard of concrete requires approximately 0·50 cubic yards of sand, an annual total of 120,000 cubic yards of sand is needed.

Other uses, for road surfacing, etc., would bring this total up to at least 200,000 cubic yards per year in the Rangoon area alone. This would total more than 225,000 long tons (dry basis).

Good construction sands must be washed to remove all loam or organic materials that might injure concrete. Such organic materials as sewage, vegetable matter, tannic acid and manure must be removed. Good sands must be of hard materials such as quartz. Sands may be obtained from sand deposits or by screening from gravel.

A sand plant is a simple plant. It normally consists of excavating equipment to suit the deposit conditions, of washing and screening equipment, and of conveying equipment. Gravel plants are similar except that more screens are required and sometimes crushers if much of the gravel is over two to three inches in size.

A moderate sized sand plant is not expensive, and should not exceed K3,00,000 for the equipment if a sand drier is not installed. A gravel plant would cost about twice as much. While no good deposit of sand is known in the Rangoon area, a search should be made to find one.

(25) Precast Concrete Products

Precast concrete products are used in Burma on a limited scale only, and not all types of such products are used or manufactured. The most commonly used precast concrete products are:

Masonry Units
Roof Tile
Structural Members
Poles and Piling
Concrete Pipe.

(a) **Concrete masonry.** The term "concrete masonry" applies to block, brick, and tile building units molded of concrete and laid by masons in walls. Plants for the manufacture of those units are commonly of moderate size, established in many locations. As the products may usually be made in all localities the plants usually serve the local community only, so that the products are not shipped very far.

For example, in the United States and Canada there are about 4,500 such plants producing over 1,500,000,000 units per year. About 40% of these are produced with light-weight aggregate. As far as is known, only concrete blocks are produced or used in Burma. The only known active plant is one in Rangoon, which has a capacity of 1,200 standard block per eight-hour day, or 2,400 blocks of half thickness. If operated 300 eight-hour days per year this plant would have an annual minimum capacity of 360,000 standard block per year.

The Rangoon block price is K80.00 per 100, which compares to the current clay brick price of K125.00 per 1000. As one concrete block occupies the same wall space as eight clay bricks, the prices are nearly equivalent. The small volume price differential is more than offset by the lower cost of handling and mason labor and by the fact that much less mortar is required in the laying.

Buildings constructed of concrete blocks compare well in cost with those of the same size and type constructed of other materials. An cxample is the two concrete block units constructed in the Minmanaung Kwethit housing area. These, with concrete floors, cost K8,500 each. The balance of the buildings in this group, constructed on a large-scale contract basis, of timber and woven matting construction and without concrete floors, are reported to have cost K5,400.00 each. One type is fireproof and permanent, while the others are not. There is no question but that if the concrete block houses were to be erected on a large scale, if the lintels and trim were precast, and if the design were simplified a little, these could be produced at about the same cost as the other type.

A two-machine block plant will cost about K75,000 for the equipment. The labor is largely unskilled, and only about four men per machine are required. Blocks can be constructed at a good profit at the present price.

As the cost of a single machine unit is small, many of these could be installed in the principal towns of Burma at little total cost, thus providing wide distribution of a good building construction product without excessive freight charges. Usually the aggregate can be found in all locations, and only the Portland cement need be shipped in. Cement costs would be higher than at Rangoon by the freight costs to the plant.

This would be better than using local clay brick at each town as the local brick are of poor quality. It would also not be practical or economical to ship the clay brick from the new clay products plant in Rangoon.

Where available, the use of light-weight aggregate would be best. The standard concrete block weighs about 45 pounds when made with natural aggregates, but only from 25 to 30 pounds when the light-weight aggregate is used. The weight of the blocks is generally the main objection to their use.

Concrete bricks are widely used elsewhere, but not in Burma. These can be made in the same type of machines as the block and are superior to the clay brick in strength and appearance. Concrete wall tiles for partitions are as easily made.

In many countries precast floor and wainscot tile are used as much as clay tile. These can be made with colored aggregates in many patterns, and when ground like terrazzo, are extremely attractive. A good market for these could be built up in Burma.

(b) Concrete roof tile. Another precast concrete product that can be made economically in Burma is concrete roofing tile. These can be made in several shapes including exact duplicates of the clay tile. These may be colored if desired. The cost would be far below that of the imported clay roof tile, and should be competitive with the tile produced in the new government tile plant in Rangoon. As these can be made in any location little breakage would occur and there would be no freight to add to the cost, except for the Portland cement. When properly made thcy are equal to the clay product, and cost no more.

(c) Precast structural members. Standard precast structural members are logical units to manufacture in Burma. These would include floor beams, floor joists, floor slabs, windows and door sills and lintels, sanitary toilet slabs, and well, cistern, and cesspool cover slabs, drainage ditch covers, highway railing and markers, and revetment blocks.

Only covers for drain ditches are used now in Burma. The use of such precast units results in important reductions in cost compared with tailored units built in place, as they save in form costs and in placement labor.

This use has greatly reduced the cost of houses and other structures in the United States and elsewhere, and can do the same in Burma.

(d) Precast poles and piling. The construction of the large electric power distribution system in Burma will require a great number of poles for both feeder and distribution lines.

Timber poles are practical if the poles are treated against rot and insects. Even so the life expectancy of wood poles is short. Wood towers for the main distribution lines are not practical. Such line supports must therefore be made from imported structural steel, or be made of precast concrete as is commonly used in Italy.

The smaller precast concrete poles for power, light and telephone lines are more economical in the long run due to their longer life and lower maintenance costs. Their uniformity also adds to the appearance of any such line installation. Some poles of this type are in use now in Burma. This type of pole may be cast in various locations along the route of power lines to save freight costs.

The river and harbor work being planned will require the use of much piling. The number and cost of such piles may be decreased if precast piling are used. These are standardized and are used on all important marine structures throughout the world. Experience has proved that the use of these precast concrete piles is economical in the long run. Portable plants for their construction are easily erected.

(e) Concrete pipe. There is a real need in Burma for a plant to manufacture concrete pipe. All pipe used in Burma is imported, and although a steel products plant is projected for Burma, it is not planned to manufacture pipe in it.

For many purposes concrete pipe is cheaper than, and equal to, steel or cast iron pipe. The principal uses are for water and sewage lines, drainage and irrigation systems, and for culvert work. Practically all concrete pipe is reinforced. Almost all large water aqueducts are made of reinforced concrete conduit, either cast in place or precast.

No clay drainage or sewer pipe is manufactured in Burma. Therefore the pipe market for such uses is completely open, and can be most easily supplied by concrete pipe.

Every non-basha type house requires drain pipe for conducting rain water away from the house. Sewage lines are required for each house, and toilet and kitchen vent pipes are required. All of these requirements can be supplied economically and satisfactorily by precast concrete pipe. As it is planned to construct 240,000 houses of this type during the next ten years, the demand for such pipe will be great. If only 100 ft. of pipe is used per house unit, a total of 24,000,000 lineal feet will be required, or 2,400,000 ft. per year as an average.

In addition, new water and sewage mains outside of private property lines will require much pipe, and of a larger size. It is easily possible that a minimum of 3,000,000 lineal feet will be required per year.

The highway program outlined in Chapter XVI will require 370,500 lineal feet of 18-in., 24-in., 36-in. and 48-in. drain tile in the next ten years.

A single unit, manufacturing spun reinforced concrete pipe, will produce about 300 lineal feet of pipe per eight-hour day, or about 90,000 lineal feet per year. As such plants are relatively inexpensive, they could be established in all localities where they might be most useful. The manufacture of such products in small local plants is not only practical, but results in the delivery of first grade pipe with little breakage and at cheaper prices than can be the case when other types of pipe must be shipped long distances from large central plants, or ports of import.

Culverts in Burma, under highways and railroads, are generally made of brick. These are much more expensive than reinforced concrete culvert pipe.

From the estimated market, about 33 pipe units are needed. However, as no one type of pipe will be used exclusively, only a part of the estimated demand will be supplied by precast concrete pipe. Therefore fewer than 33 units will be required.

It is recommended that an initial unit be established in Rangoon. As an asbestos cement pipe and sheet plant is also recommended, it is desirable to install the cast concrete plant as a department of the larger plant, which will effect economies in both investment and production costs.

Accordingly, the estimated investment costs have been incorporated in with those of the Asbestos-Cement Products Plant, under Project 30.

(26) Ready-mixed Concrete

The use of ready-mixed, or transit-mixed concrete is growing rapidly in all areas where there is a market great enough to support the operation of a plant.

As a general rule such concrete is superior to that made on the job. This is particularly true when its use replaces hand labor methods of proportioning and mixing. For larger jobs it eliminates the necessity for the contractor to invest in proportioning and mixing equipment which is idle much of the time. Its use also eliminates the necessity of reserving large areas of construction property or of city streets for storing aggregates and cement, and eliminates the cost of handling these materials.

It has been found to be profitable in most cities in the United States having a population of 15,000, or greater, and should be very profitable in Rangoon and Burma.

A ready-mixed concrete plant is designed to meet every specification, and to deliver it at the job site when wanted, at a price below that for which it can be prepared on the job.

This can be done because such a producer buys his materials in large quantities at a minimum cost, handles them mechanically at low cost, proportions accurately by scales, and because, above all, he keeps his equipment busy as in any manufacturing plant. This last is very important, as most contractors have yards full of special equipment that is idle most of the time. Such construction equipment is expensive, and thus the depreciation charges on it must be high whenever in use. This makes the use cost very high.

In order to reduce the over-all cost of delivered ready-mixed concrete, producers generally purchase their Portland cement direct from the manufacturer in bulk, without sacks. This not only reduces the cost by eliminating the cost of the paper bags, but reduces handling labor cost. In Burma, paper bags for cement cost approximately K16.70 per long ton of cement. The cost of handling and of warehousing cement in sacks in Rangoon is K6.03 per long ton. If the sack cost could be eliminated by the shipment of cement in bulk, and if the handling and warehouse cost in Rangoon could be reduced to about K1.00 by bulk handling methods (which is all it should cost), the bulk cement user should reduce the cost of cement by K21.73 per long ton. This is a reduction of 13% from the cement price of K168.00 per long ton, in sacks, ex warehouse in Rangoon.

If delivered by the cement company in bulk barges, owned and operated by them, further reductions in packing costs at Thayetmyo, and in freight, could be made and the savings passed on to the consumer. This would greatly stimulate the use of concrete in Rangoon.

Initially, when bulk cement is available, to save duplication of equipment and facilities, it would be best to have onc central bulk cement unloading and storage station. This could well be owned and operated by the cement company itself, as bags could be filled here for all non-bulk sales in the Rangoon area.

All concrete products plants using bulk ccmcnt should be on the same, or closely adjacent property, so that bulk cement could be pumped through pipelines to each such plant as required.

A common aggregate storage yard should be a part of the same set-up to minimize the cost of aggregates and of their handling. A ready-mixed concrete plant should be a unit of this group.

Such a plant is not expensive, aside from the trucks. The plant would consist of aggregate unloading and storage equipment, cement and aggregate bins, cement and aggregate proportioning scales, concrete mixer, and trucks. The cost of equipment without trucks would be about K5,00,000. The number of trucks is determined by the yardage to be sold and the average time required to deliver and return.

Almost all concrete roads, streets, airports, and runways are poured by such equipment, and it works just as well in cities where there is enough concrete used to keep a ready-mixed plant reasonably busy. It has been estimated that about 240,000 cubic yards of concrete are poured annually in the Rangoon area.

If 50% were to be supplied by a ready-mixed plant, the average daily output would have to be 400 cubic yards per eight-hour day.

As the quality of concrete produced in ready-mixed concrete plants is superior, and as it costs less delivered in forms, a plant should be constructed.

In the United States, as long ago as 1948, more than 25,000,000 cubic yards of ready-mixed concrete were produced, which had a value, at the point of delivery, of about $250,000,000, equivalent to $10.00 per cubic yard. In Rangoon, the price might be higher as the price of cement is much greater than in the United States, and aggregate costs will be higher.

(27) Limestone Products

Few limestone products, as such, are used in the Rangoon area. The principal one, lime, is presented later in this Report.

This section is confined to a discussion of unconverted limestone products such as:

Riprap (pitching stone)
Furnace Flux
Ballast
Aggregates
Agricultural Limestone.

(a) Riprap (pitching stone). Large rocks for this purpose are used normally for sea wall and river revetment work. In Rangoon there is little demand for such rock. In other areas rock produced locally can usually be found that is suitable for this purpose. A minor amount will possibly be required to protect some railway or highway fills. In any event such rock need not be limestone.

(b) Furnace flux. Limestone for furnace flux use may either be high calcium carbonate limestone, or high magnesium carbonate limestone, depending upon the process requirements. This is usually from 4 ins. to 6 ins. in size.

Both materials are available for use in Rangoon, but not from nearby deposits. High calcium carbonate limestone can be produced in the Moulmein area where extensive deposits of high grade limestone have been surveyed and mapped. These deposits are about 80–100 miles from Rangoon. High magnesium carbonate limestones are found in several of the Shan States. The nearest deposit is near Kalaw. This runs better than 40% $MgCO_3$. The limestone would have to be transported to Rangoon by rail.

No furnace flux will be required for use in any of the new industries being considered for the Rangoon area. Later, if iron ore of commercial grade is discovered in Burma, a blast furnace would be installed. Such an operation would require important quantities of flux limestone. The dolomite limestone (high magnesium carbonate limestone) will be required in the proposed glass plant, but in smaller size than flux stone grade.

(c) Ballast. Ballast for railways may be either a limestone, or any other hard rock, crushed and screened to the correct size. Railroads normally find enough deposits of suitable rock at strategic locations along their rights-of-way, and thus avoid long hauls to points of use. This size rock is usually produced on a contract basis, or sometimes in railroad-owned quarries. It is normally best for the railroads to purchase the ballast from contractors or other producers, who can sell the smaller sizes not suitable for ballast.

In any event, all ballast used in the Rangoon area must be shipped in. In the Railway Section of this Report, Chapter XI, it has been recommended that 572 miles of track be relaid with 60-pound rail. Each mile of new meter gauge track will require at least 2,000 cubic yards of ballast. The ballast requirements for restoring railway roadbeds to proper condition have been estimated at 15,000,000 cubic feet (555,555 cubic yards), and much of this will be required in the Rangoon area.

Included as ballast for estimating purposes is crushed rock for highway surfacing. The highway construction work outlined in Chapter XVI will require 17,312,000 tons (15,000,000 cubic yards) of crushed rock for base and surface use in the next ten years. While this must come from quarries close to the job site, the quantities are large.

(d) Aggregates. Aggregates are the fine and coarse-graded rock or gravel required in making concrete. As fine aggregates are usually natural sands, they are not considered in this section. Coarse aggregates are commonly produced from gravels or from hard rock deposits.

It is estimated that 240,000 cubic yards of rammed concrete are poured in the Rangoon area each year. Each yard of concrete requires about 0·90 cubic yards of graded rock. Thus approximately 216,000 cubic yards of coarse aggregate, ranging in size from three quarters of an inch to three inches, will be required. The use of concrete will increase during the next ten years, and is expected to double by 1962.

The estimated present use of coarse aggregate in cubic yards is equivalent to about the same number of long tons per year. Such aggregates may come from granite, trap rock, limestone or gravel.

Both granite and limestone are available in the Rangoon area, at Mokpalin (on the mouth of the Sittang River), and at Moulmein, respectively. Each is about 80–90 miles from Rangoon, by water.

The Moulmein area has a number of extensive deposits that cover more than 200 square miles. These have been surveyed and mapped by the Government Geological Department. One deposit covering about 16 square miles is directly across the bay from Moulmein, and is on deep water. At present, this limestone is not sold in Rangoon as aggregate.

The aggregates commonly used are gravel, and brick-bats broken by hand. Neither makes good aggregate. The gravel is too fine and is too uniform in size. The broken brick-bats are not hard enough to develop proper strengths.

(e) Agricultural limestone. It is believed that the delta rice areas are acid as compared to the interior paddy areas. There is, however, no general agreement on the subject and further research will be required before the need for liming paddy soils can be established.

However, it is possible that at some future date it may be found desirable to lime at least some of the delta farm lands. The amount of lime applied per acre is dependent upon the soil tests. An average requirement of one ton per acre would not be unusual. At present there are about 10,000,000 acres under rice cultivation. If only 25% required liming, a large demand for agricultural limestone would result. As lime is not applied annually on each piece of land, the yearly demand would be about one third of the estimated total or

$$\frac{10{,}000{,}000 \times \cdot 25 \times 1}{3}$$

or 833,000 tons per year.

To produce this would require a crushing plant having a daily capacity of 2,775 long tons. On such a volume the cost per ton could be greatly reduced to about K3.00 per long ton f.o.b. plant.

(f) Recommendations. The limestone deposits in the Moulmein area should be developed with a crushing plant of at least 1,000 long tons capacity per day of screened, crushed rock of all sizes desired for railway, highway and concrete work. Such a plant with quarry equipment would cost about K5,00,000 for equipment only, and resulting production costs should not exceed K6.00 per long ton. However, the development of a quarry in the Moulmein area should be undertaken with a consideration of the entire limestone requirements of coastal Burma, including particularly the proposed plants discussed in sections C-1-b,(28) and C-1-b,(29). The development of these plants would require considerably larger quarry facilities, and would reduce production costs per ton.

(28) Portland Cement

(a) Existing Portland cement industry. The existing Portland cement industry consists of a small manufacturing plant having a rated capacity of 60,000 long tons of cement per year. This property is owned by Burma Cement Company, Limited, and is located at Thayetmyo. Burma Ccment Company, Limited, was organized under the laws of Burma in July, 1935, and maintains its principal office in Rangoon. The company was organized and financed by a group of United Kingdom and Indian Portland cement manufacturing companies, and by Steel Brothers & Company, Limited. These same major owners still retain their controlling interests, with some stock being held by other private interests. Steel Brothers & Company, Limited, manage the plant under a "Managing Agent" contract.

All shipments from this plant are made in barges owned and operated by the Inland Water Transport Board of the Union of Burma, or on the combination freight and passenger steamers under the same ownership. The cement company does not now own or operate any barges, although it has done so in past years, and is allowed to do so now. Both rail and water freight rates are set by the Government, and are approximately equal for cement as far as the Rangoon shipments are concerned.

(b) Manufacturing operations—Thayetmyo. The Thayetmyo plant is a single-kiln, wet-process plant having a rated capacity of 60,000 long tons per year, 5,000 long tons per month, and 175–190 long tons per day, of "ordinary" Portland cement made in accordance with British Portland cement specifications. The plant is relatively self-sufficient in that it produces its own power and fuel (natural gas), in addition to the major raw materials.

The Thayetmyo plant is simple in design and arrangement, and is efficient by European standards. It was designed to manufacture a single basic type of standard cement of uniform quality in conformance with British specifications at a cost that is reasonable considering its design, equipment, capacity, and the local conditions. Additional units may be installed, if and when required, at a minimum of expense.

The major raw materials used at Thayetmyo are a high-calcium and a low-calcium limestone. The minor raw materials are silica sand and gypsum. All are procured locally.

Originally the Thayetmyo plant used natural gas from a small nearby field for all purposes, including steam generation and process use. Due to normal depletion and damage by the characteristic sliding formation of this field, the existing wells no longer supply the entire requirements when the kiln is operated at rated capacity. During the last fiscal year, the kiln was operated at a reduced capacity, and it was necessary to substitute fuel oil for the gas in the power plant at a considerable increase in cost.

The company has attempted to overcome this handicap by drilling new wells, the first of which was spudded-in in 1952. This well was recently completed at a cost over K3,00,000 but its output is not sufficient to relieve the situation. A second well has been started.

The economy of the Thayetmyo plant is dependent upon an ample supply of cheap natural gas. Due to an advantageous contract with the Government of Burma, the cement company has been paying (in addition to the cost of drilling, operating, and maintaining the gas wells) a nominal royalty for its gas fuel. This royalty is equivalent to 5% of the estimated cost (K135.75 per long ton) of imported coal delivered at Thayetmyo. The equivalent cost of coal is calculated to be K40.00 per long ton of cement; therefore the gas royalty is K2.00 per long ton of cement. If imported coal is used the manufacturing cost will increase by K38.00 per long ton of cement. This would represent an increase of 68% in the plant manufacturing costs at rated capacity.

This low cost of natural gas has enabled Burma Cement Company, Limited, to sell its product in Rangoon in competition with imported cement. As the present water freight rate from Thayetmyo to Rangoon is K38.92 per ton, it is apparent that an increase of K38.00 per long ton of cement would erase the advantage now enjoyed due to the Thayetmyo gas price, and could make it impossible to sell Thayetmyo cement against the price of imported cement, if this price were to be lowered. As from 75% to 82·5% of all sales of Burma Cement Company,

Table XXII - 19

PRODUCTION, SALES, IMPORTS, AND CONSUMPTION OF CEMENT IN BURMA

(Long tons)

*Fiscal Year Ending**	*Total Production B.C.Co. Ltd.*	*Total Sales in Burma B.C.Co. Ltd.*	*Export Sales B.C.Co. Ltd.*	*Total Sales B.C.Co. Ltd.*	*Imports*	*Total Burma Use*	*Average Declared Value of Imported Cement* †
1937	12,000	11,194	—	11,194	22,000	33,194	44.58
1938	56,500	35,517	16,039	51,556	9,000	44,517	47.20
1939	71,568	52,519	15,150	67,669	8,952	61,471	47.25
1940	62,898	56,132	4,372	60,504	4,518	60,650	56.90
1941	69,432	59,590	7,796	67,386	2,974	62,564	57.75
(1942–45—no data available)							
1946					7,601	7,601	100.50
1947					25,286	25,286	103.00
1948					40,812	40,812	110.00
1949	932‡				12,929	12,929	136.50
1950					20,118	20,118	118.00
1951	3,220‡				50,912	50,912	121.20
1952	35,891	31,889	—	31,889	35,100	66,989	142.90
Total	308,287	246,841	43,357	290,198	240,202	487,043	

*Prewar fiscal years end March 31. Postwar fiscal years end September 30.
†Average declared customs value, not landed or sales value, from GUB figures.
‡Estimated. Based on sales receipts.

Limited, are made in the Rangoon area, the situation is serious.

There are, however, three possibilities for maintaining a competitive advantage in the Rangoon market; (1) through the use of Kalewa coal, (2) through the use of fuel oil, (3) through more reasonable transportation charges.

(c) **Past and current market.** The use of Portland cement in Burma is shown in Table XXII 19 (*see previous page*), which shows the production and sales of Burma Cement Company Limited, and the imports.

Estimated Future Requirements of Cement in Burma

	L.T.
1953	68,000
1954	75,000
1955	85,000
1956	95,000
1957	105,000
1958	110,000
1959	115,000
1960	120,000
1961	125,000
1962	130,000

A great deal of the expected increase in the use of Portland cement in Burma will result from the execution of the economic development plan. For example, the three initial dams are estimated to require a minimum of 80,000 long tons of standard and special cements.

More than 240,000 houses of the non-basha type will be required during the next eight years. While many of these will use limited quantities of cement, all of them will require some. If only ten cwts. of cement are used per house unit, a total of 120,000 long tons will be required. Highways, culverts, bridges, docks, airports, public and private buildings, and industrial plants will require even greater quantities of this basic material. The estimated future requirements are considered to be conservative.

From an examination of the preceding table, it is evident that the current use has outgrown the capacity of the existing plant, and that it is necessary to expand the capacity of the national Portland cement industry, unless rapidly increasing future requirements are satisfied by imports.

(d) **Economics of importing Portland cement.** Importing the quantity required, over and above the capacity of the existing plant, will require a foreign exchange allocation of K6,12,04,000 over the next ten-year period. If the existing industry is expanded, or a new plant is built, the foreign exchange required would be respectively, K44,87,500 or K1,74,40,000.

The implementation of the development program will require large quantities of Portland cement. This commodity should be manufactured within the country. It is evident that if the enlargement of the existing industry is delayed, importation will be necessary. Therefore, to supply domestically the additional cement needs of Burma, the existing industry must bc expanded immediately. This becomes a matter of choice between expanding the Thayetmyo plant, or of constructing a new plant elsewhere.

(e) **Location of a new Portland cement plant.** Rangoon is at present thc major cement market in Burma, and uses from 75% to 82·5% of all Portland cement sold. It is also the distribution and shipping center of the country. Rangoon is thus the logical location for a second cement manufacturing plant. Its advantages and disadvantages are summarized below:

(1) *Advantages*

(*a*) The freight and handling charges for cement shipments from Thayetmyo to Rangoon amounting to K38.92 and K6.03 per long ton respectively would be saved.

(*b*) The freight charges on 5-ply paper bags, operating and repair supplies from Rangoon to Thayetmyo and a 4% breakage loss in handling bagged cement at Rangoon would be saved.

(*c*) The operation and maintenance of a river launch at Thayetmyo, required because of the absence of a rail or highway connection, would be saved.

(*d*) The cost of maintenance of quarters for managerial and supervisory staff and employees including expensive security protection would be saved.

(*e*) The cost of maintaining a landing strip required because of slow and insecure transport by river or rail between Rangoon and Thayetmyo would be saved.

(2) *Disadvantages*

(*a*) There are no limestone deposits in the Rangoon area, consequently crushed limestone would have to be transported from the nearest suitable source by barge or rail. The closest deposit of commercial proportions located to permit barge transport is near Moulmein.

(*b*) The cost of gypsum would be higher at Rangoon than at Thayetmyo. However, if it became necessary to use imported gypsum because of depletion of local sources, the Rangoon area would have the advantage.

(*c*) Labor rates are likely to be higher in Rangoon than at Thayetmyo.

(*d*) The cost of fuel for power and processing would be higher in Rangoon than at Thayetmyo, unless the latter plant has to resort to the use of coal or fuel oil in which case the two plants would have approximately the same fuel cost.

(*e*) A small plant at Rangoon could not manufacture the cement as cheaply as a plant of twice the capacity at Thayetmyo since the fixed costs would be distributed over one-half the production.

(*f*) A new company with a new staff would be necessary at Rangoon while the expansion of the plant at Thayetmyo would pose no management problems.

(*g*) The capital investment required for building a new plant at Rangoon would be approximately four times that of expanding the plant at Thayetmyo.

(f) Modernizing and enlarging Thayetmyo. The limestone quarry operation and limestone crushing and transportation system should be revised and modernized. These operations are largely manual and produce rock of larger size than is suitable for feeding grinding mills. The resulting costs are at least twice as much as they should be, and cause excessive use of power and labor in the grinding operations. The grinding circuits are obsolete and inefficient, resulting in additional power and labor waste and excessive fuel consumption.

The fuel consumption in the kiln is excessive. This is partially due to over-grinding the raw materials, partly due to the characteristics of the raw materials, and partially due to the design of the kiln itself. The clinker cooling system is obsolete and inefficient, thus compelling the use of excessive power and labor in the clinker grinding operations where over-grinding also occurs.

The finished cement storage system is completely inadequate for proper operation of the present plant in which only one product can be made. The packing and barge loading equipment is expensive to operate, and results in a 2% paper sack breakage which is about eight times normal practice. Proper unloading and handling facilities for any materials brought in by barge are lacking. If coal must be used, such facilities must be installed.

(g) Estimated costs. The cost of modernizing the Thayetmyo plant, doubling its capacity, and equipping it to manufacture special cements, has been estimated as shown in Table XXII–20.

TABLE XXII – 20

COSTS OF THAYETMYO PLANT MODERNIZATION AND ENLARGEMENT

Item	*K*
Machinery and Equipment including Electrical	38,13,760
Freight, Ocean and Inland	3,77,600
Buildings and Structures	8,26,000
Erection and Construction	8,82,640
Total Estimated Cost	59,00,000

A new plant at Rangoon would include a limestone quarry at Moulmein, bulk limestone barges to deliver crushed limestone to Rangoon, a simple clay pit operation at Rangoon, and a complete 60,000-long-ton-year-capacity manufacturing plant at Rangoon. The cost of this plant is shown in Table XXII–21.

TABLE XXII – 21

COSTS OF RANGOON CEMENT PLANT

Item	*K*
Moulmein Quarry Equipment	9,44,000
Clay Field Equipment	94,000
Process Machinery	70,80,000
Power Plant Equipment	11,33,000
Electrical Distribution Equipment	3,76,000
Electric Motors and Controls	4,72,000
Laboratory Equipment	71,000
Shop Equipment and Tools	5,90,000
Office and Stores Equipment	94,000
Water, Compressed Air, Sewerage and Process Pipelines, etc.	2,36,000
Sanitary and First Aid Equipment	47,000
Automotive Equipment	94,000
Barge Equipment	7,08,000
Brick and Refractories	1,42,200
Structural Steel and Doors, Roofing, etc.	13,00,000
Total Machinery and Equipment	1,33,81,200
Ocean Freight and Insurance	11,80,000
Erection and Construction Engineering	33,04,000
Foreign Specialist Expense	4,72,000
Company Overhead during Construction	2,36,000
Contingencies	10,14,800
Erected Cost less Real Estate	1,95,88,000
Real Estate	4,72,000
Total Plant Cost	2,00,60,000
Working Capital	23,60,000
Total Capital Required	2,24,20,000

These estimates are based on United States prices. Costs may be somewhat lower if the equipment and materials are purchased in Europe. Negotiations have been in progress since November, 1950, to sell a one-half interest in Burma Cement Company, Limited, to the Government of the Union of Burma. Should this proposed joint venture agreement be consummated, the most economical procedure would be to enlarge the Thayetmyo Plant.

If it is not concluded, and if the present owners are reluctant to increase the capacity of their plant now, or are not encouraged to do so, then the construction of a new plant at Rangoon should be undertaken immediately to insure an adequate supply of cement for the development program.

(h) Raw materials. A plant at Rangoon could obtain limestone from the nearest suitable limestone deposit. Shipment to the plant in company-owned barges would be the most economical means of transportation. Extensive deposits of high grade limestone

TABLE XXII - 22

ESTIMATED MANUFACTURING COST, COST OF SALES, AND PROFITS

Item	1	2	3	4	5	6	7	8
	Thayetmyo Plant						*Rangoon Plant*	
	60,000 L.T. per Year				*120,000 L.T. per Year*		*60,000 L.T. per Year*	
	All Gas Fuel	*Kalewa Coal*	*Imported Coal at Future Price*	*Imported Coal Present Price*	*All Natural Gas*	*Kalewa Coal*	*Imported Coal at Future Price*	*Kalewa Coal*
	K	*K*	*K*	*K*	*K*	*K*	*K*	*K*
1. Plant Cost less Fuel	32,40,000*	32,40,000	32,40,000	32,40,000	46,12,000	46,12,000	33,17,000	33,17,000
2. Fuel	1,20,000*	10,68,000	16,44,000	24,00,000	2,40,000	21,36,000	9,75,000	10,30,200
3. Total Plant Cost	33,60,000*	43,08,000	48,84,000	56,40,000	48,52,000	67,48,000	42,92,000	43,47,200
4. Admin. and Overhead	9,35,400*	9,35,400	9,35,400	9,35,400	15,45,400	15,45,400	16,96,560	16,96,560
5. Cost of Sales	42,95,400*	52,43,400	58,19,400	65,75,400	63,97,400	82,93,400	59,88,560	60,43,760
6. Gross Sales	1,05,00,000*	1,05,00,000	1,05,00,000	1,05,00,000	2,10,00,000	2,10,00,000	1,05,00,000	1,05,00,000
7. Less Freight absorbed and Handling (IWT)	24,90,000†	24,90,000†	24,90,000†	24,90,000†	49,80,000‡	49,80,000‡	—	—
8. Net Sales	80,10,000*	80,10,000	80,10,000	80,10,000	1,60,20,000	1,60,20,000	1,05,00,000	1,05,00,000
9. Less Cost of Sales (5)	42,95,400*	52,43,400	58,19,400	65,75,400	63,97,400	82,93,400	59,88,560	60,43,760
10. Gross Profit	37,14,600*	27,66,600	21,90,600	14,34,600	96,22,600	77,26,600	45,11,440	44,56,240
11. Less Taxes at 50%	18,57,300	13,83,300	10,95,300	7,17,300	48,11,300	38,63,300	22,55,720	22,28,120
12. Net Profit	18,57,300	13,83,300	10,95,300	7,17,300	48,11,300	38,63,300	22,56,720	22,28,120
13. Capital Investment	75,00,000	85,00,000	85,00,000	85,00,000	1,27,50,500	1,27,50,500	2,24,20,000	2,24,20,000
14. Percentage Return on Investment	24·7	16·25	12·9	8·45	37·7	31·5	10·50	9·90

* Furnished by Burma Cement Company, Limited.
† This could be reduced to K 7,21,350 if Rangoon cement is transported in company barges.
‡ This could be reduced to K 14,42,700 if Rangoon cement is transported in company barges.

are known to exist in the Moulmein district. One large deposit covering 16 square miles is located across the Salween River north of Moulmein. This deposit touches a deep water channel, and while the depth is not known, the volume of limestone in this deposit appears to be adequate to supply the plant for many years.

The average analysis of the limestone in this area has been determined to be 80·0% $CaCO_3$, while the best, from the Nydone quarter, tests 98·0%. This is 30–35 miles from Moulmein.

Local clays are available in the Rangoon area. Clays used for the manufacture of building-brick are usually satisfactory for use in the manufacture of Portland cement, as they contain the necessary silica and alumina. About 19,200 long tons per year will be required. Gypsum, required as a retarder for controlling the setting time, may be either imported or obtained from sources above Thayetmyo, on the Irrawaddy River.

(i) **Manufacturing cost.** To present fully the economics of either building a new plant at Rangoon, or doubling the capacity of the Thayetmyo plant, and of operating each plant with different fuels, cost estimates for each plant have been prepared as shown on Table XXII–22.

All Thayetmyo plant estimates are based upon the present I.W.T.B. water freight rates for Rangoon shipments, as well as the Rangoon handling and warehouse costs. The estimated net profits determined for each condition are shown, ranked in the order of least earnings, in Table XXII–23.

TABLE XXII - 23

ESTIMATED CEMENT PROFITS

(Ranked in order of least return)

	K
Thayetmyo at 60,000 L.T.—Present Price Imported Coal	7,17,300
„ „ „ „ —Future „ „ „	10,95,300
„ „ „ „ —Kalewa Coal	13,83,300
„ „ „ „ —Natural Gas	18,57,300
Rangoon „ „ „ —Kalewa Coal	22,28,120
„ „ „ „ —Future Price Imported Coal	22,55,720
Thayetmyo at 120,000 „ —Kalewa Coal	38,63,300
„ „ „ „ —Natural Gas	48,11,300

It is doubtful at this time that enough additional gas can be found at Thayetmyo to support the operation of the plant if the capacity is doubled. It would be safer to assume that all gas would be reserved for power generation, and that Kalewa coal would be used for process purposes. If this assumption is correct, a new plant at Rangoon and the operation of the Thayetmyo plant at its present capacity using natural gas would provide the most advantageous arrangement as is shown in Table XXII–24.

TABLE XXII – 24
BEST COMBINATION

Capacity L.T.	*Fuel*	*Annual Net Profit*
Thayetmyo—60,000 Rangoon—60,000	Natural Gas Future Price Imported Coal	K18,57,300 K22,55,720
120,000	Total	K41,13,020
Thayetmyo—120,000	Kalewa Coal	K38,63,300

However, this would not provide the most favorable return on the investment due to the greater cost of building the Rangoon plant. These would compare 31·5% for Thayetmyo against 13·75% for the two-plant combination.

At any rate, it is clear from the estimates that a 60,000-long-ton-capacity plant at Rangoon could manufacture and sell cement in Rangoon at a price below the Thayetmyo plant if the latter is not enlarged. From the estimates, the Rangoon plant could make the same gross profit, when selling at a price of K153.98 per long ton, as the Thayetmyo plant (using cheap natural gas) can when selling at the present Rangoon price of K168.00 per long ton.

This competitive advantage of the Rangoon plant will only survive as long as shipments are made to Rangoon via the IWTB barges at present freight rates, which are extraordinarily high. A plant at Rangoon could therefore establish and hold a favorable competitive position against other cement. This position could be made even more secure by selling as much as possible of its cement in bulk and thus eliminating the cost of paper sacks and Rangoon unloading and warehousing costs, amounting to K22.73 per long ton in total.

Such a plant is economically sound, even though the return on the investment would be less than on the present plant at Thayetmyo, due solely to its greater construction cost. Its construction should therefore depend upon the outcome of the negotiations to purchase a one-half interest in Burma Cement Company, Limited. The Portland cement situation is discussed further in Project No. 38.

(j) **Other products.** A new plant at Rangoon could earn additional profits from the production and sale of lime and limestone products. It was shown in the discussion of Limestone Products, Project No. 27 (b) and (c), that a large market for railway ballast, highway metal and concrete aggregates exists in the Rangoon area. The coarse concrete aggregate requirements alone were estimated to be 216,000 long tons per year.

If these requirements were supplied by the new cement mill at Rangoon from its quarries near Moulmein, the cost of production and of transportation to Rangoon would be greatly reduced.

In Project No. 29, Lime, it is shown that there is a need for quicklime and hydrated lime in the Rangoon area. Quicklime may be manufactured in a Portland cement kiln, whenever the kiln was not required for producing cement clinker. A small additional investment would be required to equip this plant for such dual purposes. Quicklime and hydrated lime cost much less to manufacture than Portland cement, though the current price in Rangoon is very little below that of imported cement.

If the Rangoon plant is built in the near future, the market may not absorb all of its capacity during the early years of operation. Consequently, the manufacture of quicklime would aid in supporting the project until a market for the full output of cement develops.

(29) Lime

(a) **Historical.** Lime for plaster is widely used in Burma for both interior and exterior purposes in building construction. In fact almost all public buildings are of this type and most pucca buildings are of this design. Such plasters are normally applied over common red brick walls. Thus large quantities of lime are required for mortar too.

The large-scale building program resulting from the execution of the Economic and Industrial Development Program will greatly increase the demand for and use of this product for housing, industrial buildings and public structures.

GUB import records do not reveal any imports of either quicklime or of hydrated lime. It is therefore safe to assume that all lime used is produced domestically. However, no statistics are available covering the quantities made or used.

(b) **Market estimates.** In the United States, about three tons of Portland cement are sold for each ton of lime. In Burma the use of Portland cement per capita is one of the lowest in the world. However, the almost universal use of lime for plaster on most permanent buildings in Burma, and the equally universal use of brick for walls, which requires mortar, should alter the ratio for Burma.

It is therefore estimated that the lime used in Burma would be more nearly on a 2 to 1 ratio with Portland cement use. If so, then the present annual use of lime in Burma would be approximately 35,000 tons per year.

It has been estimated that the use of Portland cement in Burma will double in the next ten years. The demand for lime should increase proportionately, so that the market should absorb approximately 70,000 long tons per year. These estimates are considered to be conservative, as most countries are increasing their use of cement (and presumably of lime), at a much faster rate than is estimated for Burma.

On the basis of the estimated present use of lime, about 120 long tons per day are needed. A modern lime plant of this capacity is an economic size, well able to produce high grade quicklime and hydrated lime at low cost.

From 75% to 82·5% of all cement sales in Burma are made in the Rangoon area. There is every reason to believe that lime sales would follow the same pattern, as Rangoon has a greater percentage of permanent type buildings than any other city in Burma. On the basis of 80% use in Rangoon, this market will now absorb about 28,000 long tons of lime per year, which should increase to 56,000 long tons by the end of ten years.

A lime plant having an initial capacity to produce 100 long tons per day would be a proper size for consideration, as it would handle all of the current Rangoon requirements.

(c) **Present source.** At present all lime used in the Rangoon market is made in the Moulmein district where abundant deposits of high grade limestone are known to exist. The extent of these has been reported in Project No. 28, Portland Cement. No modern lime plants exist in this area and much is made on a small scale, almost on a cottage industry scale. Much of the lime produced is not well burned and its quality is therefore very inferior.

None is packed in paper bags, but in jute bags or used tin containers. Most quicklime is shipped to Rangoon in jute bags containing about 76·5 pounds. The hydrated lime inspected is usually sold in four-gallon kerosene tins containing from 30 to 35 pounds, net weight.

The current dealer price in Rangoon is K140.00 per long ton for quicklime, and K146.41 for hydrated lime, in the above containers.

(d) **Plant location.** To supply the Rangoon market area a lime plant could be located either in Rangoon or in Moulmein. The choice of location is dependent upon the relative costs of handling and transporting the raw limestone and fuel to the major market at Rangoon, and the cost of transporting fuel to Moulmein and the finished product to Rangoon.

In the manufacture of lime, limestone is calcined in a kiln. A high grade limestone is converted from calcium carbonate ($CaCO_3$) to calcium oxide (CaO), in the kiln. There is a considerable loss of weight in this process, the loss being principally CO_2 (carbon dioxide) gas. To make one ton of quicklime, approximately two tons of limestone are required.

If the plant is located at the limestone deposit, only one half as much material must be moved to market if only quicklime is sold. Normally, however, bulk raw materials may be transported cheaper than finished products due to the fact that they can be handled more easily by mechanical methods. And, as there is a large market in the Rangoon area for railway ballast, highway metal and concrete aggregate, these requirements can best be supplied from Moulmein. The advantages of producing and selling these limestone products in Rangoon outweigh the advantages of producing quicklime at the quarry site, and the equipment for moving these products in bulk would be operated cheaper on the larger volume basis.

Fuel oil, which is the preferred fuel for producing lime, can be delivered cheaper in Rangoon than in Moulmein. Labor is available in Rangoon, as is power. It is therefore recommended that the lime plant be located in the Rangoon industrial district, on a site on the east bank of the Rangoon River and near a railroad line.

(e) **Cost of plant.** A 110-long-ton-per-day capacity lime plant would cost:

Item	*K*
Moulmein Quarry and Crushing Plant	4,72,000
Barge Equipment	4,72,000
Process Machinery	18,88,000
Electrical Distribution—Motors Controls	4,72,000
Laboratory Equipment	75,000
Shop Equipment and Tools	4,00,000
Office and Stores Equipment	94,000
Water, Compressed Air, Sewerage, Process Pipelines	2,00,000
Fuel Oil Storage and Handling	3,00,000
Sanitary and First Aid Equipment	50,000
Automotive Equipment	94,000
Brick and Refractions	1,00,000
Structural Steel, Roofing, etc.	7,08,000
Total Machinery and Equipment	53,25,000
Ocean Freight and Insurance	6,00,000
Erection and Construction including Engineering	12,50,000
Foreign Specialist Expense	4,72,000
Company Overhead during Construction	2,36,000
Contingencies	3,84,000
Actual Cost less Real Estate	82,67,000
Real Estate	4,13,000
Total Plant Cost	86,80,000
Working Capital	18,88,000
Total Capital Required	1,05,68,000

The total estimated cost may be divided between foreign exchange and local currency, as follows:

Foreign Exchange (Kyats equivalent)	K79,43,000
Local Currency	K26,25,000
Total	K1,05,68,000

(f) Construction schedule. It is estimated that it will require two years to place this plant in operation, dating from the time consulting engineers are retained. The expense during the first year would consist of a preliminary survey and report, of engineering drawing preparations, quarry and plant site acquisition and grading, some foundation construction work, and of advance payments for machinery, equipment and material. These are estimated to total K42,00,000 for the first year. This may be divided between foreign exchange and local currency, as follows:

Foreign Exchange	K30,00,000
Local Currency	K12,00,000
	K42,00,000

(g) Manufacturing cost, cost of sales, and profits. It is assumed that one half of the production of the plant will be quicklime, and one half hydrated lime. For each ton of hydrated lime produced, 0·756 tons of quicklime will be required. Thus the daily production would be 50 long tons quicklime, and 66 long tons hydrated lime, or 116 long tons per day. Limestone is estimated to cost K20.00 delivered in Rangoon. Two hundred long tons per day would cost K4,000. Operating 300 days per year, the annual cost would be K12,00,000.

About 1·1 United States barrels of Bunker C fuel oil will be required per long ton of quicklime. At a production rate of 100 long tons of quicklime per day, 110 United States barrels of fuel will be required, or 33,000 per year. This is equivalent to 1,154,000 imperial gallons. At a price of K0.6 per imperial gallon, the annual fuel cost would be K6,92,400.

The estimated manufacturing cost, cost of sales, and profits, are as follows:

QUICKLIME

Item	*Cost per Year (Kyats)*	*Cost per Long Ton (Kyats)*
Operating and Repair Labor	1,00,000	—
Operating and Repair Supplies	50,000	—
Limestone	12,00,000	—
Fuel Oil	6,92,400	—
Power	1,06,200	—
General Works Expense	1,00,000	—
Amortization of Loan	6,00,000	—
Insurance	50,000	—
	28,98,600	96.62

HYDRATED LIME

Item	*Cost per Year (Kyats)*	*Cost per Long Ton (Kyats)*
Quicklime	14,49,300	—
Operating and Repair Labor	50,000	—
Operating and Repair Supplies	25,000	—
Power	2,12,400	—
General Works Expense	75,000	—
Amortization of Loan	2,30,495	—
Insurance	25,000	—
	20,67,195	104.39

Paper sacks and packing costs will increase the unit costs per ton by approximately K16.00, making the ex-warehouse costs K112.62 per long ton for quicklime and K120.39 per long ton for hydrated lime.

At present prices, the following gross profit would result:

15,000 L.T. Quicklime at K140.00	K21,00,000
19,800 L.T. Hydrated Lime at K146.41	K28,98,918
Gross Income	K49,98,918
Cost of Sales:	
15,000 L.T. Quicklime	K16,89,300
19,800 L.T. Hydrated Lime	K23,83,722
	K40,73,022
Gross Profit per Year	K9,25,896
Per cent Return on Investment	8·75

Spreading the amortization costs over 25 years instead of 20 years would reduce the annual payments by K98,915, which would reduce the average cost per long ton by K2.84.

(h) Recommendations. Because the anticipated need for lime will increase rapidly as the development program gets under way, because lime manufactured in a modern plant will be superior in quality and thus more valuable per ton, because it can be made profitably in Rangoon, and because the construction of such a plant meets every requirement of the development program, a plant of this type should be built in Burma.

There would be definite savings in both investment and manufacturing costs if lime were manufactured as a division of a Portland cement plant. Therefore this should be carefully investigated before an independent plant is built, even though the latter can be justified alone.

(30) Asbestos Cement Products

(a) Introduction. The Economic and Industrial Development Program will substantially increase the demand for all types of building construction materials. Asbestos cement roofing, siding, and interior wall and ceiling sheets, are among the building materials for which the demand is rapidly increasing.

All pipe now used in Burma is imported. Although a steel products plant is proposed, it is not planned to include the manufacture of cast iron or steel pipe. No clay or concrete pipe is presently being manufactured in Burma. Excellent pressure pipe can be made in a relatively simple plant from asbestos and Portland cement. This pipe is manufactured in four classes, corresponding to working pressures of 50, 100, 150 and 200 pounds per square inch. It resists corrosion much better than metal pipe. Asbestos cement sewer pipe and ducts are also in common use.

(b) The market. The market for asbestos cement sheets in Burma is increasing at a rapid rate. The import records show this clearly.

IMPORTS OF ASBESTOS CEMENT SHEET PRODUCTS

Fiscal Year	*Long Tons*
1937–38	1,028
1938–39	895
1939–40	1,207
1940–41	1,030
Prewar average	1,040
1945–46	—
1946–47	1,639
1947–48	2,768
1948–49	1,283
1949 50	326
1950 51	2,196
1951–52	6,514
1952–53*	6,771*
Postwar average	2,454

*First eight months only.

Approximately 240,000 new houses of the non-basha type will be built in Burma during the next ten years. If these use an average of only 2,000 sq. ft. of roofing each, the total square feet of laid roofing required will be 480,000,000.

The three fire-resistant types of roofing used in Burma are clay tile, asbestos cement and metal. If only one fourth of this roofing is to be corrugated asbestos cement, 120,000,000 sq. ft. of laid roofing of this type will be required. Without considering any overlaps, this would be equivalent to 139,285 long tons. An average per year would be 13,928 long tons. This would be over 200% of the 1951 52 imports. This estimate does not include corrugated roofing for factory or warehouse buildings, corrugated siding or flat sheets. It is estimated that the demand would increase the total to 29,000 long tons per year. The requirements for water, sewer, and other pipe and conduit are estimated to be in excess of 6,000 tons per year.

It should be possible to reduce the selling price if and when asbestos cement sheets are manufactured in Burma, which will stimulate sales and use. Asbestos cement pipe should be produced and sold at prices below metal pipe, which will increase its use.

(c) Plant location. There are only two feasible locations for an asbestos cement products plant; at Thayetmyo, where Portland cement is produced, and at Rangoon, where the imported asbestos will be received. Rangoon is the major market for all building materials, and is the distribution point for commodities to all parts of Burma by water, rail, highway and air.

If manufactured at Thayetmyo the imported asbestos would be transported by water to the plant, and about 75% of the finished products would have to be shipped back to Rangoon. At prevailing freight rates this would be uneconomic. Portland cement could be supplied in bulk, thus eliminating the packing cost and cost of paper bags. However, the pricing policies of the cement company prohibit the manufacture of asbestos cement products at Thayetmyo, as the selling price of Portland cement made and sold at Thayetmyo is K192.00 per long ton compared to K168.00 in Rangoon.

The lower cost of each raw material in Rangoon, and the elimination of extra transportation charges on both raw materials and finished products, favor a Rangoon location.

Because all raw materials will be delivered to the plant by water, and because much of the finished product will move from the plant by water transport, the plant should be located on the east bank of the Rangoon or Hlaing River. Rail and highway connections will be required. A suitable site may be found in the Insein industrial district, either above or below the village of Kamayut.

(d) The proposed plant. After studying the present and estimated future market demand for asbestos cement products, it is recommended that a combination sheet and pressure pipe plant be erected. Many economies will result if the two plants are contiguous and under one ownership and management.

Non-pressure pipe can be manufactured cheaper as concrete pipe without asbestos. Therefore it is recommended that a separate division for manufacturing such pipe for drain and sewer use be added to the asbestos cement plant. The initial capacity of an asbestos cement sheet plant should be 700 long tons per month, or 8,400 long tons per year, which would require a two-machine plant. Additional units can easily be added as required to meet expanding demands. The initial capacity of the asbestos cement pipe plant should be 550 long tons per month. This would provide 6,000 long tons per year, net. The non-pressure concrete pipe plant should have an initial capacity of 50 six-foot lengths per day, or 300 lineal feet total, of various diameters. This would be an annual capacity of 90,000 lineal feet. It is proposed to operate each plant 300 days per year to obtain the rated capacities of each division.

The three divisions would be designed around a central cement, asbestos and aggregate storage plant that would serve all three units. The asbestos storage must be of large enough capacity to receive and store shipload consignments of this product, in several grades. Each unit requires large storage and curing areas. The cement storage may be smaller as this material may be obtained in Burma.

(e) **Investment cost.** The cost of each unit in the proposed three-unit plant is estimated as shown in Table XXII–25.

TABLE XXII – 25

COSTS FOR A THREE-UNIT ASBESTOS CEMENT AND CONCRETE PIPE PLANT

Item	*Estimated Cost—Kyats*		
	Asbestos Cement		*Concrete Pipe Plant*
	Sheet Plant	*Pressure Pipe Plant*	
Pan Mill and Disintegrator	21,700	21,700	—
Conveyors, Blower, Storage and Bagging Bin, Scale and Vibrator	9,300	9,300	—
2 Sheet Machine Units	10,07,500	—	—
Pressure Pipe Unit	—	6,97,500	—
Spun Concrete Pipe Equipment	—	—	3,48,750
Machinery and Electrical Equipment	10,38,500	7,28,500	3,48,750
Ocean Freight, Insurance, Buildings, Engineering, Erection and Training	8,30,800	5,82,800	1,74,375*
Erected Cost Less Property	18,69,300	13,11,300	5,23,125
Real Estate	77,500	77,500	31,000
Total Plant Cost	19,46,800	13,88,800	5,54,125
Working Capital	9,30,000	6,20,000	1,55,000
	Three-plant Total		55,94,725

*No buildings required.

The total capital required may be divided into foreign exchange and local currency, as follows:

	Foreign Exchange K	*Local Currency K*
Asbestos Cement Sheet Plant	13,48,500	15,28,300
Asbestos Cement Pressure Pipe Plant	9,30,000	10,78,800
Spun Concrete Pipe Plant	3,87,500	3,21,625
	26,66,000	29,28,725

(f) **Construction and expenditure schedule.** The asbestos cement units will require the following time for completion. (1) To manufacture machinery, construct buildings in Rangoon, and train key operators abroad, ten months. (2) To install machinery, six months. (3) Commissioning period, three to six months.

Total time, 19–22 months.

The spun concrete pipe unit could be erected in less time, but for practical purposes will be considered as requiring the same time as the other units. All time estimates are based upon the date that contracts are signed for engineering work.

The expenditures for the first year will be principally for acquisition of real estate, grading plant site, dock construction; foundations, engineering work, machinery, equipment and material. These expenditures for the first year would total, for the three units, about as follows:

	Foreign Exchange K	*Local Currency K*
Asbestos Cement Sheet Plant	11,00,000	6,00,000
Asbestos Cement Pressure Pipe Plant	8,00,000	4,00,000
Spun Concrete Pipe Plant	2,75,000	1,25,000
	21,75,000	11,25,000

(g) **Financing of project.** A project of this type may be financed and owned in any one of three ways. One would be a 100% private ownership by either national or foreign interests. A second method would be a joint venture operation with the Government of Burma participating in the equity ownership on an agreed basis with the balance in the hands of national or foreign private interests, and with the management responsibility in the hands of the private interests. The third method would be a 100% equity ownership by the Government of Burma.

A method of financing by the Government of Burma would consist of the GUB extending a 100% capital loan to a wholly GUB-owned corporation formed for the purpose of building, operating and managing these enterprises. The loan would be secured by the assets of this corporation.

The loan would bear compound interest at the rate of 5% for all foreign capital loaned, and at the rate of 4% for all local currency advanced. The loan would be repaid out of earnings, in equal annual payments, made over a period of years corresponding to the useful life of the machinery, equipment and buildings. A weighted average useful life of 20 years has been assumed. The annual payments on each unit, to fully recover 100% of the capital loan, with compound interest at the rates above, in 20 years, are calculated as follows:

	Amount (K)	Factor	Annual Financial Cost (K)
Asbestos Cement Sheets			
Foreign Exchange	13,48,500	·08204	1,08,203
Local Currency	15,28,300	·07358	1,02,452
Total	28,76,800	—	2,10,655
Asbestos Cement Pressure Pipe			
Foreign Exchange	9,30,000	·08204	74,623
Local Currency	10,78,800	·07358	79,377
Total	20,08,800	—	1,54,000
Spun Concrete Pipe			
Foreign Exchange	3,87,500	·08204	28,093
Local Currency	3,21,625	·07358	23,662
Total	7,09,125	—	51,755

The foregoing annual financing costs would be charged into the unit cost of each product, based upon the total volume of production of each. No depreciation, as such, will be assessed against manufacturing costs in a corporation financed in this manner. Therefore, no capital recovery reserve will be maintained. Any additional capital required will be obtained in the same manner as the original capital, and will be repaid in the same manner. Such a wholly GUB-owned corporation would presumably operate on a non-profit basis, and would be exempt from import duties and taxes.

From investigations made, it is certain that private capital in Burma is able and willing to invest in these enterprises, either on a 100% private basis, or upon a joint venture basis with the Government of the Union of Burma. If these interests are encouraged to undertake these projects on either basis, other methods of financing would probably be used. The estimated gross profits would be slightly lower because duty

TABLE XXII – 26

ESTIMATED COST OF SALES AND GROSS PROFITS FOR ASBESTOS CEMENT SHEET AND PRESSURE PIPE PLANT

	Sheet Plant		*Pressure Pipe Plant*		*Spun Pipe Plant*	
	Annual Cost	*Cost per Long Ton*	*Annual Cost*	*Cost per Long Ton*	*Annual Cost*	*Cost per Lin. Ft.*
	K	*K*	*K*	*K*	*K*	*K*
1. Operating Labor	2,18,400	—	40,500	—	33,600	—
2. Operating and Repair Supplies and Labor	1,08,000	—	1,62,000	—	10,000	—
3. Asbestos Fiber	7,98,000	—	12,90,000	—	5,000*	—
4. Portland Cement	9,24,000	—	7,92,000	—	22,000	—
5. Power	72,000	—	48,000	—	12,000	—
6. Water	6,000	—	3,600	—	500	—
7. General Works Expense	36,000	—	12,000	—	6,000	—
8. Administrative Expense	54,000	—	18,000	—	12,000	—
9. Insurance and Local Taxes	24,000	—	12,000	—	5,000	—
10. Amortization of Capital Loan	2,10,650	—	1,54,000	—	51,755	—
11. Sand	—	—	—	—	} 30,000	—
12. Aggregate	—	—	—	—		
13. Total	24,51,050	291.79	25,32,100	422.01	1,87,855	2.08
14. Allowance for Manufacturing Breakage	2,45,100	29.18	2,53,200	42.20	18,785	0.21
15. Cost of Sales Ex-Warehouse	26,96,150	320.97	27,85,300	464.21	2,06,640	2.29
16. C.I.F. Cost	35,95,200	428.00	31,62,000	527.00	2,33,000†	2.59
17. Breakage Allowance	1,79,760	21.40	3,16,200	52.70	23,000	0.26
18. Gross C.I.F. Cost	37,74,960	449.40	34,78,200	579.70	2,56,000	2.85
19. Port Charges, Stevedoring—Warehousing	3,01,990	35.95	2,78,250	46.38	21,555	0.23
20. Gross Cost Ex-Warehouse	40,76,950	485.35	37,56,450	626.08	2,77,555	3.08
21. Less Cost of Sales	26,96,150	320.97	27,85,300	464.21	2,06,640	2.29
22. Gross Profit or Saving	13,80,800	164.38	9,71,150	161.87	70,915	0.79
23. Capital Investment	28,76,800	—	20,08,800	—	7,09,125	—
24. Per cent Return on Investment	48·0	—	48·4	—	10·0	—
25. Consolidated Investment	—	—	—	—	55,94,725	—
26. Per cent Return	—	—	—	—	40·8	—

* Wire. † Estimated, none imported.

would have to be paid on all imported materials and because taxes would be assessed. Such an arrangement offers the advantage of experienced management.

(h) Manufacturing cost—cost of sales and profit. The manufacturing costs, cost of sales, and profit, for a wholly owned GUB corporation, as estimated, are shown in Table XXII 26. The estimated costs are based upon current prices of raw materials, or upon estimated prices. Asbestos would have to be imported. Several grades are required for the sheets and for the pressure pipe. The basic unit in the sheet plant is the three sixteenth inch flat sheet. These require

11·6 pounds of Portland cement per square yard,
1·8 pounds of asbestos fiber per square yard,

13·4 pounds material, plus water.

The sheet weighs 15·75 pounds per square yard, dry weight.

Asbestos of lower quality (shorter fiber) is used in the manufacture of sheets. A normal mixture of the grades required would cost K972.16 per long ton c.i.f. Rangoon. The better grade required for the pressure pipe would have an average value of K1,770.72 per long ton, c.i.f. Rangoon. The cement asbestos ratios vary in the flat and corrugated sheets, being about 8:1 by weight for the flat sheets, and 6·4:1 for the corrugated. A considerable allowance for breakage must be made in the manufacturing cost estimates.

From these estimated figures it is clear that each of the products could be manufactured in Burma at a low cost and that they could be sold at a good profit at prices much lower than for the same imported products. If the Portland cement can be purchased in bulk, considerable reductions in cost would result.

A volume-based price discount could probably be arranged with the cement manufacturer, as the combined use of Portland cement in the three plants would total over 10,000 long tons per year. This amount represents 16·67% of the capacity of the existing plant at Thayetmyo. The initial plants will not supply all of the estimated requirements of Burma for asbestos cement products. If enlarged to do this, the cement purchases would double. If they did reach the total of 20,000 long tons per year, these plants would absorb one third of the new cement manufacturing capacity that has been recommended in the reports on Projects 28 and 38. This is an example of how a single new industry can affect the business of another supporting industry.

(i) Economies of importing. Should the asbestos cement sheets and pipe be imported instead of manufactured in Burma, and should the use be as estimated, the foreign exchange required over a ten-year period would be as follows, based upon present prices.

	K
Sheets:	
290,100 L.T. × K428.00 (c.i.f.)	12,41,62,800
Pipe:	
62,680 L.T. × K527.00 (c.i.f.)	3,30,32,360
Total	15,71,95,160
Less Asbestos Imported:	
290,100 L.T. × K95.00 (Sheets)	2,75,59,500
62,680 L.T. × K215.00 (Pipe)	1,34,76,200
Total	4,10,35,700
Net Foreign Exchange for Material	11,61,59,460
Less Plant Machinery	26,66,000
Net Saving in Foreign Exchange	11,34,93,460

The three plants will (at the initial capacities) create many new jobs. The annual labor payrolls alone are estimated to total K4,32,500. About 300 men will be employed. The production of the three plants will have an annual total value of K81,10,955. This addition to the national income, K8,11,09,550 for ten years, approximates 70% of the foreign exchange saved over imports. This foreign exchange can be released for other purposes that will add to the health and living standards of the people.

The estimated gross profit, if applied to reducing the selling price of these asbestos cement products, will increase the purchasing power of the people, and release income for other purposes.

(j) Conclusions and recommendations. There is a growing demand for these imported products which can be manufactured in Burma and sold at a fair profit at prices well below the ex-warehouse prices of similar imported commodities. The products increase the life and reduce the fire hazard of any structure in which they are used.

The foreign exchange released will be an important help in increasing the living standards of the people, and steady employment of many people at manufacturing wage scales will contribute to the stability of the Union and to its national income. Operation of these plants will also provide secondary employment in other supporting industries and services, such as Portland cement and transportation.

As all of the products to be manufactured will be needed in carrying out the industrial development program, and as these plants are of the basic type that is desired to make this development plan successful, it is strongly recommended that they be approved and steps taken for immediate implementation.

(31) Steel Products Plant

(a) Introduction. At present there are no facilities for the manufacture of steel or of steel products in the Union of Burma. It is necessary to import them. Ocean freight, insurance, port charges and duty must be included in the delivered cost of these commodities. Consequently the resulting selling price is higher than in countries where such products are manufactured. High selling prices restrict the use of steel products. Nevertheless, 40,000 tons are being imported annually. A large block of foreign exchange must therefore be allocated each year to cover the cost of purchasing and delivering them to this country.

The quantity of steel products imported annually is sufficient to warrant the establishment of a national steel industry if suitable raw materials are available. As the Government of the Union of Burma is taking steps to make this country as industrially independent as possible, and is implementing a comprehensive program of economic and industrial development to carry out this objective, the establishment of such a basic national industry is a logical part of such a plan. One purpose of this Report is to explore the economics of establishing a steel products plant in Burma.

(b) The market. The five-year average of prewar imports of all steel products into Burma was approximately 70,000 long tons per year. While the postwar average is below this figure, it is believed that the total use will be approximately double the prewar average use by the end of the next ten-year period.

As will be discussed later, any steel produced in Burma, at least initially, must be made entirely from steel scrap available or to be generated in Burma, or from imported steel scrap or billets.

A steel products plant should be planned to produce only selected steel commodities because the rate at which steel scrap is generated would not support a mill of capacity great enough to meet all needs, and because a plant equipped to manufacture all of the types and sizes required would be too elaborate and expensive. Only the lighter steel products should be manufactured. These should consist of light shapes, bars, rods, sheets, and such wire products as black and galvanized wire, barbed wire, nails, screws, nuts and rivets.

An examination of the imports of light steel products 1936–37 to 1940–41 average reveals the following:

Bars and Flats and Reinforcing Steel	5,300	long tons
Wire Nails	4,120	,, ,,
Rivets, Washers, etc.	1,350	,, ,,
Bolts and Nuts	770	,, ,,
Wood and Metal Screws	450	,, ,,
Wire other than Fencing	950	,, ,,
Fencing Material including Wire	410	long tons
Hoops and Strips	690	,, ,,
Small Structural Shapes	1,000	,, ,,
Plates and Sheets—Black, Galvanized and Tinned	19,000	,, ,,
Total	34,080	,, ,,

(c) Plant capacity. To supply the present minimum market demand for light steel products the plant should have a capacity of from 30,000 to 35,000 long tons per year. This capacity would leave no room for an increase in demand resulting from a normal growth. To meet the increasing demand a plant of 40,000 to 50,000 tons annual capacity could be justified. However, the necessary domestic raw materials are not sufficient to support this production rate, consequently the capacity must be limited by available raw materials.

The Ministry of Industries made a preliminary study of the proposed steel products plant, and as a result, on July 9, 1952, issued invitations for tenders for the machinery, equipment and erection of a complete plant to manufacture the following steel products:

Product	*Long Tons*	*Long Tons*
Angles from $\frac{3}{4}'' \times \frac{3}{4}'' \times \frac{1}{8}''$ to $3'' \times 6'' \times \frac{1}{2}''$	575	
Channels from $2'' \times 4''$ to $3'' \times 6''$	100	
H Beams from $4'' \times 1\frac{3}{4}''$ to $5'' \times 3''$	30	
T Beams from $1\frac{1}{2}'' \times 1\frac{1}{2}'' \times \frac{1}{4}''$ to $4'' \times 4'' \times \frac{1}{2}''$	100	
Flats from $\frac{1}{2}'' \times 1''$ to $1'' \times 4''$	1,030	
Rounds from $\frac{3}{16}''$ to $4''$	2,000	
Squares from $\frac{1}{4}''$ to $3''$	156	
Total Shapes and Bars		3,991
Bolts and Nuts from $\frac{1}{4}''$ to $1''$	1,250	
Rivets from $\frac{1}{4}''$ to $1''$	350	
Wood Screws from $\frac{1}{2}''$ 6gg to $3''$ 12gg	275	
Total Hot and Cold Process Products		1,875
Wire Nails	4,165	
Barbed Wire	150	
Galvanized Steel Wire 4–22gg	112	
		4,427
Flat Galvanized Sheets—		
24gg × 3′ × (6′–7′–8′–9′–10′)	1,400	
22gg × 3′ × (6′–7′–8′)	1,500	
Corrugated Galvanized Sheets—		
22gg × 2′–8′ × 10/3 × (6′–7′–8′–9′–10′)	2,600	
Total Sheets		5,500
Plates, $\frac{1}{16}''$ to $1''$		300
Railway Materials		410
Hoop Iron		600
Total Annual Minimum Production		17,103

Note: A further 5,000–10,000 tons of sheets for private consumption was noted as an additional goal.

It was also specified that the products listed be produced in a plant using 16,000 long tons of scrap and

4,000 tons of railroad rails which were to be re-rolled but not re-melted. Several other studies have been made to determine the size of the plant. All of these, considering availability of steel scrap and variety of steel products used, indicate that the proposed plant should have a capacity of about 20,000 long tons per year. By eliminating all sheet and plate manufacture, the plant could produce all of Burma's present demands for wire, rod, and light shapes. This would total about 15,000 long tons per year. However, more than 50% of Burma's use of light steel products are light sheets, black galvanized, flat and corrugated. The manufacture of such products should be included in the plant.

If the plant is built to a capacity of 15,000 long tons it will cost very little less than a 20,000-ton plant. The size of the equipment would be about the same in either case, as the size is determined partially by the ability of the equipment to reduce billets and slabs of a practical and standard size to smaller sections. If the plant is constructed initially for 15,000 tons annual capacity and if it becomes necessary to enlarge it later, the installation of parallel units of 5,000 or 10,000 tons capacity would be impractical because these units could not handle the same ingots and slabs as would the original and larger units. The result would be that the original equipment would have to be duplicated at a much greater cost than installing 20,000-ton equipment originally.

The proposed plant would, in fact, have a capacity in excess of 20,000 long tons per year, because it is to be planned for a 16-hour-per-day, 300-day-per-year

TABLE XXII - 27

SUMMARY OF ESTIMATED TONNAGES, ACTUAL AND POTENTIAL, OF IRON AND STEEL SCRAP IN BURMA

Source or Location	*Actual Tonnage Known*			*Potential Tonnage*			Total	Remarks
	Carbon Steel and WI	*Alloy*	*Cast Iron*	*Carbon Steel and WI*	*Alloy*	*Cast Iron*		
Burma Railways	35,820	—	—	—	—	—	35,820	
Road Bridges	2,045	—	—	—	—	—	2,045	*Actual Carbon Steel*
River Craft	—	—	—	5,000	—	—	5,000	80% *1st* Quality Scrap
Ledo Road	—	—	—	17.500	—	—	17,500	18% *2nd* Quality Scrap
Tamu Road	—	—	—	12,000	—	—	12,000	2% Under $\frac{1}{8}$ in. thick
Mandalay	—	—	—	1,100	—	100	1,200	
Myitkyina	1,400	—	350	200	—	—	1,950	
Sahma	300	—	—	—	—	—	300	*Potential Carbon Steel*
Prome	—	1,400	—	—	—	—	1,400	50% *1st* Quality Scrap
Akyab	2,000	—	100	—	—	—	2,100	45% *2nd* Quality Scrap
Kyaukpyu	2,925	250	100	—	—	—	3,275	5% under $\frac{1}{8}$ in. thick
Chauk	5,000	—	—	—	—	—	5,000	
Yenangyaung	5,000	—	—	—	—	—	5,000	
Lanywa	500	—	—	—	—	—	500	To assess these percentages accurately, scrap must be collected and sorted
Meiktila	220	60	—	—	—	—	280	
BOC, Syriam	8,000	—	2,000	—	—	—	10,000	
Tank Farms, Seikkyi	5,000	—	—	—	—	—	5,000	
Rangoon								*Note:*
Tram Rails	—	—	—	4,000	—	—	4,000	Heavy steel scrap not less than $\frac{1}{4}$ in. thick is *1st* Quality
Port Area	200	500	—	—	—	—	700	Medium steel scrap not less than $\frac{1}{8}$ in. thick is *2nd* Quality
Montgomery St. and Thompson St.	—	—	—	8,000	—	2,000	10,000	
Monkey Point	650	—	100	—	—	—	750	
Shwedagon Pagoda	2,750	—	250	—	—	—	3,000	
Windermere Park	450	—	100	—	—	—	550	
Slaughter House	100	—	200	—	—	—	300	
Mingaladon	—	750	—	—	—	—	750	
Miscellaneous sources in Rangoon	—	—	—	1,000	—	250	1,250	
	72,360	2,960	3,200	48,800	—	2,350	129,670	
Undiscovered sources	—	—	—	8,000	2,500	2,000	12,500	
P.S.P.	—	—	—	10,000	—	—	10,000	This is a conservative estimate for all the P.S.P. in the country in use on airfields or as fencing, etc. With the right persuasion, it might be released
				68,800	2,500	4,350	152,170	

operation. Such a schedule is not economical or practical in practice; the plant would operate 24 hours a day for only 200 days per year to produce the same tonnage. This would leave at least 100 days open for greater production when required. Thus, the proposed plant could produce 30,000 long tons per year, or more if it were in operation more than 300 days per year. It could operate at least 330 days and still have sufficient time for repairs.

(d) Raw materials. No deposit of iron ore of commercial value has been found in Burma, and no coal of coking quality is known to be available. It is therefore proposed to manufacture steel products from steel scrap. The accumulation of steel scrap from the war, plus the new scrap generated each year, is estimated to be sufficient to support the operation of a moderate-sized steel products plant capable of making the Union of Burma at least partially independent of imports.

(1) *Steel scrap*

Initially, only steel scrap of melting grades will be required. A survey of the present No. 1 and No. 2 steel scrap accumulation has been made by Mr. John Hipwell under the auspices of the United Nations, and is shown in Table XXII–27 (*see previous page*). This survey suggests that a total of 152,000 long tons of suitable scrap may be available in Burma. The estimates have been reviewed and have been found to be basically sound.

The five-year average export of steel scrap from Burma, from 1932–33 through 1936–37, was 10,237 long tons. Considering the total annual imports of steel products into Burma, there should be at least 10,000 long tons of new scrap generated each year. As Burma develops industrially, the generation of new scrap should increase proportionately. It is therefore conservative to assume a ten-year average production of 10,000 long tons of new scrap per year. Of this amount it has been estimated by GUB officials that approximately 4,000 long tons of worn-out railway rail are included in the total annual scrap accumulation figure. It is proposed that this be re-rolled into high carbon steel products, thus by-passing the electric furnace.

The capacity of the proposed plant has been established at 20,000 long tons per year. On this basis, the annual raw material requirements would be as follows:

16,000 long tons of mixed scrap (without rails)
4,000 long tons of railroad rails

20,000 long tons per year.

The 16,000 tons of mixed scrap should initially be taken from the accumulated reserve of 152,000 long tons to prevent further oxidation and appropriation losses. This reserve then would last 152,000/16,000 or 9·5 years.

The plant costs, as shown later, are based upon a 100% amortization, or write off, in 20 years. During that period there should be 200,000 long tons of new scrap generated, of which (4,000 × 20) 80,000 long tons would be railway rail, leaving a balance of 120,000 long tons of mixed steel scrap. This balance of mixed scrap would be used when the present accumulation is exhausted, and would supply the plant for 120,000/16,000 or 7·5 years.

The plant could operate for 17 years at a rate of 20,000 tons per year using domestic scrap only. There is an apparent shortage of 16,000 × 3, or 48,000 long tons, to balance out the full 20 years. This could be supplied by imported scrap or steel billets.

The entire supply would be as follows:

Accumulated scrap	152,000 L.T.
New scrap (10,000 × 20)	200,000 L.T.
Imported scrap or billets	48,000 L.T.
	400,000 L.T.

$$\frac{400{,}000}{20{,}000} = 20 \text{ years.}$$

The use of imported billets is not uneconomical. At the present time these are quoted f.a.s. Japan at $93.00 per metric ton which is equivalent to K445 per long ton. With an estimated freight rate of K25 per long ton, these could be delivered for about K470 per long ton. This compares to the estimated manufacturing cost of billets in the proposed plant of K337. If 4,000 long tons were imported each year, the increase in cost would be 4,000 × (470−377), or K5,32,000. This amount spread over 20,000 long tons, would increase the average cost by only K26.60 or by 4·6%.

To collect the existing scrap scattered all over Burma, and to collect all future scrap generated, it is suggested that the most efficient and cheapest method would be to take advantage of existing GUB agencies, thc Civil Department and PWD. The town officers have all necessary authority and power, which may be required in recovering appropriated scrap, and the PWD has the men and equipment required.

(2) *Iron ore*

No iron ore deposits of commercial importance have been found in Burma. However, iron-bearing ore has been found on Cheduba Island which has been analyzed and found to contain 53·57% iron oxide, 24·02% silica, and 22·02% moisture. The extent of this deposit should be determined to establish whether it is great enough to be of commercial value.

(3) *Pig iron*

The projected zinc smelter for Myingyan will produce 2,700 long tons per year of pig iron as a by-product. This would be most valuable in supplying Burma's iron foundries which now operate on a small scale.

(4) *Power*

The steel plant will require 14,827,200 kWh per year of electric power. If operated 300 days per year, the daily requirement will be 49,424 kWh. The cost is estimated to be K0.20 per kWh. It is proposed initially to obtain this power from the Rangoon thermal plant system, if the new load can be carried. Later, this load may be carried by the proposed Pegu River hydroelectric generating plant. A standby power plant for emergency use is included in the project.

(5) *Miscellaneous*

Other materials are minor. Fuel oil, coal, sulphuric acid, zinc and other chemicals will be needed. Most of these will be available nationally as the industrial development program progresses. Some must be imported.

(e) **Plant location.** Rangoon is the largest metropolitan area of the Union of Burma, is the industrial and business center, and is the principal seaport of the nation. The city is also connected by water, rail and highway to all parts of the country, and is the most important distribution center. For these reasons the proposed steel products plant should be located in the Rangoon area.

It is proposed that the steel products plant be erected in the Insein suburban area north of the city of Rangoon, on a site acquired by the Government for industrial purposes. This property is served by highway and by a main line railway. However, there are several reasons why the steel plant should not be located on this tract. In the first place, this site does not front on the Rangoon River or its tributaries. As more of Burma is accessible by water transport than by rail or highway, it is important that the proposed steel plant be located where it can be served by water transport. In such a location, scrap can be delivered directly to the plant by barge, and the finished product can be distributed by the same means, as well as by rail or highway. Any imported materials, such as iron ore, pig iron, steel scrap or steel billets, can be landed directly at the plant, thus avoiding rehandling and inland transportation costs. Furthermore, if the present search for iron ore in commercial quantities in the Union of Burma is successful, the steel plant would be enlarged. In such event, the iron ore, coal or coke, and limestone, would be brought to the plant by water, as this is universally the cheapest method of transportation for bulk materials.

In the second place, one part of this industrial site is already occupied by the Government cotton spinning and weaving factory, and a second has been allocated for a Government pharmaceutical plant. These two industries should not be located adjacent to a steel plant as their products must be manufactured in clean atmospheric conditions which are almost impossible to obtain near a steel plant.

For these reasons the site for the steel products plant should be west of the present government-owned tract, on the east bank of the Hlaing River. Plate 14 shows a suggested location for the plant.

(f) **The process.** Operating on steel scrap exclusively, the furnace will be of the electric arc type, which is best suited for this purpose. If additional output is desired imported steel scrap or steel billets may be used. The billets would be the most economical as they need only to be heated before going to the rolling mill.

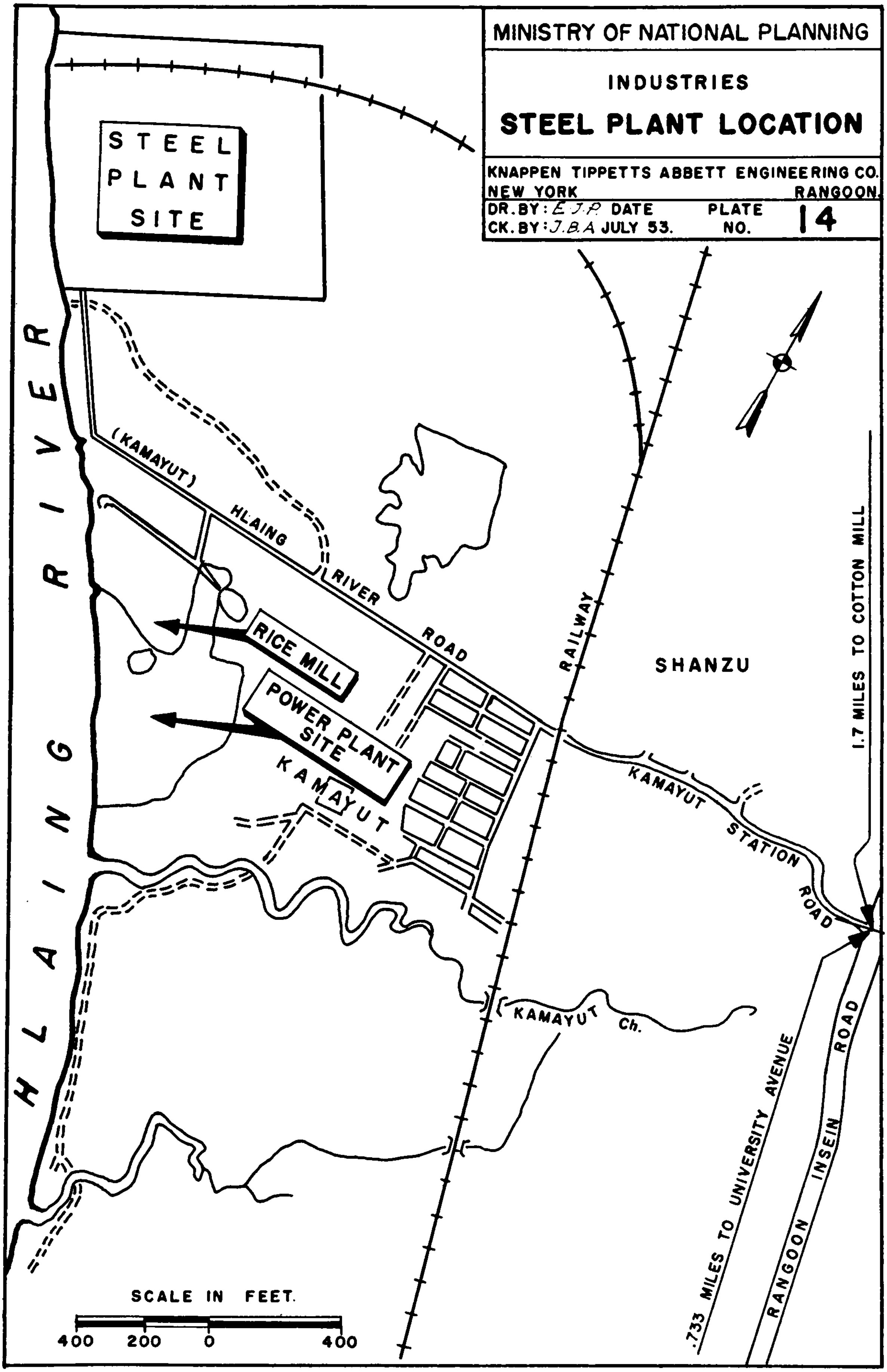
The equipment should consist of an electric arc melting furnace, a rolling mill, wire drawing mill, a plate-sheet mill, a shape and bar mill, a cold and hot products mill, and a galvanizing plant. Auxiliary equipment and facilities such as offices, laboratory shops, warehouses, emergency power plant, inter-plant railway, and water and sewerage must be included.

On Plate 15 is shown a suggested plant layout of the proposed steel products plant.

(g) **Estimated costs.** The total capital required to erect the 20,000-long-ton capacity steel products plant, and to place it in operating condition, is estimated as follows:

	K
(1) Machinery and Equipment	
(*a*) 15-Ton Electric Furnace	32,00,000
(*b*) Rolling Mill	1,16,00,000
(*c*) Wire Drawing Mill	28,00,000
(*d*) Electrical Equipment	26,00,000
(*e*) Water and Sewerage System	4,75,000
(*f*) Compressed Air System	70,000
(*g*) Fuel Oil System	75,000
(*h*) Shapes and Store Room	11,25,000
(*i*) Laboratory	82,500
(*j*) Inter-plant RR and Rolling Stock	7,50,000
(*k*) Automotive Equipment	1,50,000
Subtotal, Machinery and Equipment	2,30,27,000
(2) Structural Steel	28,65,500
(3) Ocean Freight	20,60,500
(4) Insurance	3,45,000
(5) Duty	—
(6) Burma Inland Freight	2,00,000
(7) Machinery Erection	27,00,000
(8) Foundation and Construction Work	43,50,000
(9) Burma Living Costs and Travelling Expense: Foreign Experts	4,72,000
(10) Rental on Construction Equipment	4,72,000

(*Continued on page* 786)


MINISTRY OF NATIONAL PLANNING
INDUSTRIES
STEEL PLANT LOCATION
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK RANGOON.
DR. BY: E.J.P. DATE PLATE
CK. BY: J.B.A JULY 53. NO. 14
STEEL PLANT SITE
HLAING RIVER
(KAMAYUT) HLAING RIVER ROAD
RICE MILL
POWER PLANT SITE
KAMAYUT
RAILWAY
SHANZU
KAMAYUT STATION ROAD
1.7 MILES TO COTTON MILL
KAMAYUT Ch.
.733 MILES TO UNIVERSITY AVENUE
RANGOON INSEIN ROAD
SCALE IN FEET.
400 200 0 400

(11) Overhead Expense: Owning Company, Officers' Salaries, Clerical Salaries, Travelling Expense, Cables, Telegrams, Telephones, during Construction	4,72,000
(12) Contingencies	4,72,000
(13) Total Erected Cost	3,74,36,000
(14) Real Estate—graded	18,72,000
(15) Total Plant Cost	3,93,08,000
(16) Working Capital	28,32,000
(17) Total Capital Investment	4,21,40,000

Note: Cost estimate does not include connecting railroad spur to plant site, or of access highway, electric power line, water line, etc., outside of plant site.

(h) Construction schedule. It is estimated that approximately three years will be required from the time consulting engineers are retained to complete the proposed steel plant. This time may be broken down as follows:

(1) Survey of site, preparation of preliminary drawings and specifications, and ordering machinery, equipment, and materials: six months;

(2) Grading of plant site, construction of foundations, roads, docks, railway connection, water and power connection and warehouses: to begin within six months, and to be complete before one year;

(3) Machinery delivery to start within 15 months of placement of orders, and to be completed one year later;

(4) Erection to take about 12 months, the time overlapping the machinery delivery period.

(i) Expenditure schedule. The total cost of the plant is divided as follows between foreign exchange expenditures (K3,40,08,000) and local currency (K81,32,000).

(1) *Foreign exchanges*

The foreign exchange required for the first year would be principally for the engineering work and for the initial payments for machinery, equipment and materials. The initial payment will vary with the custom of the manufacturer and will range usually between 15% and 25%. For budgeting purposes 25% should be used, which would require the equivalent of K80,01,000 in foreign exchange. An additional amount of K4,99,000 should be allowed for engineering work and miscellaneous purposes, making the total estimated expenditure for the first year K85,00,000 or its equivalent. Expenditures for the second and third years would be about equal as partial payments are made on the machinery, equipment and material, and would be approximately K1,27,54,000 for each year.

(2) *Local currency*

The kyat expense for the first year would consist mainly of the acquisition and grading of the plant site and of foundation construction work. This is estimated to cost K30,00,000. The balance of the kyat expense would be divided about evenly during the next two years at K25,66,000 for each year.

The uniform annual figure necessary for 100% capital recovery in 20 years of both local currency and foreign exchange is obtained by the following factors as follows:

Currency	*Kyats*	*Factor*	*Annual Cost (K)*
Local	81,32,000	×·07358	5,98,350
Foreign Exchange	340,08,000	×·08024	27,28,800
		Annual Total	33,27,150

In the preceding, the total should be debited against the annual cost of manufacture on a unit-of-production basis dependent upon the annual production of each product.

(j) Production costs—cost of sales

(1) *Cost of sales*

An estimate has been made of the cost of producing and selling the various types of steel products to be manufactured. This is on Table XXII–28 (*see p.* 788). This is based upon using domestic scrap only, with no imports of scrap or billets. The cost of manufacturing and of sales of the various products is shown below.

Commodity	*Long Tons per Year*	*Estimated Cost per L.T. (K)*	*Estimated Total Cost (K)*
Shapes and Bars	4,100	402	16,48,200
Drawn Goods	1,150	463	5,32,450
Black Plate and Sheets	1,850	446	8,32,450
Galvanized Sheets	6,600	693	45,66,905
Nails, Loops, Barbed Wire	4,455	540	24,12,325
Hot Process Products	1,305	720	9,37,345
Cold ,, ,,	770	880	6,78,345
Total or Average	20,230	574	1,10,07,580

The preceding list of products meets closely the requirements of the bid invitation of the Ministry of Industry and Mines, as in the succeeding table, except for the provision for sheets for private consumption.

Item	*Ministry Requirement (L.T.)*	*Report Requirement (L.T.)*
Shapes and Bars	3,991	4,100
Galvanized Sheets	5,500	6,600
Black Sheets and Plates	1,310	1,850
Nails, Galv. Wire, Barbed Wire	4,427	4,455
Hot and Cold Process Production	1,875	2,075
Other Drawn Products	—	1,150
Total	17,103	20,230


HLAING RIVER
DOCK
SCRAP YARD
CRANE
PUMP
STORE ROOM
SWITCH-GEAR
FINISHED PRODUCTS
SHEET GALVANIZING
FURNACE
ELECTRIC FURNACE
REPAIR SHOP
STORAGE AND SHIPPING
ROLLING MILL-B.
FURNACE
ROLLING MILL-A.
ROLL STORES
COOLING BED
PLATFORM
FINISHED PRODUCTS
FINISHING
NAIL SHOP
WIRE GALVANIZING
POT SHOP
PICKLING
STORE-ROOM
OFFICE
120'
38
270'
50'
740'
SCALE IN FEET
MINISTRY OF NATIONAL PLANNING
INDUSTRIES
SUGGESTED PLAN
STEEL PRODUCTS PLANT
RANGOON
KNAPPEN TIPPETTS ABBETT ENGINEERING CO
NEW YORK
RANGOON
DR BY
CK BY
DATE
JULY 53
PLATE
NO
15

MINISTRY OF NATIONAL PLANNING
PHARMACEUTICAL PLANT RANGOON
KNAPPEN TIPPETTS ABBETT ENGINEERING CO. NEW YORK RANGOON.
DR. BY E.J.P. CK. BY P.A.W. — DATE MAY '53 — PLATE NO. 16

As the proposed plant is flexible the quantities of each commodity may be varied to suit demand.

(2) *Profits at current wholesale prices*

Based upon the current selling prices of these commodities in Rangoon, and upon the quantities it is planned to produce, the following gross profit, without taxes, would result:

(3) *Manufacturing costs—cost of sales and profit*

	L.T./Yr.	*Total (K)*	*Average (K)*
Estimated Average Sales (Current Prices)	20,230	2,38,77,500	1,180.00
Less Cost of Sales	20,230	1,16,07,580	574.00
Gross Profit or Surplus		1,22,69,920	606.00
Return on Investment		27·5%	

(4) *Profits at current prices less duty and dealer profit*

Based upon a c.i.f. Rangoon cost, plus stevedoring, port charges and warehousing, but without license fees, duty, or dealers' profit, the foregoing estimated gross profit would be as follows:

(5) *Manufacturing costs—cost of sales and profit*

	L.T./Yr.	*Total (K)*	*Average (K)*
Estimated Average Sales (Adjusted Current Prices)	20,230	1,83,34,985	906.00
Less Cost of Sales	20,230	1,16,07,580	574.00
Gross Saving to GUB		67,27,405	332.00
Return on Investment		15·95%	

The preceding government warehouse cost price of imported steel products is then comparable to the manufacturing, warehousing and packaging cost of the same products manufactured in Burma in a wholly government owned plant operated on a tax-free and non-profit basis. Both prices would be those paid by government agencies accepting delivery f.o.b. government warehouse, or for sale to other purchasers on a non-profit basis.

From the last table it is clear that it would be definitely advantageous for the Government to own and operate the proposed steel products plant, as a saving of K67,27,405 per year would result. This is equivalent to a price reduction of 35% compared to the cost of duty-free importations, if the entire output was purchased by government agencies.

(k) Economic features. The manufacture of the selected steel products in the proposed plant will release foreign exchange for other purposes, and its operation will not require large importations of materials or supplies. It is estimated that the foreign exchange required for the importation of the selected 20,000 long tons of steel products to be manufactured in Burma amounts to K1,66,00,000 per year.

The plant will employ approximately 500 people at manufacturing wage rates and salaries. The annual payroll will exceed K11,00,000, which should add importantly to the national income.

An important feature of the project is that it will eventually be almost completely self-sustaining. The plant is also of importance from a defense viewpoint, as the best alloy steels for use in the manufacture of arms are made in electric furnaces.

(l) Conclusions and recommendations. There is no question of market and the necessary raw materials appear to be sufficient to support the proposed plant. The estimated manufacturing costs indicate that this plant can operate at a good profit, or that the prevailing prices may be reduced drastically.

As all steel products are now imported and as the profits are assured, the program should be implemented at once, and placed in the First-year Plan.

(32) Pharmaceuticals and Drugs

(a) The market. The current annual consumption of pharmaceuticals and related products in Burma amounts to K1,88,10,444 plus certain items procured by the Government duty free and additional supplies furnished by WHO and TCA. There is sufficient demand for pharmaceuticals and drugs to support an industry designed to supply the various medicinal products in general use by the Ministry of Social Services in its activities concerned with public health.

(b) The plant. The details of a plant to manufacture bulk pharmaceuticals, biologicals, vitamins, yeast, penicillin, nicotinic acid, milk substitute and infant foods are covered in a project report previously submitted to Government. The plant proposed would, in the beginning, manufacture only those items required by Government with possible surpluses in certain products to be made available to the pharmaceutical and medical professions. Eventually the plant could supply the total needs of Burma in biological vaccines, antibiotics and sulfa drugs.

The plant would consist of a group of self-contained departments housed in separate buildings supplied with the required utilities, electricity, compressed air, steam, treated water and gas from central facilities, and distilled water (Plate 16).

The estimated cost of the plant is given in the following Table XXII–29.

It would require about three years to design, construct, and place the plant in operation. The engineering design for the complete plant must be finished during the first year, and all facilities in Group A started as promptly as detailed plans are available. Groups B and C can follow as needed.

TABLE

ESTIMATED MANUFACTURING

DEPARTMENTAL

Item	*Spread Costs*	*Furnace Department*		*Rolling Mill*		*Rolling Mill Shapes and Bars*	
	K		K		K		K
1. General and Administrative Expense	4,86,300	—	1,21,575	—	1,21,575	—	—
2. Electrical Distribution	2,65,900	—	66,475	—	66,475	—	—
3. Water System	34,490	—	3,100	—	29,320	—	—
4. Compressed Air System	17,035	—	6,830	—	4,255	—	—
5. Fuel Oil System	44,350	—	885	—	31,505	—	—
6. Railroad	16,500	—	2,360	—	2,360	—	—
7. Shops and Stores	2,61,820	—	20,200	—	2,06,270	—	—
8. Depreciation	27,54,540	—	2,89,000	—	8,28,140	—	4,95,000
LABOR							
9. Manager	—	1 1+3 laboratory	25,000	1	17,000	— —	— —
10. Foreman	—	3 Furnace for	9,150	1		2	6,100
11. Unskilled Men	—	62	54,500	—	—	68	59,000
12. Social Charges	—	—	88,650	—	17,000	—	65,100
SUPPLIES							
13. Lubricants	—	—	1,120	—	560	—	1,700
14. Water	—	—	150	—	250	—	—
15. Oxygen	—	—	8,100	—	—	—	—
16. Acetylene	—	—	5,450	—	—	—	—
17. Fuel Oil	—	—	5,100	—	1,70,000	—	—
18. Zinc	—	—	—	—	—	—	—
19. Sulphuric Acid	—	—	—	—	—	—	—
20. Milk of Lime	—	—	—	—	—	—	—
21. Zinc Chloride	—	—	—	—	—	—	—
22. Sawdust	—	—	—	—	—	—	—
23. Hydrochloric Acid	—	—	—	—	—	—	—
24. Ammonium Chloride	—	—	—	—	—	—	—
MAINTENANCE							
25. Maintenance	—	—	22,750	—	98,000	—	88,000
26. Brick Lining—Furnace	—	—	11,150	—	—	—	—
27. ,, ,, —Saddles	—	—	1,42,500	—	—	—	—
28. ,, Special for Ingot Casting	—	—	1,11,500	—	—	—	—
		Furnace 10,067,200	20,13,440	—	—	—	
29. Power kWh at K0.20	—	Other 940,000	1,88,000	330,000	66,000	7,000,000	1,20,400
30. Scrap (K100/L.T.)	—	16,000 L.T.	16,00,000	—	—	—	—
31. Added Other Material	—	5–8·5%	80,000	—	—	—	—
32. Rails (K200/L.T.)	—	—	—	—	—	4,000 L.T.	8,00,000
33. Purchased Billets	—	—	—	—	—	—	—
34. Material in Process	—	—	—	—	—	10,125 Ingots and Slabs at 337	34,12,125
35. Gross Cost	—	—	48,76,985	—	16,58,710	—	50,47,425
36. Credits	—	—	—	—	—	(2,125 T)	2,12,500
37. Net Cost	—	19,360 L.T. Ingots and Slabs	48,76,985	19,360 L.T. Throughput	86 251	Net Cost 12,000 L.T.	48,34,925
Cost per L.T.	—	—	251	Ingots and Slab Ingots	337	Net	402

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COST OF STEEL PRODUCTS

COSTS

Rolling Mill Plates and Sheets		*Wire Drawing and Rod Mill*		*Cold Processing Department*		*Hot Processing Department*		*Nails, Loops, Barbed Wire*		*Galvanizing Sheets*	
	K		K		K		K		K		K
—	—	—	48,630	—	48,630	—	48,630	—	48,630	—	48,630
—	26,590	—	26,590	—	26,590	—	26,590	—	—	—	26,590
—	—	—	2,070	—	—	—	—	—	—	—	—
—	—	—	1,190	—	1,190	—	1,190	—	1,190	—	1,190
—	—	—	885	—	—	—	3,540	—	3,100	—	4,435
—	—	—	2,360	—	2,360	—	2,360	—	2,360	—	2,360
—	—	—	7,575	—	7,575	—	7,575	—	7,575	—	5,050
—	2,01,000	—	1,07,500	—	96,500	—	1,37,500	—	1,21,000	—	1,04,500
—	—	1		1		1		1		1	
—	—	Prop 1/5	4,500	Prop 1/5	4,500	Prop 1/5	4,500	Prop 1/5	4,500	Prop 1/5	4,500
2	6,100	1		1		1		1		1	
48	41,500	18	22,600	36	31,250	26	22,300	22	18,850	34	29,100
—	47,600	—	27,100	—	35,750	—	26,800	—	23,350	—	33,600
—	1,150	—	1,150	—	1,150	—	1,150	—	1,150	—	600
—	—	—	3,260	—	—	—	250	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	5 kg/T (27·1 T/Yr)	4,650	—	—	110 T/Yr	18,400	100 T/Yr	17,000	165 T/Yr	27,100
—	—	—	—	—	—	—	—	—	—	1200 T/Yr	14,70,000
—	—	216 T/Yr	28,400	—	—	—	—	4 T/Yr	510	—	—
—	—	—	11,150	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	1·5 T/Yr	2,460	—	—
—	—	—	—	—	—	—	—	—	600	—	—
—	—	—	—	—	—	—	—	—	—	540 T/Yr	60,200
—	—	—	—	—	—	—	—	—	—	60 T/Yr	34,800
—	34,000	—	8,950	—	8,500	—	6,460	—	8,150	—	5,250
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
825,000	1,65,000	680,000	1,36,000	144,000	28,800	384,000	76,800	342,000	68,400	165,000	33,000
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
9,235 L.T. Ingots and Slabs at 337	31,23,570	6,500 L.T. Cogged Steel at 402	26,13,000	850 L.T. Drawn Goods at 463	3,93,550	1,400 L.T. Bars at 402	5,62,800	4,500 L.T. Drawn Goods at 463	20,83,500	6,000 L.T. Plate and Sheets at 446	26,76,000
—	36,46,510	—	30,57,560	—	6,86,345	—	9,46,845	—	24,12,325	—	45,66,905
(1,385 T)	−1,38,500	—	—	(80 T)	−8,000	(95 T)	−9,500	—	—	—	—
Net Cost	35,08,010	—	30,57,560	—	6,78,345	—	9,37,345	—	24,12,325	—	—
7,850 L.T.		6,500 L.T.		770 L.T.		1,305 L.T.		4,455 L.T.		6,600 L.T.	
Net	446	Drawn Goods	463		880		720		540	G.I. Sheets	693

TABLE XXII - 29

COSTS OF PHARMACEUTICAL PLANT

Department or Item	Total Cost (K)	Local Cost (K)	Foreign Currency (K)
GROUP A			
Bulk Pharmaceuticals	95,18,050	22,46,750	72,71,300
Biologicals	29,02,250	12,43,312	16,58,938
Packaging Department	22,04,000	7,62,375	14,41,625
Administration and Laboratories	2,37,500	1,78,125	59,375
Warehousing	4,98,750	3,74,062	1,25,688
Utilities	38,08,550	8,76,850	29,31,700
Yeast	16,05,000	3,82,500	12,22,500
Engineering and Contingencies	41,13,500	11,00,100	30,13,400
Total Group A	2,48,87,600	71,64,074	1,77,23,526
GROUP B			
Penicillin	37,90,500	9,95,125	27,95,375
Nicotinic Acid	22,36,775	5,60,073	16,76,702
Total Group B	60,27,275	15,55,198	44,72,077
GROUP C			
Milk Substitute and Infant Food	29,40,107	6,53,863	22,86,244
Grand Total	3,38,54,982	93,73,135	2,44,81,847

The annual production of the plant is estimated at K1,41,55,000 initially, rising to K2,00,00,000 after six years of operation. It is estimated that the manufacturing costs of the products will not exceed K1,09,00,000 for an outturn of K1,41,55,000; the savings per year would therefore be about K32,55,000 over import costs.

(c) **Raw materials.** Some of the raw materials are indigenous, such as plants for natural extracts and alkaloids, cultures for biological products and penicillin, and cultures for yeast. Other basic raw materials are available, but for pharmaceuticals must be converted into usable intermediates, such as sugar to alcohol; acetalihyde and acetanilide; rice for starch and dextrose, etc. Other raw materials will result from other industries under consideration such as acetic acid and methanol from wood distillation, ammonia from the proposed fertilizer plant and sulphuric acid. A detailed analysis of each raw material will be required to determine the economics of manufacture compared with importation.

(d) **Management.** The manufacture of pharmaceutical products involves complex chemical processes and close coordination of manufacturing procedures. The plant will require more technicians and experienced supervisors than it will be possible to train during the time required to implement the project. The multiplicity of problems that will be encountered in training personnel for highly specialized production would be increased considerably by the number of people that require simultaneous training. The administration and maintenance of the plant require judgement that can be accumulated only by experience. In view of the problems involved in operating a plant of this type it is preferable that it be operated under a management contract with a firm experienced in the manufacture of pharmaceuticals.

(e) **Conclusions and recommendations.** The products which are proposed in this project are essential to the health of the nation. Therefore the plant will be making a substantial and worthwhile contribution if it enables Burma to become self-sufficient on a number of critical drugs and other medical items.

The child mortality rate, the venereal disease rate and the tuberculosis rate are all extremely high, and reduction in these would have large economic benefits to the individual, the community and the nation.

The production cost of some articles might be more than the c.i.f. cost, but in the majority of cases it would be lower. It is estimated that the investment could be repaid out of profits in approximately 11 years. Therefore the project can be justified on economic grounds, as well as national interest for self-sufficiency in items important to health and defense.

It is therefore recommended that the GUB immediately contract with a reputable pharmaceutical manufacturer to act as management agents for this project. The duties of the management agents would be: to brief the consulting engineers on the chemistry of the processes involved, advise the architects on manufacturing processes in order to obtain the most modern and efficient plant layout, train selected GUB personnel, provide technicians or management personnel where no GUB personnel are available and train counterparts for these positions, operate the plant until the GUB personnel are competent to take over, and provide continuing consulting service for new products, new applications for old products, new processes, etc.

After obtaining the services of the pharmaceutical manufacturer, completion of plant design and letting construction contract could be accomplished within 12–18 months. Completion of buildings is possible within 18–24 months from completion of design.

(33) Tobacco and Tobacco Products

(a) **The market.** The people of Burma consume more tobacco per capita than do the people of any other country except the United States, the consumption comparing as follows:

United States	10·1 pounds per year (1949)
Burma	9·7
New Zealand	9·0
Canada	7·3
United Kingdom	5·5

All forms of tobacco are used in Burma, the principal forms being mild cheroots, strong cheroots, cigars, cigarettes and pipe tobaccos. While the nation is self-sufficient as far as total production is concerned there is a shortage of some types, consequently Burma both imports and exports tobacco and tobacco products.

(b) **Tobacco production.** Approximately 130,000 acres of land are used for growing tobacco. Most of the land so used is flooded land on the banks of the large rivers. The holdings are small, the average being about five acres. The principal producing areas are in Thayetmyo, Tharrawaddy, Myingyan, Mandalay, Toungoo and the Pegu districts.

The recent crops have averaged 117,000,000 pounds per year of dried cured tobacco. This has an approximate wholesale value of K20,20,000 per year. In 1951–52 a total of 235,622 pounds of cured tobacco was imported at a declared value of K5,98,721. No export figures are available for the last three years. Imports of unmanufactured tobacco have decreased considerably since before the war when an average of more than 14,500,000 pounds was brought in each year. The imports of cured tobacco are principally Virginia types.

Cigarettes are the principal imported tobacco product, their quantity being much greater than that of cigars, pipe tobaccos and other forms together. In 1951–52 620,000,600 cigarettes (1,549,663 pounds) were imported at a declared value of K1,31,96,845. There are normally no exports of manufactured tobacco or tobacco products, except cigars.

(c) **Tobacco industry.** A tobacco industry has developed in Burma. Thirty-five factories produce cigars, 46 produce cheroots, four produce beedies, and three produce cigarettes. Rangoon has become the chief tobacco manufacturing center with 27 factories of the total of 88. Mandalay is a close second with 25. All cigarette plants are located in Rangoon. Myingyan, Prome, Bassein and Pegu have several tobacco plants.

The industry employs 5,083 people, 598 of whom are men and 4,485 women. Most of the factories are small. The cigar factories rarely employ more than 20 to 25 persons. Only ten plants employ more than 100, and of these five plants employ over 200. The largest employs 454. Most of the industry is on a cottage industry basis.

The curing and warehousing methods are not modern, and none of the factories have driers or humidifying equipment. Consequently the tobacco gets too wet and molds during the wet season, and is too dry during the dry season. All cigars, cheroots and beedies are hand made. Grades of some tobaccos are substandard.

None of the three cigarette factories at Rangoon are modern. Most of the equipment is Japanese and does not operate well or efficiently. The three plants have a rated capacity of about 655,000,000 cigarettes per year operating eight hours per day. The estimated actual production is only 38,000,000 cigarettes per year.

The plants, with present equipment, thus have the capacity to supply nearly all of the requirements of Burma.

Imports	620,000,600
National Production	38,000,000
Total	658,000,600
Capacity	655,000,000

The owners report that they cannot sell more Union-made cigarettes from the tobacco used because of the preference for the imported tobaccos containing Virginia tobacco blends. Virginia tobacco was introduced into Burma in 1935, but less than 2% of the tobacco acreage is used for the production of this type.

The problems of the industry are two-fold. The first is agricultural. Better grades of tobacco must be grown, and curing and drying methods improved. More tobacco of the Virginia types should be grown for cigarette use to reduce imports of unmanufactured tobaccos and of cigarettes. Better quality tobacco of the proper type would improve the quality of the cigars and cheroots and thus reduce the quantity of cigars imported. Nevertheless, Burma is almost self-sufficient in the manufacture of cigars.

(d) **Recommendations.** The manufacturing methods should be improved to produce a better-made product. The cigarette plants should be modernized by installing drying and humidifying equipment. This would improve output, reduce costs, and insure a better product.

As the existing cigarette plants have ample capacity to meet the national demand, there is no present need for additional manufacturing capacity. Since the consumer prefers imported blends of tobaccos to national blends the manufacturers should attempt to duplicate these in the national plants. As far as possible the required types of tobaccos should be grown in Burma. Until the successful production of suitable tobacco to meet the outside competition it would be more economical to import the proper cured tobaccos required. As the cost of the imported tobacco in cigarette form is four times the cost of the same tobaccos in the unmanufactured form, the importation of the cured tobacco for the local manufacture of cigarettes would save foreign exchange to the amount of K98,97,633 per year.

(34) Fruit Processing

The wide range of latitude and large differences in elevation and weather in Burma make it possible to find the optimum climatic conditions for growing almost all kinds of fruit. At present the principal fruit-growing section of Burma is in the Shan States. This area does not produce all of the fruit requirements; thus some fruit is imported. Orchards can be expanded to meet the country's requirements.

The fruit industry is too small at present to support modern plants for packing, storing and processing fruit or fruit products. A small experimental fruit canning plant has been established near Taunggyi. As fruit cannot be preserved or stored it must be sold when ripe for domestic consumption.

The importation of fruit that can be grown domestically is contrary to the objectives of the development program and as fruit is an important part of the diet of a healthy people, its production and processing should be encouraged.

A first step is to promote a program for increasing the acreage devoted to fruit growing, and to improve the quality and the yield of the fruit. When a sufficient quantity of fruit of acceptable grade has been grown, modern packing plants and fruit processing plants with cold storage facilities should be established.

The packing plants would pack the fruit to enable it to reach the consumer in the best possible condition. Cold storage would permit the sale of fruit to be spread over any desired period and would prevent a depressed price at the peak of a season. Fruit processing and canning plants can be established to conserve the surpluses for off-season use.

As the development of a sound fruit and fruit products industry will require several years, the establishment of any commercial-sized fruit processing plant should be deferred until the production can sustain it. It is recommended that these plants be included in the long-range program.

(35) Fisheries and Seafood

(a) The market. Fish and fish products comprise about 30% of the food budget of a typical Burmese family in Rangoon. Lack of an organized fishing and seafood industry tends to keep retail prices high. Imports are necessary to supplement the local catch, another factor contributing to the relatively high price of what should be a low-priced food item.

It is estimated that imports represent approximately 76% of consumption. Imports for 1951 52 (9,060 tons valued at K2,34,43,060) were the largest since 1939–40.

Difficulties of distribution and lack of income largely restrict consumption to the coastal perimeter. It is estimated, on the basis of 19,000,000 population, that nation-wide consumption will not exceed 200,000 tons annually or 23·6 pounds per capita. As a comparison, Japanese per capita consumption is 75 pounds. Means are not available at present to establish a more accurate estimate of the probable ultimate demand.

In addition to the lack of any organized fishing and seafood industry in either processing or catching, there are no shore facilities of any consequence to handle, preserve or process fish or seafoods, nor are there any proper distribution facilities to insure that fresh fish or seafoods reach interior consumers in edible condition.

(b) Possibility of domestic production. (1) The deep-sea fishing industry in Burma at the present time is carried on by a small fleet of privately owned trawlers operating out of Tenasserim ports, principally Mergui. The fishing grounds that appear to be the most productive are the waters around the Mergui Archipelago. Japanese fishing vessels are said to have operated profitably along the Tenasserim coast prior to and during the war. Some Japanese maps indicate that tuna are to be found in the coastal waters of Burma at certain seasons of the year. Statistics on the extent of salt water fishing, the types of fish caught, and the location of the most productive fishing grounds are meager. A part of the local catch is taken from the inland rivers.

Existing trawlers are not equipped with cold storage facilities nor are shore facilities available for freezing or canning fish. Most of the catch is sold fresh in the coastal markets, and any surplus that may be left is dried or salted.

(2) The project would comprise:

1 Fishing fleet
1 Tuna cannery
1 Fish meal and fish oil plant
3 Cold storage plants.

Labor for all phases of the industry would have to be trained. It is understood that an arrangement is being made with a Japanese firm to furnish vessels and training crews for a trial period before entering into a joint venture. Such an arrangement would provide for training personnel at all levels.

(c) Economic feasibility. (1) A project report in which capital and production costs have been detailed for the fishing industry has been completed.

The capital cost for the program is estimated:

1 Fishing fleet unit	K36,87,500
1 Tuna cannery	7,07,750
1 Fish meal and fish oil plant	4,27,500
3 Cold storage plants	33,77,250
Total estimated cost	K82,00,000

Of the total, the equivalent of K51,11,000 will be required in foreign exchange, the balance, K30,89,000, will be in local currency.

(2) *Production costs.* Production costs have been estimated for the four units comprising the industry and are summarized.

	Total Per Year	Average Cost per Long Ton
	K	K
(a) Fishing Fleet		
Cost of production	29,10,000	97.00
Gross sales—raw fish	1,73,88,000	579.60
Gross profit	1,44,78,000	482.60
(b) Cannery		
Cost of production	29,30,000	—
Gross sales—canned fish	45,00,000	3,000.00
Sales of offal	30,000	20.00
Gross sales	45,30,000	—
Gross profit	16,00,000	—
(c) Fish Meal, Fish Oil		
Cost of production	6,17,950	—
Sale of fish meal	4,18,000	—
Sale of fish oil	3,25,500	—
Gross sales	7,43,500	—
Gross profit	1,25,550	—
(d) Cold Storage Plants		
Receipts from fish storage K1,08,00,000		
Rental of space 14,00,000		
	1,22,00,000	—
Operation cost	79,60,000	—
Gross profit	42,40,000	—

Summarizing the above:

Units	Products	Expenditure	Income	Gross Profit
		K	K	K
Fishing Fleet	30,000 tons fish	29,10,000	1,73,88,000	1,44,78,000
Cannery	1,500 tons canned fish 1,500 tons offal	29,30,000	45,30,000	16,00,000
Fish Meal Oil	418 tons meal 46,500 gals. oil	6,17,950	7,43,500	1,25,550
Cold Storage	9,000 tons frozen fish plus rental for 1,500 tons fruit, vegetables, dairy products and meats	79,60,000	1,22,00,000	42,40,000
	Total	1,44,17,950	3,48,61,500	2,04,43,550

The difference between current wholesale prices and the estimated costs is K2,04,43,550 per year. This represents the savings to the people as a whole if these products be sold at cost.

c. The Myingyan Industrial Group

The development of the Kalewa coal mine and riverine transport system for hauling coal will make it desirable to establish an industrial center in the middle Irrawaddy Valley close to the fuel supply, and within easy hauling distance of the Shan Hills and Kachin mineral areas. A location near the confluence of the Irrawaddy and Chindwin Rivers offers the best access by all modes of transport.

A site near the city of Myingyan originally recommended as the most desirable because of the availability of river transport, railway and highway facilities has now been found subject to overflow during flood stage of the river. A more suitable site for industrial development has therefore been selected in the vicinity of Nangate on the east bank of the Irrawaddy River, opposite Pakokku where the ground surface is well above flood stage.

For the development of this proposed site there have been recommended a steam power plant fired with Kalewa coal, a zinc smelting and refining plant, a sulphuric acid manufacturing plant, and a fertilizer plant, all of which industries are interdependent, and require coal as the basic material.

Future development in this vicinity of other industries based on processing agricultural, forest, and mineral raw materials will be advantageous to the general economic improvement of central Burma.

The Myingyan area is used broadly in this Report to include a considerable part of central Burma tributary to the site. Short extensions of the existing railway and highway would be necessary to serve this site.

(36) Limestone

As far as is known, there are no commercial limestone quarry and crushing plants in the Myingyan area. Limestone is known to exist in both mountain ranges forming the east and west rims of the great central basin of Burma, and has been found near Myingyan.

While little concrete work is now being done, a great deal will be done in this area in executing the industrial development plan. Some of the aggregate required can be granite, which is also available in this region.

Railroad ballast and highway metal will also be required in substantial quantities. Because of the lack of an adequate market at present it will be best to produce the current requirements by means of small crushing and screening plants located where suitable deposits exist near market areas.

When the industrial group at Myingyan is approved and construction is started, a crushing plant for concrete aggregate must be established as close to the plant site as is possible. A self-contained portable crushing and screening plant, using manual labor for loading rock, may be purchased for about $35,000 (K1,65,200).

This plant may be included as a part of the construction cost of all of the Myingyan projects, or it may be set up as a separate unit.

Limestone of good quality is available at Thayetmyo in the quarry of Burma Cement Company, Limited. However, a screening plant would have to be installed at Thayetmyo to segregate crushed rock by sizes, before it would be available from that source. The production of agricultural lime in this area must be included in the industrial plan.

(37) Lime

The lime requirements of Burma have previously been discussed under Projects 1- a- (3), and 1- b- (29). It is the purpose here to explore the possibility of manufacturing lime in the Myingyan area.

The nearest known active limestone quarry operation is that belonging to Burma Cement Company, Limited, at Thayetmyo. Here are ample deposits of high calcium carbonate limestone that are believed to be suitable for the manufacture of quicklime and hydrated lime. The organization and management skills and many of the facilities that would be required are available, and lime could be manufactured at Thayetmyo with a minimum investment.

Quicklime can be manufactured in the Portland cement plant by the addition of suitable equipment. At present, however, the capacity of the Thayetmyo plant is not sufficient to supply the current demand for Portland cement, so the present facilities should not be used for the manufacture of lime. Consideration is being given to enlarging the capacity of the Thayetmyo plant, as it is estimated that the demand for Portland cement will at least double in the next ten years. If this is done now, as it should be, to supply the anticipated requirements for cement, there may be some idle capacity that will permit the manufacture of quicklime with a minimum of capital investment. Later, when all of the capacity can be utilized for Portland cement, new lime-burning equipment may be added.

To explore the economies of manufacturing lime at Thayetmyo on a part capacity basis, some assumptions must be made: both Portland cement and lime could and would be made simultaneously, one half of the capacity of a second kiln would be utilized for burning lime, the present limestone quarry would be madernized and mechanized, and a screening plant would be a part of this improvement. To burn limestone in a rotary kiln only a single size gradation of limestone must be used at one time. This can only be obtained by screening. A fourth assumption would be that natural gas would be available for both Portland cement and lime burning. On these assumptions, estimated costs have been prepared which are shown in Table XXII–30 (*see next page*).

These estimates indicate that Portland cement costs are not affected by the manufacture of lime on a part-time basis. The unit cost of K53.91 per long ton compares to K53.31 when operating full time on cement.

The estimated cost of quicklime on this basis is K54.27 per long ton compared to K96.62 for a separate lime plant in Rangoon (see Project 1- b- (29)). The estimated cost of hydrated lime made at Thayetmyo compares K72.22 per long ton with K104.39 when made at Rangoon. Thus lime made at Thayetmyo using cheap natural gas can be shipped to Rangoon, or to Akyab, and sold cheaper than lime made at Rangoon.

The increase in investment cost at Thayetmyo, to make lime, is small, being about K9,44,000. The per cent return on the investment remains about the same as if the Thayetmyo plant were to be operated entirely on cement.

However, if the lime is not manufactured as a part-time enterprise, the costs at Thayetmyo would increase if the second (new) kiln were idle part of the time. It may therefore be concluded that the Thayetmyo plant is the most economical manufacturing point for lime in Burma.

(38) Portland Cement

The subject of Portland cement has been covered in Project 1- b- (28), and in a separate project report.

It is a matter of economics and of policy whether the additional manufacturing capacity required to meet the growing needs of Burma is to be obtained by means of increasing the capacity of the plant of Burma Cement Company, Limited, at Thayetmyo, or by the construction of a new plant at Rangoon.

The economic factors indicate that the required new capacity may be obtained more cheaply by enlarging the existing plant at Thayetmyo.

(39) Natural Gas Products

The production of natural gas by petroleum companies in Burma is discussed in Chapter XXI, Mineral Industries. If an ample supply of this fuel becomes available, it may then be feasible to manufacture carbon black, which is required by the rubber tire and paint industries.

TABLE XXII - 30

ESTIMATED MANUFACTURING COST, COST OF SALES, AND PROFIT

Thayetmyo Plant ¾ Cement—¼ Lime

Item	*Annual Cost Cement (K) 90,000 L.T.*	*Cost per L.T. (K)*	*Annual Cost Quicklime (K) 15,000 L.T.*	*Cost per L.T. (K)*	*Annual Cost Hydrated Lime (K) 10,000 L.T.**	*Cost per L.T. (K)*
1. Operating and Repair Labor	2,40,000	—	40,000	—	20,000	—
2. Operating and Repair Supplies	3,20,000	—	60,000	—	20,000	—
3. Limestone—Cement	2,25,000	—	—	—	—	—
4. Limestone—Lime	—	—	75,000	—	—	—
5. Silica Sand	18,000	—	—	—	—	—
6. Gypsum	3,06,000	—	—	—	—	—
7. Power	2,90,000	—	40,000	—	30,000	—
8. General Works Expense and Cont. and Royalty	4,80,000	—	80,000	—	40,000	—
9. Fuel—Cement	1,80,000	—	—	—	—	—
10. Fuel—Lime	—	—	30,000	—	—	—
11. Depreciation Cement	7,39,200	—	—	—	—	—
12. ,, Lime	—	—	1,38,600	—	93,400	—
13. Reserve for Gas Wells	80,000	—	20,000	—	—	—
14. Insurance	80,000	—	15,000	—	5,000	—
15. Depletion	—	—	—	—	—	—
16. Reserve Bad Accounts	4,800	—	600	—	600	—
17. Sales Commission and Expenses	2,70,000	—	45,000	—	45,000	—
18. General Administration and Overhead	67,500	—	11,250	—	11,250	—
19. London Office } 20. Rangoon Office }	30,000	—	5,000	—	5,000	—
21. Directors' Fees	4,050	—	675	—	675	—
22. Staff Bonuses	15,000	—	2,500	—	2,500	—
23. Cost of Sales less Sacks	33,49,550	—	5,63,625	—	2,73,425	—
(½ Quicklime to Hydrate Plant)	—	—	−2,81,813	—	+2,81,813	—
24. Adjusted Cost of Sales less Sacks	33,49,550	—	2,81,812	—	5,55,238	—
25. Cost of Sacks	15,03,000	—	1,25,250	—	1,67,000	—
26. Gross Cost of Sales	48,52,550	53.91	4,07,062	54.27	7,22,238	72.22
27. Gross Sales	1,57,50,000	175.00	10,92,000	145.60	15,22,668	152.26
28. Less Freight and Warehousing—Rangoon	18,72,000	20.80	1,56,000	20.80	2,08,000	20.80
29. Net Sales	1,38,78,000	154.20	9,36,000	124.80	13,14,608	131.46
30. Less Cost of Sales	48,52,550	53.91	4,07,062	54.27	7,22,238	72.22
31. Gross Profit	90,25,450	100.29	5,28,938	70.53	5,92,370	59.24
32. Less 50% Income Tax	45,12,725	50.14	2,64,469	35.27	2,96,185	29.62
33. Net Profit	45,12,725	50.15	2,64,469	35.26	2,96,185	29.62
(Quicklime)	2,64,469	—	—	—	—	—
(Hydrated Lime)	2,96,185	—	—	—	—	—
34. Total Net Profit	50,73,279	—	—	—	—	—
35. Capital Invested	1,36,94,500	—	—	—	—	—
36. Return on Investment	37·1%	—	—	—	—	—

*7,500 L.T. of quicklime becomes 10,000 L.T. of hydrated lime when water is added.

(40) and (41) Petroleum and Zinc

These projects were included in the master chart as sources of materials and products required by various industries. The reports on these two industries are included in Chapter XXI, Mineral Industries.

(42) Sulphuric Acid

(a) The market

(1) *General requirements*

Burma would use over 3,000 tons of sulphuric acid per day to produce sufficient superphosphate and ammonium sulphate fertilizer to cover its rice land.* At the present time, Burma's consumption is approximately one ton of sulphuric acid a day.

The leading and most heavily used basic chemical in the world today is sulphuric acid. It is used in chemical reactions for the manufacture of pharmaceuticals, paints and pigments, formic acid for the coagulation of raw rubber, insecticides, dyes, iron and steel pickling, petroleum refinery processing, sodium phosphate, nitric acid, phenol, and many other chemicals. The needs for sulphuric acid lie, therefore, first, in consideration of the agricultural program for the production of fertilizers, and second, in laying the foundations for modern industry.

(2) *Access to the market*

The largest need for sulphuric acid is in the manufacture of superphosphate and ammonium sulphate fertilizer which will constitute 98·5% of the immediate market. The sulphuric acid plants should be located as closely as practicable to these two fertilizer plants. Myingyan has been considered as the site for these industries inasmuch as it is centrally located in Burma with respect to availability of cheap power, cheap coal, raw materials, rail and water transport. Good railway connections are available north to Mandalay, south to Rangoon, northeast to Lashio, and southeast to the southern Shan States. Water transport is available as the location is near the junction of the Chindwin and Irrawaddy Rivers. Power availability is included in plans for construction at Myingyan of a coal-generated electric power plant to produce 20,000 kilowatts.

(b) Possibility of domestic production

(1) *Cost of imported sulphuric acid*

Import costs are out of all proportion to the manufactured value of sulphuric acid. This high import cost is due to the excessively high cost of transport which in turn is due to the special handling required by the acid, special care, special containers, high cost insurance, high cost freight, high risk, and because it represents both bulk and weight at a proportionally low value. The following Table XXII–31 illustrates the estimated price differential between sulphuric acid manufactured in Burma and imported sulphuric acid.

*At one ton each of superphosphate and ammonium sulphate fertilizer per every 11·2 acres of rice.

TABLE XXII – 31

SULPHURIC ACID (H_2SO_4) PRICE DIFFERENTIALS

Plant Designation	Sulphuric Acid Manufactured from:	Price of Sulphuric Acid: Burma Manufactured Cost*	Price of Sulphuric Acid: Imported Sulphuric Acid at Myingyan	Price of Sulphuric Acid: Increase Per cent
Plant "A"	Zinc Smelter Gases, Sulphur Dioxide (SO_2) (50·9 tons H_2SO_4/day)	K96.31 per ton	K596.22 per ton	520
	Imported Bulk Sulphur (83·1 tons H_2SO_4/day)	K182.74 per ton	K596.22 per ton	226
Plant "B"	Imported Bulk Sulphur (342 tons H_2SO_4/day)	K154.11 per ton	K596.22 per ton	286
Plant "A" and "B" Average		K144.39/ton	K596.22/ton	313

*As per 100% sulphuric acid.

(2) *Input materials and utilities*

The proportion of input materials and utilities required per ton of manufactured sulphuric acid is very small. The electric requirements are minor; the man-hours of labor are low; less than one gallon of water is required per one pound of sulphuric acid; the outstanding consideration is the availability and cost of one third ton† of imported bulk sulphur for each ton of sulphuric acid. A list of the utilities and materials required to produce one ton of 100% sulphuric acid by the contact process is given in Table XXII–32.

†0·344 tons sulphur to one ton of sulphuric acid.

TABLE XXII – 32

MATERIALS REQUIRED PER TON OF SULPHURIC ACID MANUFACTURED (Contact Process)

Type of Material, Utility, or Service	Amount of Materials Required per Ton of Manufactured Sulphuric Acid (2240 lbs.)
Sulphur	770 pounds
or Sulphur Equivalent	9% Sulphur Dioxide Gas from Smelter
Air	280,000 cu. ft.
Water	1,870 gallons
Steam‡	224 pounds
Electricity	5·6 kWh
Labor	1·143 man-hours

‡Furnished by waste heat boiler or heat exchanger.

(3) *Direct and indirect employment*

The number of personnel necessary to operate the sulphuric acid plant is comparatively small. Much of its operation is automatic and the plant is unusually compact. In regard to indirect employment, the production of sulphuric acid is far-reaching. The use of fertilizer will increase farm labor requirements for its application and for harvesting the heavier crops. A corresponding increase will develop in processing facilities for rice, cotton, tobacco and other produce. In the manufacture of industrial products such as steel, chemicals, paper, textiles, paints and petroleum, the use of sulphuric acid will increase the productive employment of many thousands of people.

(4) *Skilled workers*

The sulphuric acid plant does not need a large number of skilled workers. The plant manager, plant chemist and supervisor for each shift (3), are the only personnel who require a special technical background. The plant manager, and possibly the plant chemist, should be European trained with a chemical engineering background. The remainder of the personnel will receive further training and directions under their supervision.

(5) *Foreign exchange conservation*

The amount of foreign exchange conserved by the manufacture in Burma of the 142,800 tons per year of sulphuric acid required by the combined yearly production of 277,500 tons of superphosphate and ammonium sulphate fertilizers is K6,40,00,000 per year or approximately 300%* of the price required to manufacture the amount in Burma. The complete saving resulting from the use of domestic fertilizer in lieu of imported fertilizer is brought out in the presentation of project 42.

(c) Economic feasibility

(1) *Description of plant*

Two sulphuric acid plants are recommended. One plant, referred to as Plant "A," is a medium-sized plant with a 134 ton/day capacity of which 127 tons will be utilized in the production of superphosphate fertilizer and the remaining seven tons in the manufacture of other industrial requirements. This plant will be located directly adjacent to the proposed Myingyan zinc smelter and will utilize the zinc sulphide waste fumes† for the production of one third of its total sulphuric acid output. This section of the plant is referred to as Plant Section I of Plant "A."

*Refer to Table XXII 31 "Sulphuric Acid Price Differentials."

†Will utilize total zinc sulphide ore concentrates available. Resulting sulphur equivalent is: 60·3 tons/day $ZnS \times 29\%$ sulphur=17·5 tons/day sulphur.

The remaining two thirds output of sulphuric acid will draw its raw material supply from imported bulk sulphur, and this section of the plant will be referred to as Plant Section II of Plant "A."

The second plant, referred to as Plant "B," is a large plant with a 342 ton/day capacity which will be utilized entirely in the production of ammonium sulphate fertilizer. This plant will use imported bulk sulphur as a raw material and will be located as close as possible to the ammonium sulphate plant which it serves. Its use of imported sulphur as a raw material will enable it to be located at any particular site convenient to the ammonium sulphate plant whether this be Myingyan or some location closer to Rangoon.

(2) *Raw material cost, production cost and earnings*

In Table XXII–33, the "Sulphuric Acid Project Master Chart," various operational phases are shown which affect the economies of Plant "A" (Section I and Section II), Plant "B," and both plants totaled or averaged together. Production costs, raw material costs and earnings are shown for all plant sections. Earnings have been represented as the difference between production cost and the estimated cost of sulphuric acid imported at Myingyan.

The difference between the production cost of sulphuric acid manufactured in Burma and the imported cost of sulphuric acid at Myingyan is K2,14,100 per day for 476 tons; or, for one year of 300 working days, an equivalent gain of K6,42,30,000. Against this "gain" of over six crores, the required capitalization is very small at K1,90,87,528.

(d) Existing production facilities. At the present time, no sulphuric acid is being produced in Burma. Prior to the war, the Burmah Oil Comany (BOC) had two sulphuric acid plants of 20-ton-per-day capacity each. Both plants were designed to operate 24 hours a day throughout the year, but due to a limited demand were working at half capacity and produced only ten tons per day each. The plants were almost completely destroyed and dismantled during the war. The reconstruction of these older plants (1929) has not been considered practical as the design of modern plants is so much more compact and economical. Both plants employed the contact process using imported sulphur with a SO_3 conversion efficiency of 94% and an over-all efficiency of 88% to 90%. The acid produced was 95% strength with a specific gravity of 1·8407 at 15·56° C.

Under the present refining policy, no sulphuric acid is used by the Burmah Oil Company and none is planned. Prior to the war, sulphuric acid was used solely for refining products as BOC had no cracking process equipment.

TABLE XXII – 33

SULPHURIC ACID (H_2SO_4) PROJECT MASTER CHART

Basis of Plant Operation		*Unit*	*Plant "A" 134 ton/day*		*Plant "A" Subtotal (Average)*	*Plant "B" 342 ton/day*	*Plant "A" and "B" Subtotal (Average)*
			Plant Section I	*Plant Section II*			
			Zinc Smelter Fumes	*Imported Bulk Sulphur*		*Imported Bulk Sulphur*	
Sulphur Equivalent used as Raw Material		Tons/day	17·5	28·6	46·1	117·6	163·7
Cost of Raw Material (at Myingyan)		K/ton	70	383	227	383	305
		K/day	1,225	10,930	10,470	41,200	49,800
Amount of Sulphuric Acid Manufactured		Tons/day	50·9	83·1	134·0	342	476
Production Cost		K/ton	96.31	182.74	139.53	154.11	146.82
		K/day	4,895	15,200	18,700	52,700	69,900
Equivalent Cost of Imported Sulphuric Acid (at Myingyan)		K/ton	596.22	596.22	596.22	596.22	596.22
		K/day	30,300	49,500	79,800	2,04,000	2,84,000
Difference between Production Cost and Imported Cost (Earnings)		K/ton	499.91	413.48	456.69	442.11	449.40
		K/day	25,405	34,300	61,100	1,51,300	2,14,100
Percentage Difference between Manufacturing Cost and Import Cost		%	520	226	327	286	306
Plant Cost		K	47,62,986	41,24,542	88,87,528	1,02,00,000	1,90,87,528
Ammonium Sulphate Fertilizer from Sulphuric Acid*	Ammonium sulphate produced	Tons/day	nil	nil	nil	450	450
	Sulphuric acid required	Tons/day	nil	nil	nil	342	342
Superphosphate Fertilizer from Sulphuric Acid†	Superphosphate produced	Tons/day	189	286	475	nil	475
	Sulphuric acid required	Tons/day	50·9	76·1	127	nil	127
Explosives and Industrial Manufactures from Sulphuric Acid	Explosives and Industrial Manufactures produced	Tons/day	nil	150	150	nil	150
	Sulphuric acid required	Tons/day	nil	7	7	nil	7

*0·760 ton H_2SO_4 = 1 ton ammonium sulphate.
†0·268 ton H_2SO_4 = 1 ton superphosphate.

(e) Recommendations

(1) *Expenditure schedule*

Out of a cost of K1,90,87,528 for both sulphuric acid plants "A" and "B," the amount required for foreign currency expenditure is 72%, or K1,38,30,446. This will include all machinery, chemical equipment, transport to Burma, and engineering services and supervision.

Local capital requirements will constitute the remaining 28%, or K52,57,082, of all expenditures. This will include buildings, land, installation charges, and further transport of equipment in Burma from Rangoon to Myingyan.

(2) *Construction schedule*

Schedules of construction will parallel those to be established by both the ammonium sulphate and the superphosphate fertilizer plants. As the production of the sulphuric acid plants will be almost entirely absorbed (98·5%) by the foregoing fertilizer plants, it follows that the actual construction of the acid plants will await disposition of final plans for the ammonium sulphate and superphosphate plants before proceeding.

With Plant "B," 100% of its 342 tons/day of sulphuric acid will go into the manufacture of ammonium sulphate fertilizer. With Plant "A," 95% of its 134 tons/day of sulphuric acid will go into the manufacture of superphosphate fertilizer. The remaining 5% will go into the manufacture of other industrial requirements.

Schedule of construction for Plant "A" will also be affected by plans for the Myingyan zinc smelting plant project. As the Plant "A" sulphuric acid plant will be built directly adjacent to the zinc smelter and will derive one third of its raw material supply for this source, it follows that plant "A" would not ordinarily go into capacity operation without the zinc smelter.

The building of the necessary sulphuric acid plants must therefore await two developments: (1) the construction of the ammonium sulphate and superphosphate fertilizer plants and (2) the construction of the Myingyan zinc smelter.

With eventual clearance of the two foregoing factors, the construction of the sulphuric acid plants will require from 18 to 24 months following delivery of equipment on location at Myingyan. The newer type sulphuric acid contact plants are unusually compact and can ordinarily be assembled rapidly, often in 12 months; but to include time for site preparation and contingencies, 24 months should be allowed.

(43) Gypsum Products

This project was included in the master plan and chart as a possible industrial project because Burma is known to have some deposits of gypsum, though no deposits of commercial significance have been discovered.

Gypsum is needed to provide sulphuric acid for the proposed fertilizer plant at Myingyan, and to avoid the necessity of importing sulphur for this purpose. A limited supply of sulphur will be available from the zinc refining plant but it will not be sufficient to support the fertilizer industry.

Gypsum can also be used to manufacture building construction and other products, such as:

Plaster of Paris	Gypsum Partition Block
Keene Cement	Gypsum Shingles
Gypsum Wall Board	Gypsum Plasters

The crude gypsum is used only for the manufacture of sulphuric acid and as a retarding agent to control the setting time of Portland cement.

When gypsum is used in the manufacture of sulphuric acid, a lime sludge residue results which is normally a waste product as it usually contains a small percentage of sulphuric acid. A better use of gypsum would be through the adoption of another process for the simultaneous production of sulphuric acid and Portland cement. In this process the additional raw materials required for the manufacture of Portland cement are fed into a rotary kiln with the proper amount of gypsum. The sulphuric acid is recovered from the stack gases, while the Portland cement clinker is discharged from the other end of the kiln. About one ton of sulphuric acid to one ton of Portland cement clinker results from this process, and there is no residual waste product.

The proposed fertilizer plant would require about 1,150 long tons of gypsum per day or 337,500 long tons per year. The present Portland cement industry uses about 2,400 long tons per year, and when its capacity is doubled the demand will increase to about 4,800 tons.

Gypsum has been found in Burma in the Myingyan area. The known deposits extend north from Thayetmyo to Chauk, on both sides of the Irrawaddy River. Crude gypsum used by Burma Cement Company, Limited, in the manufacture of Portland cement at its Thayetmyo plant is produced near Yenangyaung, 125 miles upstream from the cement plant. Other deposits have been worked near Thayetmyo and the mineral is known to exist in the Magwe area.

All of the gypsum found in Burma has been in the crystalline form. This exists in surface deposits in the form of sheets, from very thin up to two inches in thickness. It is normally covered by some overburden. As the deposits thus far discovered are thin, the cost of production is high. While existing in considerable quantity in this form over a large area, the deposits cannot be considered commercially workable.

No deposits of the solid, white-rock gypsum have been located. If a solid sheet of the crystalline gypsum extended over a single square mile and had an average thickness of one half inch, there would be available a total of 56,950 long tons per square mile. In most areas the deposit is not continuous, so the available gypsum per square mile would not be over 25,000 long tons, as an average.

The known deposits are sufficient to supply the needs of the Portland cement industry, which can afford to pay a high price for a small percentage of its raw material requirements, but no industry depending upon gypsum as its principal raw material can operate on such a basis.

The cement company pays K75.00 per metric ton delivered in its storage. The freight to the plant is K19.25 per ton. Before the war the price paid was K20.00 per ton from deposits near Thayetmyo.

BOC has drilled the area on the west bank of the Irrawaddy. A check of the well logs does not reveal any lower deposits of rock gypsum. The Burma Geological Department has no information on any deposits other than the surface deposits described previously in this Report.

As this is the "arid" section of Burma, a water well drilling program is being implemented to provide water for the villages. Every effort should be made to check the logs of each well drilled to determine if any gypsum deposits exist. If this does not reveal such deposits, then a core-drilling program should be organized to drill test holes elsewhere, or at lower levels than required for water wells. This mineral is important to the economy of Burma and an extensive exploration program to find commercial deposits is justifiable.

(44) Fertilizer

(a) The market. The need for fertilizer in Burma is large. No substantial amount of fertilizer has been used in the country, and over a long period of years a depletion of the chemicals of the soil necessary for the growth of foodstuffs, particularly rice, has occurred. Natural fertilizers or soil conditioners such as rice bran have been used but not on a large scale. None of them supply the amount of nitrogen urgently needed and recognized as necessary to prevent the continual depletion of the soil and the further reduction of the yields per acre of crops, especially rice.

Phosphorus is also recognized as a necessary fertilizer material in many locations although it is not held to be universally required. It is used as a supplement to nitrogen which is applied to the soil in the form of ammonia or ammonia compound.

Potash, the third usual principal fertilizer material, is not regarded as of prime essentiality. It could be added, as could also other trace elements, if soil conditions demand in a program of producing balanced or complete fertilizer products. In any case, potash will have to be purchased from overseas in its finished form as such and will not require processing.

For Burma, the essential ingredient of fertilizer manufacture is ammonia, since rice, the principal crop, responds best to this compound. Phosphorus is an important secondary material in the balanced fertilizer for rice application.

The factories proposed will have annual capacities of 42,900 tons of ammonia and 157,000 tons of superphosphate. These capacities are estimated to be about 10% of the country's potential need. Entire production is intended for domestic use. The Government would be the principal monetary beneficiary of the increased agricultural production that fertilizer will make possible.

(b) Possibility of domestic production. (1) The fertilizers considered for domestic manufacture are urea and ammonium sulphate. The estimated production cost for urea bagged and ready for shipment is K325 per ton and K248 for ammonium sulphate. The selling price of urea in these countries where it is available is equivalent to about K700 per ton. Likewise, the mill cost of ammonium sulphate is attractive when compared with selling prices elsewhere in the world. If a fertilization program on a national scale is adopted, on the basis of production costs, the manufacture of those components for which the raw materials are available in the country should be undertaken. It will be necessary to import phosphate rock for superphosphate, the manufacture of which is simply a treatment with sulphuric acid.

(2) The principal raw materials required are coal, air, electricity and sulphur in their element form or as compounds such as gypsum or sulphur-bearing metallic ores.

As a chemical enterprise, the manufacture of fertilizer has many variations depending on the raw materials which are available to produce the desired final products. Some fertilizers, particularly ammonia compounds, may compete among themselves for the same market. Hence, a careful evaluation of costs of production based on different raw materials and different end products is essential.

As a matter of practical application to crops, it is necessary that ammonia be in solid form which may be either urea or ammonium sulphate. Urea is advantageous, particularly in Burma, since it does not require the use of any form of sulphur—a relatively scarce commodity. All of the ammonia produced may be converted to urea by recycling, a process that is relatively expensive. A simpler process which converts only part of the ammonia into urea is recommended instead. The unconverted ammonia is then made into ammonium sulphate in simple and cheap equipment (provided a source is available), rather than being recycled. While there are many aspects which make the complete conversion of all ammonia to urea desirable, even by the more expensive recycle process, it is not recommended for this first fertilizer project; instead it is recommended that only the simple process be used on a "once through" basis, and the balance neutralized to give ammonium sulphate. Some sulphur probably will be available later from zinc smelting operations, but the quantity will be relatively small in comparison to requirements, making sulphur importation necessary.

Ammonium nitrate is another apparently advantageous solidified form of nitrogen which has been considered. It is not recommended, even though it requires no sulphur, since it presents some explosive hazard in handling, and its efficiency in rice culture is questionable.

(3) Two fundamental methods for making ammonia have been considered. Estimates of costs and analysis of advantages have been made for each process.

The first of these methods for producing the necessary synthesis gases, hydrogen and nitrogen, for the production of ammonia would utilize coal from Kalewa as the prime ingredient, together with air and water. The recommended location for such a plant is just below Myingyan at the location of a proposed industrial center.

The second method would utilize large amounts of electric power which must be made available at a cost of about one pya per kilowatt hour when balanced against the cost of Kalewa coal.

The detailed analysis (see project report under preparation) indicates the coal process as most advantageous. Comparison of the two methods is too complex for detailing in the space of this section.

(4) With due consideration of all factors including the probable time necessary to make available the cheap electric power and the relatively high cost of the electrolysis plant, it is recommended that the method utilizing approximately 470 long tons per day of Kalewa coal be adopted and that a plant be built near Myingyan for the synthesis of 130 long tons per day of ammonia. Adjacent to and as a part of the synthesis plant would be factories with all utilities and accessories for the production of 90 long tons of urea per day on a "once through" basis; of 450 long tons of ammonium sulphate a day (estimates are made for production from either sulphuric acid or from gypsum); of 475 tons per day of superphosphate; of 50 tons per day of mixed fertilizers; and of adequate sulphuric acid, steam and electric power supplies.

Some small part of the anhydrous liquid ammonia, which would be made in the amount of 130 long tons per day, may be utilized also for the industrial and refrigeration needs of the country. Assuming that only about ten tons per day would be so utilized, 450 long tons a day of ammonium sulphate will be produced. Alternatively, if urea is made by the "once through" process, some 90 long tons per day will be produced; and the balance will be utilized to give some 300 long tons of ammonium sulphate per day.

A plant for utilizing almost the entire production of ammonia as ammonium sulphate is therefore recommended. This requires sulphuric acid manufactured from imported sulphur or from zinc sulphide smelting and the sulphur oxides so produced. Alternatively, gypsum may be used to produce ammonium sulphate; but known sources of the mineral would be inadequate to supply demand. Adequate amounts should be found if careful explorations are instituted in the area now supplying gypsum for the cement plant at Thayetmyo. However, a producing plant for ammonium sulphate utilizing gypsum as a source of sulphur has been outlined and estimated. It is recommended that it be used as an alternative to the ammonium sulphate project if and when adequate supplies of gypsum are proven.

In addition to ammonium compounds, phosphorus is also required as a fertilizer material; the usual form being superphosphate made from phosphate rock. No phosphate rock is known to be available in Burma although no adequate non-metallic minerals survey of the country has ever been made. It is recommended that phosphate rock be imported and that a plant be built to produce 475 long tons of superphosphate per day. This amount, from the standpoint of utilization on crops, will balance roughly the ammonia fertilizer that will be produced.

Required sulphuric acid may be made from imported sulphur, from sulphuric oxides resulting from zinc smelting or from gypsum. The material selected for the initial installation is imported sulphur, although costings have been made for the acid from zinc smelting.

Lastly, a fertilizer mixing plant is required to prepare the complete product for utilization by the cultivator. This is merely a compounding or blending station. It may well be located also at the Myingyan fertilizer center for convenience in manufacture and distribution. Additional mixing plants may be built at other locations near the center of agricultural lands utilizing the fertilizer itself. It is recommended that a mixing plant at Rangoon be built immediately to make possible a major demonstration and educational program which will, by itself, be quite profitable. It would use domestic additives and foreign ammonium sulphate and superphosphate at first, and later the products of the domestic fertilizer plant.

(5) As with other projects in the industrial development scheme, labor will have to be trained under foreign management for a period of years. Counterpart local management also will receive training in a gradual taking-over process. The project will afford direct employment to some 400 people in all categories.

(c) **Economic feasibility.** (1) Estimated costs of plants comprising the initial industry are:

	Foreign Exchange Equivalent	*Domestic Currency*	*Total*
	K	*K*	*K*
(*a*) Ammonia	5,17,75,000	1,68,62,000	6,86,37,000
(*b*) Urea	1,20,88,000	32,77,000	1,53,65,000
(*c*) Ammonium Sulphate	53,20,000	34,67,000	87,87,000
(*d*) Superphosphate	20,18,000	20,66,000	40,84,000
(*e*) Mixed Fertilizer	14,01,000	21,37,000	35,38,000
Total	7,26,02,000	2,78,09,000	10,04,11,000

Cost of ammonium sulphate plant using gypsum is K1,85,25,000. This plant is not recommended for the initial installation.

(2) To arrive at over-all profitability and to simplify calculations, only ammonium sulphate and superphosphate will be considered as total end products. Because of the lower price per ton of fixed nitrogen in urea, its consideration would show a greater profit than that demonstrated here.

(3) *Annual Production Costs*

150,000 long tons ammonium sulphate (31,500 tons nitrogen)	K3,27,00,000
157,000 long tons superphosphate (33,000 long tons P_2O_5)	K2,75,00,000
Total cost per year including amortization	K6,02,00,000
Cost of transportation, distribution, use and handling of increased yields of rice assumed at two thirds of production cost	K4,00,00,000
Total national cost of fertilization	K10,02,00,000

(4) The original assumption in developing the capacities of the plants suggested was that one tenth of the average land might be fertilized with a more or less average dosage. On the other hand, the maximum gains from a given amount of fertilizer would be obtained by fertilizing land with present subnormal yields of rice with a lower dosage. The maximum profit would depend on balancing several economic factors which are very difficult to compute.

For the purpose of this simple calculation, assume that lands are selected having relatively lower than average present yields, say in the range of 1,000 pounds paddy per acre per year. Experiments on such lands have shown increases of over 100% in the production of rice by using an equivalence of 20 pounds nitrogen plus 20 pounds superphosphate per acre.

On such a dosage, the nitrogen and phosphate fertilizer available would serve to enrich a total of 3,500,000 acres.

Production yield increases established by the use of these relatively low dosages of fertilizer are first year increases which probably may be bettered somewhat until the land reaches its optimum with continuous dosage. The point of optimum yield has not been established and need not be considered here. A conservative 430 pounds of paddy, taken as the increment resulting from fertilizer use, will lose about 30% of its weight in producing rice products, mainly polished rice. Neglecting any monetary value in this 30%, a recovery is obtained equivalent to 300 pounds of polished rice as the increment per acre due to the use of fertilizer. This amounts to 1,050,000 pounds for the land fertilized or roughly 470,000 long tons of increased rice production at a cost of K10,00,00,000 or K213 per ton.

If this increased rice production is sold at the present export average price of K800 per ton, there will be an increased revenue to the Government of K27,50,00,000. The cost of this increase is K10,00,00,000; the apparent profit is K17,50,00,000 or a return of about 175% on the investment.

D. RECOMMENDATIONS

After completing the study of the entire industrial development program outlined for the Union of Burma, after considering the immediate and future needs of the projects not included in this industrial section, and after studying the immediate and future needs of the nation as a whole, it is evident that each industrial project can be placed in one of several categories.

It was found that certain products to be manufactured in certain of the projected plants were basic products that were critically needed to implement the economic and industrial development program, or to conserve foreign exchange, or both. The plants to manufacture these basic products were placed in an initial program with the recommendations that these projects be implemented immediately. This initial program has been called the "First-year Plan."

Other products less critical to the implementation of the program, or the manufacture of which depends upon one or more of the products of the plants included in the First-year Plan, were placed in a secondary group of projects for construction at a later date. This secondary grouping has been called the "Intermediate Program."

The balance of the projects have been placed in a third group for future study, action and implementation. Some of these cannot now be considered for construction due to insufficient information or due to lack of suitable known sources of raw materials. Others have been deferred because the present or immediate future market studies indicate that the demand for the products of these plants would be too small to justify a minimum sized plant to produce them. Still others are duplicate industries in separate areas that are not required now to supply the present or immediate future demands for the particular product. At a later date the initial plants will not be able to supply the anticipated demands outside of the area in which they are to be located. At that time the duplicate plants should be established in other regions to reduce transportation costs. This grouping has been called the "Long Range Program."

In dividing the projects into the three groups, consideration was given to the wishes of the government officials, to the ability of the Government of Burma to finance the program out of surplus revenue, and to the availability of national managerial and technical talent of the types required.

1. FIRST-YEAR PLAN

This initial program has been carefully worked out after consultation with the government officials. Prior to the completion of this Report a separate condensed report was submitted in which this First-year Plan was presented. This separate report included recommendations covering the entire economic and development program, as well as industrial projects.

The industrial projects included in this First-year Plan report were the following:

(*a*) A steel products plant.
(*b*) A joinery plant.
(*c*) Expansion of Portland cement manufacturing facilities.
(*d*) An asbestos-cement products plant.
(*e*) A rice bran oil extraction plant.
(*f*) A jute textile and bag plant.
(*g*) A bamboo paper pulp and paper factory with supporting chemical plants.
(*h*) An ammonia-based fertilizer plant.

It will be noted that four of the included projects are for the manufacture of construction materials. These are amply justified by the heavy construction program planned in implementing the economic and industrial development program. A fifth construction material project covering clay roofing tile and clay brick has not been included because the machinery and equipment has already been ordered. It need only be considered in totaling the financial requirements for the industrial program. Additional projects to be added to this group would be a pharmaceutical plant, as this has been advanced to this classification recently, and a fishing and a sea products industry. The balance of the projects forming the First-year Plan are basic industries to manufacture products now being entirely imported, and which are essential to the economy of the Union of Burma.

The number of these projects is approximately all that should be implemented at one time considering the financial and management resources of the nation. It is recommended that all of these be implemented as early as possible.

It is believed that all of these projects may be placed in operation within a period of from one to four years. The First-year Plan may then be considered to cover an initial period of about four to five years.

2. INTERMEDIATE PROGRAM

The study of the basic plan indicates that certain other industries should be established as soon as possible after the First-year Plan industries have been implemented. Basically these should follow during the second five years, although there can be and should be some overlapping toward the end of the First-year Plan time period in order to insure a continuity of the development plan.

The industries that should be included in this intermediate plan period are the following:

a. Akyab District

(1) Calcium carbide and vinyl plastic plant.
(2) Paper bag plant.

b. Rangoon District

(3) Additional cotton spinning and weaving factory capacity.
(4) Cotton bleaching, dyeing and printing plant.
(5) Soya milk products plant.
(6) Additional rice bran oil extraction plants.
(7) A sugar refinery with sugar chemical plants.
(8) A veneer and plywood plant.
(9) A wood waste wallboard plant.
(10) A furniture factory.
(11) A wood waste chemicals plant.
(12) A tannin and cutch extraction plant.
(13) A paint and varnish plant.
(14) A rubber products plant.
(15) A modern lime plant.

c. Myingyan District

(16) A gypsum products plant (if commercial deposits of gypsum are located).

The intermediate plan should be flexible enough to allow for changes in the plan to meet new conditions. Certain industries that start on a small scale and do not provide self-sufficiency should be enlarged as rapidly as men can be trained and funds become available. Such industries are the cotton spinning and weaving and the rice bran oil extraction plants.

3. LONG RANGE PROGRAM

This will be an expansion period in which initially established industries will be enlarged to produce all of the requirements of Burma for the products of these plants. It will also include the establishment of other new industries as fast as they become economically justified. By-product plants of other industries will be included as the full possibilities of each raw material are explored and the need for such products can be justified. By this time such large products as rayon production, auto tire plants, mechanical rubber goods plants, etc., may become economic possibilities. If so they should be established.

E. IMPLEMENTATION PROCEDURE

No development program of the magnitude and importance of the one proposed for the Union of Burma, and in which the Government itself will directly participate to such a great extent, may be successfully implemented unless and until all of the resources of the Government are strongly in support of it and unless these resources have been thoroughly and properly organized to direct and manage it efficiently along business principles.

Of equal importance with planning the program, with selecting the industries to be developed and with financing their construction, is the procurement and training of the managerial, technical and skilled personnel to staff the new industrial enterprises. These must be provided in time to be available when the new industries are ready to be placed in operation.

The power and resources of the Government must be placed in support of the program as a matter of high policy, which must be a consistent and continuing policy as the program is a long range plan.

1. MINISTRY OF INDUSTRY FUNCTIONS

Authority to plan the program and to implement it must come from the legislature and be transmitted through the executive branch of the Government to a Governmental agency whose affairs are directed by a Cabinet officer. This procedure insures that any Union program of industrial development will receive suitable recognition in the top levels of the Union Government, and that the industrial program will be developed within the broad policies of the Government.

In the Union of Burma this has been provided by the establishment of the Ministry of Industry, whose directing head is a member of the Cabinet. The functions of such a Ministry are partly political, as they must be, to insure that the political policies of the Government will be expressed in every channel through which the Government operates.

The Ministry of Industry is charged with the responsibility for promoting industrial growth to the end that the Union of Burma may be as independent as possible of imported products. It may, in the interests of national security, even promote industries that are not economically justified in order to be completely independent of imports of some critical commodities.

It is empowered to plan, finance, construct and operate industrial plants and may organize these as wholly government-owned enterprises, or as joint venture operations with private capital interests. It may also encourage private capital to develop industries.

Certain inherent disadvantages invariably become apparent when any governmental agency attempts to operate an industry. The routine governmental regulations and business methods usually hamper industrial enterprises.

2. THE INDUSTRIAL DEVELOPMENT CORPORATION

In order to overcome the disadvantages of attempting to direct the affairs of an industrial enterprise by a political governmental agency, many countries have established more or less independent industrial development corporations whenever they have embarked upon an industrial development program.

Generally such industrial development corporations are independent entities. In many cases they are empowered to plan an orderly development of industry within the nation. This is usually done by the employment of experienced consultants to make an exhaustive survey of the industrial resources of the nation and to recommend an immediate and long range program.

Such corporations are empowered to finance each project within limits established by the Government. They may wholly own such projects or may participate in the equity ownership of an industrial enterprise on any basis necessary to finance a project. They may also underwrite the securities or loans of a privately financed industrial enterprise.

An industrial development corporation of this type is generally headed by a managing director having a wide business, financial and industrial background and who is as independent of politics as is possible.

A corporation of this type usually acts as a holding company for all governmental enterprises and seldom attempts to actively direct the operation and management. Each individual project is usually established as an autonomous entity, directed by an experienced managing director who works within the budget and broad general policies established by the corporation directors. Whenever such a plan has been tried it has been successful. There is no successful record of an industry being managed efficiently by a governmental ministry.

All of this was reported in the Preliminary Report. This report recommended the establishment of a similar corporation in Burma. This recommendation was approved by the Government, and such a corporation was established by enacting "The Industrial Development Corporation Act of 1952."

Under this act a corporation was organized for this purpose. It is managed by nine directors appointed by the President of the Union of Burma. Three of the directors are members of the Cabinet. One is a representative of the Union Bank of Burma. Four others are to be men with business or financial experience. The ninth acts as the Director-General.

The Industrial Development Corporation has broad powers to initiate plans for industrial development, to finance such projects, to buy private industrial properties in whole or in part, to borrow money, issue securities, obtain foreign credits, and take any legal steps to carry out the missions with which it is charged.

It is strongly recommended that all project industrial corporations established and controlled by the Industrial Development Corporation be given full autonomous status to insure successful operation.

3. MANAGEMENT AND MANAGEMENT TRAINING

a. Importance of Training Program

The procurement of experienced top executive management to direct the new industrial enterprises is one of the most important problems to be solved in implementing the industrial development program as Burma has few men qualified to direct these organizations.

The entire subject is discussed in Chapter VII of this Report. It is, therefore, not necessary to repeat this discussion for the industrial section alone.

The recruitment and training of an experienced managerial group for the new industrial enterprises is plainly one of the most important functions and responsibilities of the Industrial Development Corporation.

In view of the crucial importance attributed to this problem in the development program, this responsibility of the IDC to provide facilities for training and education of executives is of the greatest importance and must not be underestimated. Appropriate programs should be vigorously initiated beginning now, so that the maximum possible training will have been achieved by the time new ventures are ready to go into operation.

b. The Training of Executive Officers and Managers

The selection of properly qualified candidates for training as executive officers and managers must be done with care. The qualities and abilities needed by a manager include not only technical knowledge; it is even more important that they have business acumen and the capacity to make judgements in a wide variety of matters, and that they have leadership abilities. Much depends on the personal qualities of the individual concerned. Potential managers should be selected on the basis of organizing ability, business acumen, capacity for effective human relations, sense of responsibility, integrity, enthusiasm, drive and leadership.

There is no guarantce that any amount of formal training and experience can produce a capable manager unless he possesses native talent and aptitude for such work. Having made a careful selection of individuals for management training, the actual training and experience can best be gained abroad where advanced technical training and "in service" experience in industry can be obtained. This can and should be supplemented by training in business administration and in finance.

4. TECHNICAL AND SKILLED PERSONNEL TRAINING PROGRAM

The recruitment, selection and training of these types of industrial personnel is an equally important function of the IDC. Without these men and women it will be impossible to operate the new industrial plants effectively.

a. Professional Training

The professional training of engineering and scientific personnel can be carried out by the University of Rangoon College of Engineering augmented by training students abroad until the staff and facilities of the College of Engineering have been expanded to meet the requirements.

The selection of candidates for such training can be made from those whose educational record, work experience and references indicate they have the qualities required. Their selection need not be limited to graduates in engineering, though in most cases engineering training would be an asset. The formal or university training provides only the foundation for those who are eventually to manage industrial developments. Experience in the actual field in which they are to work is more important than educational training. After completion of their formal education, candidates for managerial posts must work in plants of the type they will be called upon to manage a sufficient time to become thoroughly familiar with the problems of management. Where a new industry is to be operated under a management contract, most of that experience may be gained in the industry under the foreign managers and technicians after their return to Burma, but it is desirable to have at least two years in a well-organized plant abroad before starting practical training at home.

It is reiterated that candidates for management posts must be carefully selected on the basis of their general ability and fitness rather than on academic records. Performance in service is the ultimate test and a continuous "weeding-out" process of the inefficients and advancement of the capable is an indispensable part of the process of developing a trained management group. Here again, the academic training is only the foundation on which to build experience in supervising and controlling industrial operations and processes. The actual experience must be gained in the industry. A capacity for organizing is important and should be considered along with technical ability in selecting personnel for these supervisory positions, since the responsibility for maintaining efficiency in operations and for maintaining the quality and uniformity of the product will depend upon them. Advanced engineering degrees are not important in the training of operating personnel except for a few positions where product control or research may require such specialized training.

During the period of fabrication of the equipment for the plant, those who are to serve as supervisors and engineers should work abroad in the factory of the fabricator or in an industry of comparable type using similar equipment in order to gain experience on the construction, operation and maintenance of the machines. The experience thus gained will go a long way toward insuring efficiency in the operation of the new plant.

When the decision is reached as to the specific industries that are to be developed in the early stages of the industrial plan, the Ministry of Industry and the Ministry of Education should jointly plan the orientation of courses at the University and the number of students that should be trained to meet the needs of the industries.

b. Sub-professional Training

Many sub-professional engineers will be needed as assistant supervisors, foremen, laboratory assistants, draftsmen, etc. While less intensively and less broadly trained than University students they obtain in three years of study sufficient engineering knowledge within their specific field to do most of the operational engineering work. Because they can be trained more rapidly than graduate engineers, and because many more of them will be needed, they will be of great importance in an accelerated development program. Facilities for their training deserve very high priority.

The Government Technical Institute at Insein has been re-established to train sub-assistant engineers. The first class will be graduated in 1954. There are 154 students this year, in their first two years of work. An additional 120 can be admitted next year, but both equipment and faculty are lacking. There are at present four instructors and two lecturers. Ten additional instructors must be obtained. The Ministry of Finance has granted sanctions for salary increases too small to attract instructors. Salaries are still so low that government departments outbid the Government Technical Institute. This bottleneck is of great importance to the development program. This institution should be given preferential treatment. Sanction should be obtained at once for considerable salary increases and if local personnel are not available a responsible official should be sent to India or elsewhere with power to make final arrangements for the necessary instructors.

The Government Technical Institute is now under the Ministry of Education. The training program and the graduates of the school are of more concern to the Ministry of Industry than to any other Ministry. Consideration should be given to the transfer of this institution to the Ministry of Industry in order that more direct control of the expansion program and orientation of courses to meet the need of industry may be attained.

c. Artisan Training

Some industrial skills under existing conditions will require basic formal training. These include electricians, machinists, mechanics, and maintenance and repair men. As industries become organized and their operating forces gain experience in their work, many of the positions in this category can be filled by "in service" training and by promoting unskilled assistants or helpers who show particular aptitude in their work. The time of greatest need for skilled workers with some formal training will be during construction and the early years of operation of the industry.

The Government Artisan Training Center can provide the basic training for industrial skills. At present only one such center exists in Rangoon. It offers a two-year course to some 150 students in nine trades. These include machinists, carpenters, diesel engine mechanics, foundry men, radio technicians, fitters and welders, automobile mechanics and blacksmiths. A building, some equipment and some staff are available for a training center at Mandalay. Thc opening is dependent on the construction of a workshop by the Public Works Department. This should be expedited.

Teachers must be trained before other centers can be opened. Teachers can be obtained by selecting the most promising graduates of the Artisan Training Center and the Technical Institute and giving them further specialized training using the same facilities. Such a plan would save time and would economize in the use of scarce training facilities.

d. Skilled Labor

The Rehabilitation Brigade is carrying out a specialized program of training workers in construction and related works. It has expanded rapidly. It should be encouraged but needs no special help at this time. It is organized as a Board, and has been freed from the financial restrictions that are retarding the other educational programs. The demand for the trades being trained by the Rehabilitation Brigade will be considerable during the construction period of each industrial plant and will be much less after the plant is put into operation. These forces may be transferred from a project for which the construction has been completed to one on which construction is to be started. The demands from other fields including housing, irrigation, port develcpment, mining and highway construction will draw heavily on the available supply of these trades and the need for further expansion of this training service must be emphasized.

5. CONTINUITY OF INTEGRATED PROGRAM

It must be emphasized that a large-scale development program of this type is not a static or fixed program. To make it most effective it must be kept fluid. Certainly a well planned initial program is essential in order to insure the orderly development of the resources of the Union in the most effective way.

Resources that are not now considered to be suitable for conversion into useful products may become suitable due to the development of some new process. New raw materials such as iron ore may be discovered. Known sources of raw materials located in inaccessible regions may become available due to the establishment of new transportation facilities. The funds available for the construction of new manufacturing facilities may accumulate more rapidly than has been anticipated, or more slowly, allowing or requiring adjustments in the basic plan. To obtain the maximum results from a development program it must be constantly revised to keep it abreast of changing conditions. To do this requires constant and intelligent supervision. This can best be provided by maintaining a small planning and economic group attached to the Industrial Development Corporation.

CHAPTER XXIII

THE DEVELOPMENT OF SMALL-SCALE INDUSTRY

A. IMPORTANCE OF SMALL-SCALE INDUSTRY IN THE BURMESE ECONOMY

By far the largest part of the manufacturing and processing activity of Burma is carried on in small local enterprises using simple methods of production. Under any plan of development, their importance will continue for a long time to come. There is a need, therefore, for considering the role, nature and problems of these activities and to make appropriate recommendations.

Generally, in the discussion which follows, the data and comments apply to all types of small manufacturing and processing units. These may be taken to include both "cottage industry"—work carried on wholly or primarily by members of a family; and "small-scale manufacturing"—establishments operated mainly with hired labor, employing up to 50 workers when power is not used and 20 when it is. The more general term, small-scale industry, will be used to apply to both.

1. PRESENT EMPLOYMENT AND PRODUCTION

Until the present census is completed, there will be no reliable country-wide data on this sector of the economy. Very rough estimates of the present number of workers in small-scale industry by major types are presented in Table XXIII-1. These were derived, by a series of assumptions, from 1931 census data on industrial occupations, and must be interpreted as only the most approximate of indicators.

TABLE XXIII - 1

ESTIMATE OF NUMBER OF WORKERS IN SMALL-SCALE INDUSTRY

(Excluding some working dependents and some workers with principal occupation elsewhere)

	Estimated Number of Workers	*Per cent of Total*
Cotton spinning, sizing and weaving	304,000	38
Rice processing; sugar, toddy and other food industries	88,000	11
Work with lacquer and bamboo, cane, and other woody materials	80,000	10
Tailoring, shoemaking and other industries of dress	80,000	10
Silk spinning and weaving	56,000	7
Carpentry and furniture making	40,000	5
Wood cutting and charcoal burning	32,000	4
Jewelry and ornament making	24,000	3
Tobacco manufacture	24,000	3
Metal working—blacksmiths, etc.	24,000	3
Ceramics	24,000	3
Timber sawing	8,000	1
Building industries	8,000	1
Match, oil, soap, paper, and other chemical product industries	8,000	1
Total	800,000	100

The indicated total of 800,000 workers presumably includes some but not all working dependents and workers who had a principal employment other than in small-scale industry. The actual total including all such workers is probably in the neighborhood of one million. This suggests that approximately 75% of all industrial workers and perhaps 12% of the total working population are engaged in small-scale manufacturing or processing for at least part of the year.

The typically small number of days worked per man per year and the low productivity of labor in small-scale industry to some extent also characterize the large agricultural and trade sectors. Likewise, the aggravation of these factors by the present depressed state of activity is widespread. Nevertheless, there are indications that annual production per worker in small-scale industry is somewhat below the national average for all economic activity. This means that the proportion of total national output and income which is produced by small-scale industry is less than 12%, i.e., less than the proportion of total workers who participate in small-scale industry. It is probably in the neighborhood of 10%.

A type of economic organization which is employed in the production of a broad variety of goods, which is widely dispersed geographically, which provides some employment to more than one out of eight workers, and which produces about 10% of the nation's output and income is obviously an integral and important part of the present economy.

2. PROSPECTIVE FUTURE ROLE OF SMALL-SCALE INDUSTRY

The ability to supply limited local markets with perishable or bulky commodities, to produce individualized artistic products, to employ part-time labor, and other special characteristics make small-scale production the most suitable form of enterprise in certain areas of production. It is sometimes assumed that wherever large-scale factory production can turn out more product per man-hour than small-scale industry, after allowance for the cost of operating the machinery, factory production is economically and socially advantageous to small-scale production. This conclusion is not tenable. There are many persons eager for work who can accept it in their villages, in many cases for only part of the year, and whose lives will benefit by the work, but whose family circumstances are such that they cannot be drawn to a factory, even at wages two or three times their earnings in small-scale industry in or near their homes. In other cases, the workers can be drawn to factories, but the social costs of the disruption of community life are great. In these circumstances, small-scale industry provides employment which is socially and economically advantageous to the country.

Still, a much larger part of total industrial output than is now the case could advantageously be produced by large centralized enterprises. However, whatever the direction or extent of economic development in Burma, common sense and historical experience elsewhere indicate that introduction of such large-scale production as is economically and socially advantageous takes considerable time and is never fully realized. Movement in this direction is a gradual process. The elements of such a change—technological re-organization not only in industrial production but also in transport, trade, and other sectors of the economy which have to be suitably expanded and modified, capital accumulation, and concentration, mobility and re-orientation in aptitudes of the labor force—are long-run evolutionary processes. They can be speeded along by such plans and proposals as are incorporated in this Report, but the development program cannot rapidly transform the economy into one of large-scale plants, intensive mechanization, high-level productivity and resulting high-income jobs.

Small-scale industry will continue to furnish to many workers higher income employment than any alternative available to them. It will be a source of output to meet local needs which could not otherwise be fulfilled. This will be true for a great many years, though in gradually lessening degree. Its importance will begin to decrease relatively to other sectors of the economy only as the number and diversity of sizable manufacturing plants substantially increase in Burma. Actually, small-scale industry has certain features which will make its expansion desirable for some years to come.

3. SPECIAL IMPORTANCE AS SOURCE OF EMPLOYMENT FOR SEASONAL LABOR

Additional importance attaches to this form of economic enterprise because, in view of its limited requirements for capital, organization and highly trained labor, it can, to a very large extent, be operated intermittently. It therefore can, and does, provide supplementary employment to some part of the large seasonal labor force which would otherwise be idle for a large part of the year.

Seasonal unemployment in Burma is attributable mainly to the agricultural cycle. Of the agricultural labor force, an estimated five million workers are potentially free of cultivating duties for part of the year. Not all are available for employment in small-scale industry. Some are firmly content with or insist upon remaining idle. Some, especially in inaccessible backwoods areas, are not otherwise employable because of geographic and occupational immobility. A few find complementary seasonal work in large-scale industry. (A prewar study indicated that employment in the largest industrial outlet, rice-milling, whose peak and trough roughly complement those of agriculture, varied over the year by only some 30,000 workers. The seasonal variation for the larger enterprises in rice, cotton and saw milling, petroleum extraction and refining, mining and in public administration, combined, was of about the same magnitude.) A relatively large number of cultivators and hired farm workers could be absorbed in seasonal public works projects, such as roads, bridges and buildings. Brief and intermittent employment is and will continue to be found in collection of various kinds of forest produce, carting, boating and miscellaneous casual labor, as on the docks. A good many engage in petty trading or do odds and ends of other useful work intermittently, but very few of these can be properly considered as effectively employed. Extension of double-cropping by means of irrigation will reduce the available number of seasonal agriculture workers. However, making maximum allowance for all these factors, including future expansion of manpower needs, it is estimated that a pool of up to two million workers remains, which cannot be employed during the off-season in any reasonably productive manner other than in small-scale industry.

This two-million figure represents only agricultural workers free in the off-season; it does not include other types of seasonally unemployed workers or those who, for whatever reasons, are obliged to seek their main means of livelihood in small-scale industry. It is abundantly clear, therefore, that compared to the estimated one million workers of all kinds who now participate in this sector of the economy, the number who could and would be willing to be so employed and who have no alternative job opportunities in prospect, at least for a large part of the year, is far larger. This suggests the desirability of rapid expansion of small-scale industry in the Burmese economy in the immediate future.

B. POLICIES FOR DEVELOPMENT OF SMALL-SCALE INDUSTRY

The problems which must be overcome to improve and expand small-scale industrial enterprises largely overlap and can be considered together. Because this sector of the economy is made up of small, isolated production units, using diverse raw materials and techniques and often operated intermittently, it is a natural "problem area." Under existing economic conditions, it faces "critical" problems running the gamut from procurement of raw materials to disposition of end product. This has often led to the proliferation of exhaustive and complex schemes for thoroughgoing reconstruction of small-scale industry. However, the same conditions that create these problems render their solution especially difficult and elusive. To attack them all individually would exhaust the administrative talent and energy at the disposal of the Government, and would yield exceedingly small returns for efforts put forth. Indeed, the economic cost would probably be greater than the gain. The most feasible approach is to focus attention on fostering certain key developments which will act as catalysts for further improvement. In broad terms, these consist of extending the market for products of small-scale industry, stimulating cooperative organization for self-help purposes, providing adequate credit facilities, and providing cheap electricity for power. In addition, certain direct steps to improve productive methods can be helpful. Specific policies for effecting these developments are discussed below.

1. EXTENSION OF THE MARKET

The greatest single inducement for expansion and improvement of Burmese small-scale industry is to be found in an increased demand for its products. The degree of expansibility—in the form of unused resources, native ingenuity, spirit of enterprise, and the knowledge or the ability to acquire independently knowledge of better methods—which now exists on the production side is sufficient to meet a very large increase in demand without specific aid from the Government. Small-scale industry is operated by individual enterprises. Their best abilities are induced when there is a market for their goods.

By far the greatest opportunity is offered by the home market. Conventional products of small-scale industry cannot generally compete in price or quality in foreign markets. The foreign market for specialty items is small, demanding, and unstable, and only a few Burmese products would be suitable. Any major effort in the direction of exploiting foreign markets would produce disproportionately small returns.

The stimulation of domestic demand in general through enlarging purchasing power and the money supply is desirable on many grounds. It requires broad policies discussed elsewhere. The demand for products of small-scale industry will increase in full measure with such an increase of income and demand in general.

Some of the current demand and more of the potential demand for products of small-scale industry in Burma cannot be exploited because of inadequate internal transportation and communication facilities and sales services. Local resources, traditions, and other factors make for considerable specialization within Burma both in products and qualities. However, trade between the regions of the country is frustrated by the inaccessibility of distant markets and absence of convenient sales outlets. Many distinctive and seemingly marketable items produced elsewhere in Burma are not even available in the large Rangoon market. As a result production is largely orientated to restricted local demand; often to traditional customers plus occasional special orders.

The long range benefits which would accrue to small-scale industry from the development of a cheap efficient network of road, rail and river transport and of rapid communication are incalculable. The extent of the network must not be limited by the requirement that it be self-supporting immediately. The expansion of activity which will eventually increase transport and communications revenues must await the prior provision of these services themselves. The stimulus to small-scale industry and to all other sectors of the economy as well, and the political and social effects of binding the Union together, justify investment and current operating costs in these fields far beyond those justified by immediate direct financial returns. A broad program for the needed development of transport and communication facilities is outlined in Parts IV and V of this Report.

The organization of sales services in Burma is primitive. Competition and local knowledge insure that the profit margin exacted by the marketer of products produced within a small community for the local market is held to a minimum. But such non-local trade as exists in the products of small-scale industry follows inflexible, traditional channels, and is typically in the hands of monopolists, many of whom exact very heavy margins. The principle of high unit margins rather than high volume is advantageous to the individual monopolist. The resulting high prices discourage sales, while the low returns to producers minimize incentives to production.

The need for government action in this field has long been recognized. Even in prewar days, aid in marketing as well as in procurement of raw materials and equipment was provided to the important weaving industry through a "Burma Handloom Textile Depot," which had a working capital of K40,000. In 1948 this was reconstituted as the "Central Procurement and Marketing Depot" with the aim of providing such aid to all small-scale industries. However, it has only the barest minimum of staff and facilities and only K20,000 available as working capital. Consequently, its activities have been limited to advice on supply sources and prices and occasional procurement of a small amount of critically needed materials and equipment, primarily for a few cooperatives and industrial associations. Marketing operations are virtually non-existent.

Even in its original conception, the depot does not begin to meet needs. The marketing function, by itself, warrants treatment as a major project. This would take the form of bulk purchase of small-scale industry products from organizations of producers, preferably cooperatives, and the display and large-scale sale of such products, both wholesale and retail.

To provide the necessary autonomy and flexibility for commercial operations, such a project should be conducted outside of the framework of conventional governmental administrative and budgetary procedures. Precedent is found in the various Government trading boards, the Civil Supplies Board offering the nearest parallel. Which Government department would exercise nominal control is a matter of administrative expediency. At the outset, it would seem advisable to continue to place responsibility for marketing of small-scale industry products with some branch of the Ministry of Industry. In any case, the governing board should consist of representatives of all interested agencies, including the appropriate branches of the Ministries of Industry, Commerce, and Cooperation and Commodity Distribution.

As a first step, such a board should be constituted to make a brief study of the problem (including perhaps an investigation of the operation of the large Government retail store in Bangkok), and then to organize and place into operation a large emporium in Rangoon. Both the desirability of immediate action and need to gain experience dictate that the original enterprise should not be too ambitiously planned—in terms of buildings, facilities, and even scale of operations. For example, it should not initially match the establishment at Bangkok. However, the scale should be that of a large commercial enterprise to give the project an adequate trial and to provide realistic experience in such operations.

If an increasing volume of sales is successfully promoted by making the products readily and cheaply available, and without Government subsidy of costs after full operation is reached, the program should be gradually expanded to cover other large population centers. The extent of Government activity in this area should be determined by the achievement of the results desired. A relatively small participation may be sufficient to "pitch" the market to reasonable and stable price levels and to prod private trade into more efficient practices. As cooperative organization matures, it will be desirable to transfer such activity to a federation of producer cooperatives. Experience elsewhere indicates that effective cooperative production requires organization in the marketing field as well. In the meantime, governmental activity in this field will promote the further development of cooperatives which is necessary before they can take over.

Such a project would contribute indirectly but effectively to the solution of other problems for which direct measures are not presently feasible. Large orders and regular marketing would foster stability in prices and output, and promote uniform quality and standard weights and measures. Unreasonable middlemen profits would bc reduced, including the large interest element for carrying stocks until they are sold. The marketing agency would also be in an excellent position to help in channeling cheap Government credit to small-scale industry. The resulting greater returns to producers would stimulate production and both encourage and enable them to introduce new techniques and to acquire capital equipment, even on their own account.

2. DEVELOPMENT OF COOPERATIVES

The tiny size of small-scale enterprises tends to render them permanently "backward" unless they are integrated in some way. Governmental aid cannot be effectively applied at each point of operation, and individual resources and know-how are ultimately inadequate for independent progress. The most hopeful path for realizing most of the reforms needed is association of enterprises with similar interests along cooperative lines. These associations can serve as agencies for bulk purchase and marketing, financing, standardization, and introduction of new techniques. They can initiate such activities spontaneously and also serve as channels through which Government action is funneled and organized. A by-product would be the greater ease with which Government could obtain data for ascertaining needs and for checking on progress.

The problems involved in cooperation are numerous and complex: education in cooperative techniques, active member participation, training of officers, internal financing, administration by a properly staffed organization for the larger cooperatives. Cooperative growth must proceed gradually, apace with the solution of these problems. However, "growing pains" are inevitable, and minor errors and difficulties should not deter vigorous promotion of this basic organizational change needed in small-scale industry.

3. PROVISION OF CHEAP AND READILY AVAILABLE CREDIT

Very few individual small-scale enterprises have enough capital to finance ordinary operating costs, much less expansion and improvement of capital equipment. In the absence of other sources of credit, chief reliance is placed on "loan sharks," particularly middlemen who provide raw materials on credit and, often as a condition for such credit, obtain the finished products. Their monopoly position enables them to levy exorbitant charges and to keep small operators in a state of virtual peonage. At the lacquer center of Pagan, for example, loans are made at the rate of 3% per month, and are restricted by the requirement of gold collateral (jewelry with a gold content of twice the value of the loan).

Loans from commercial banks or other private agencies at reasonable rates are inaccessible. Independent financing by cooperatives on any sizable scale is a long way off. Government credit to date has been inadequate in amount and has involved complex procedures. In the case of loans to weavers, for example, 27 field supervisors investigate applications and make recommendations to the Cottage Industry office, which, after processing and checking, forwards them to the district commissioners. At this level, final action is taken by a special committee headed by the district commissioner. The supervisors are responsible for collecting loans.

Under these conditions, the provision of cheap credit by Government represents a basic need which can be met immediately and with relative ease. Methods of channeling this credit to small-scale industries are discussed in detail in Chapter IV. Overall credit policy should continue to be formulated at the top levels of administration generally responsible for fostering small-scale industry. But individual loan transactions should be made on the spot by a special financial organization. The proposed credit organization would constitute a component branch of the Directorate of Industries re-organized as suggested in Section C of this chapter. It would open up loan offices only in areas where there will be a sufficient volume of credit demand to keep the administrative costs of loans low. These would be mainly in the larger urban areas. In other areas funds can be provided by the credit organization through the district branches of the State Agricultural Bank, or the Directorate of State Agricultural Credit.

4. PROVISION OF POWER AND EQUIPMENT

The provision of a cheap means of mechanical power is probably the most useful single contribution which can be made toward creating an environment favorable for continuing improvement in methods of production in small-scale industry. This has been a major element in industrial revolution elsewhere, and its potential effectiveness in Burma is foreshadowed by the eagerness and success with which mechanical power has been used when available.

Burma is fortunate in possessing the water and coal needed to develop rapidly a national grid for servicing the entire country with inexpensive electrical power. In addition to providing the indispensable basis for technological advancement in industrial production, which in Burma for some time to come signifies small-scale industrial production, the broader advantages of such a development—cultural, social and political, as well as economic—would be vast in scope. It follows, therefore, as in the case of transport, that cheap power need not be required to pay for itself immediately. The stimulus which new power projects would provide for small-scale industry alone should not be viewed as an incidental by-product, but as a prime rationale for their introduction. An appropriate power program for Burma is described in Part VI of this Report.

In cases where power equipment of certain types is unfamiliar, it will be desirable that Government supply pilot models. When the necessary organization can be created, standard items capable of widespread use such as sewing machines, power looms, wood- and metal-working machines (and certain kinds of non-power tools and apparatus as well) could even be supplied on a large scale under easy credit terms. Such aids would serve to accelerate the rapid technological transformation which would follow upon the provision of a cheap means of power.

5. DIRECT AID IN IMPROVING METHODS OF PRODUCTION

Methods of production in Burmese small-scale industry are primitive and inefficient. In the important handloom-weaving industry, for example, it is estimated that only about one fourth of the looms are equipped with the flyshuttle. In this and other cases, very small and simple improvements would produce quite remarkable results. However, small-scale industry consists of scores of different occupations and of many thousands of establishments scattered in villages throughout the country. The largest single industry or group of industries—cotton spinning, sizing and weaving—includes only about one twentieth as many workers as agriculture, but is scattered almost as widely throughout the country. The institution of such reforms in small-scale industry—by means of research, extension services, training centers, pilot plants and other devices—is therefore an extremely difficult and long range task. It is tempting to recommend an elaborate research service to learn of and test simple improvements and a corresponding extension service to carry demonstrations of them to small-scale establishments throughout the country; but it is believed that the problem of obtaining technicians who could do it effectively and of setting up and operating the necessary administrative machinery are such that the project would draw heavily on the scarce administrative resources of the Government and would not bring returns commensurate with its cost. The resources of the Government will be most effectively utilized if they are concentrated on promoting selected improvements which can most readily be introduced into widespread practice.

A United Nations Technical Assistance program intended to accomplish this purpose has been established. A team of 11 foreign technical assistants and several Burmese experts from the Cottage Industries office have instituted a program of technical aid to small-scale industry. Concrete plans have been made and in some cases implementation is under way for introducing improvements in the textile printing, power-loom weaving, sericulture, silk reeling, silk weaving and dyeing, pottery, handmade paper, sugar refining, and condensed milk industries. Two additional technical assistants will arrive soon to extend the program to the woodworking and electroplating and anodizing industries. The forms of aid vary and include the establishment of training centers, which in some cases will be built around complete pilot plants; establishment of research and development facilities; and on-the-job advice to existing enterprises. Primarily, the orientation is the introduction of new or improved production techniques and improvement in quality, design and pattern of the products. In some cases, attention is also devoted to marketing and industrial organization, especially cooperative organization. The significance of this program is enhanced by the fact that it is orientated to the immediate practical needs of the industries and to persons working or about to be working in them. For example, some 15 printers who have attended textile printing classes already have introduced the new screen-printing process in their establishments, and it is planned that sericulture trainees will be used for instruction and other work in implementing the three-year program for self-sufficiency in silk production.

Such aid can be made more effective if, having demonstrated the advantage of simple improvements in methods, the Government arranges to provide on credit the kit of tools or set of equipment needed to put them into practice. This has been suggested above in relation to the introduction of power; there is no reason why it should be limited to the introduction of power tools. Such a program is however subject to abuse and waste; handling it is one of the processes which requires the detachment from other duties of an administrator of ability. Without proper administration the program could be costly and ineffective. It is believed that this selective aid can be of great value. To attempt to elaborate it into a full-scale extension system for all small-scale industry is however not recommended.

C. IMPLEMENTATION OF POLICIES FOR DEVELOPMENT OF SMALL-SCALE INDUSTRY

Responsibility for governmental encouragement and control of small-scale industry is mainly in the hands of the Directorate of Industries, within the Ministry of Industry. The growth of cooperatives tends to increase the role played by the Cooperative Societies Department of the Ministry of Cooperation and Commodity Distribution. The coordination of the activities of these two agencies towards the end of fostering common goals will require increasingly closer liaison. The establishment of a permanent joint committee to insure mutually consistent plans and, as far as possible, mutually exclusive fields of operation would serve a useful purpose.

Within the Directorate of Industries, work in connection with small-scale industry is presently carried on directly by the Directorate itself and by two sub-agencies The Directorate of State Aid to Industries and the Office of the Superintendent of Cottage Industries with its several sub-departments. The allocation of duties reflects the gradual accumulation of new functions and their superposition on the previous structure. The result is that responsibilities and powers are not clearly defined and that some activities are duplicated while others are inadequately provided for. The system of loan administration discussed earlier is a case in point. The observations in Chapter VI concerning the need for internal restructuring of governmental agencies are fully applicable here and a reorganization of this important department is recommended.

The Directorate of Industries is responsible for industrial development as a whole including large-scale industry. However, for a long time to come, the latter will consist of relatively few enterprises, whose actual operation in any case will be under the aegis of the Industrial Development Corporation. Other Burmese industry can be treated together for purposes of governmental aid and administration. This suggests that sections of the Directorate of Industries should be organized along functional lines, each responsible for a specific major program such as planning, research, credit, technical aid and procurement of supplies and equipment, training, inspection, marketing, and collection of information. Existing staff could be concentrated in a section concerned with the highest priority programs; other sections would be built up over time. With each such section reporting directly to the Director, integration and implementation of plans for industry as a whole would be promoted. Functional specialization would have the particular advantage of rationalizing the use of Directorate personnel, an important factor in view of the chronic shortage of staff. The necessity now of combining divergent duties in one man or section could be partially reduced by eliminating duplication of certain activities among sections.

The planning and implementation units recommended for each major governmental agency in Chapter VI will have very important roles to play in the Directorate of Industries. Effective work by these units will require much more information than is now available concerning the small-scale industry sector of the economy. Comprehensive statistical data for this sector are particularly difficult to collect and interpret. However, selective surveys and field studies can be very useful when existing information is so scarce. Consequently, a special section within the Directorate of Industries should be adequately staffed so that it can undertake collections of statistical and other information of the highest priority.

The personnel problem requires immediate and direct attack. The present staff can hardly keep up with existing routine activities, much less expand its program, engage in long range planning and exploratory work, and collect necessary data. The policies for development of small-scale industry suggested in this chapter were based to a great extent on the fact that only limited administrative resources would be available for a long time to come. However, additional activities of any kind could not be successfully sponsored with present staff, nor with the addition of only a few more persons. Special training is unavailable for administrators in this field. The only course is to recruit a growing number of energetic persons of good intelligence and an interest in this type of work who will acquire experience on the job. These large, general personnel requirements cannot be met with foreign technicians. However, the latter can be of great value in helping to set up programs and train staff. Industry specialists also can help to meet some of the specific needs of individual industries, such as introduction of new techniques.

D. SUMMARY OF RECOMMENDATIONS

1. Improvement of transportation and communication and development of cheap electric power should be accelerated for their effect on small-scale industry as well as on the economy generally.

2. A test should be made by the Government of the effect on the market for products of small-scale industry of quantity purchase and marketing. If successful in stimulating sales of products from other sections of the country in the Rangoon market, this procedure should be expanded.

3. The Government should encourage the orderly growth of cooperatives as agencies for bulk purchase and marketing, financing, standardization, and introduction of new production techniques in respect to small-scale industries.

4. The Government should establish an expanded system for directly providing cheap credit for small-scale industries.

5. The Government should assist in making electrically-driven and other tools and equipment available to small-scale enterprises.

6. Present technical assistance programs for improving production methods of Burmese small-scale industry should be continued.

7. The Ministry of Industry and Ministry of Cooperation should, perhaps by creation of a joint committee, establish a closer liaison in respect to small-scale industry matters. Reorganization along functional lines of the sections of the Directorate of Industries dealing with small-scale industry and clarification of lines of authority is also desirable.


THAILAND
INDO-CHINA
GULF OF SIAM
ANDAMAN SEA
YUNNAN (CHINA)
THAILAND
ASSAM (INDIA)
BENGAL (E.PAKISTAN)
BAY OF BENGAL
20 0 20 40 60 80 100
SCALE IN MILES
MINISTRY OF NATIONAL PLANNING
RESERVED FORESTS OF BURMA
KNAPPEN TIPPETTS ABBETT ENGINEERING CO, NEWYORK. RANGOON
DR BY.
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PLATE NO. 1

CHAPTER XXIV

FORESTRY AND OTHER INDUSTRIES

A. FORESTRY

The forests of Burma comprise one of her greatest assets, and the exploitation of forest products one of Burma's potentially most useful industries. The status and composition of the forests, the present arrangements for forest management, and data on present consumption of forest products were given in the Preliminary Report. Projects for the further exploitation of a few specific forest products are discussed in Chapter XXII of this Report. Additional information is presented here regarding extraction, milling, and commercial utilization of both teak and other woods. The forest reserves of Burma are shown on Plate 1.

1. CONSUMPTION

a. Teak

For teak, available information indicates that the sustained extraction is approximately 400,000 cubic tons of round logs a year. The total will exceed this because all dead and windblown trees will be taken out as encountered. During the war years no normal extraction operations were carried on. The only teak extraction was performed by the occupying forces for military needs. Because of the limited extraction in recent years it would be theoretically admissible to exceed the normal sustained-yield figure for a period of ten years during which up to 500,000 cubic tons could be withdrawn without any harmful effects on the forest reserves.

Practical considerations however set effective limits on teak extraction. Security conditions constitute such a limitation. Equally important, perhaps, is the limitation set, under present methods of extraction and transport, by the number of trees girdled.

A girdled teak tree must be left standing at least three years before being felled and extracted, and extraction and transport to mill take another three years. The backlog of girdled standing trees should therefore be in the neighborhood of two and a half million cubic tons of round logs to support a sustained yearly flow to sawmills of 400,000 cubic tons. The present backlog of girdled trees does not exceed 1·2 million cubic tons.

Extractions for the year 1952 53 are estimated at about 80,000 cubic tons and new girdlings at 60,000 tons, so that even at the present reduced rate of operations the backlog of girdled trees is decreasing instead of rising. Unless methods of transporting logs shift from flotation to barge, rail, or truck—and it is by no means clear whether such a shift is feasible and economic—a marked and immediate step-up in the amount of trees girdled is vital not only to the achievement of output targets in the teak industry, but even toward the sustaining of current output levels. Under present security conditions this can probably be accomplished best by a reallocation of security forces as between girdling and extraction in order to restore balance between them. For the time being, this would favor girdling. As security conditions improve, the emphasis on girdling should be maintained until the backlog of "fellable" trees reaches a point where it can continuously support the extraction level contemplated.

b. Non-teak Hardwoods

With respect to non-teak hardwoods, studies made in the last three years have indicated that the utilization and extraction of such hardwoods can be greatly expanded. It has been estimated that 130,000 cubic tons of durable, 560,000 cubic tons of semi-durable, and 50,000 cubic tons of non-durable hardwoods could be used for the year 1952 53. For the year 1959–60, approximately 190,000 cubic tons of durables, 640,000 cubic tons of semi-durables, and 60,000 cubic tons of non-durables could be consumed.

2. EXTRACTION

a. Elephants

For the past 100 years, Burma has been working her forests almost wholly with animal power, particularly trained elephants. In 1941 it was estimated that approximately 5,000 well-trained elephants were used in the extraction of timber. There are now about 3,000.

To have sufficient power to meet the indicated demand for round logs will require immediate steps to develop additional power sources. One possibility would be an intensive program for training work elephants. However, it is questionable whether enough elephants could be trained to support the planned expansion. For this reason it now seems advisable to supplement extraction process by additional mechanical equipment.

b. Personnel

At the time of the nationalization of the timber industry, there were approximately 4,800 persons engaged in extraction. These were all specialized, experienced and trained personnel. There are at present about 4,000 persons in the extraction department of the State Timber Board. It is estimated that there are available in Burma about 600 trained extraction specialists available to the Board. The Board considers that this number would be sufficient to produce the required amount of round logs. When a training and experimental program of mechanical extraction is established, it will be necessary to train men in new techniques of extraction.

c. Mechanization

There are many features of mechanization that can contribute greatly in acquiring a more efficient and expanded extraction. Increased mechanization of extraction will require more roads that will withstand the monsoons and the rough treatment from mechanical equipment. Such roads will be needed not only to transport logs but also to bring in fuel, supplies and parts. Expansion of Burma's general network of roads must also be closely coordinated with the exploitation of forest reserves.

Dr. Ing. K. A. Miedler, FAO forestry officer, has made recommendations which include a list of equipment for a proposed experimental and training extraction unit. This list proposes: tractor yarding equipment, loading equipment, trucks, special equipment, power saws, babbitting tools, and spare parts. The total estimated cost of this equipment is between $165,000 and $200,000. The State Timber Board Extraction Department has at present 15 pieces of old army surplus equipment comprising D–4, R 4, and D–8 tractors in use at two forest reservations. This equipment is in very poor mechanical condition with practically no spare parts available. Operations are therefore much handicapped by breakdowns and delays.

There are no data or figures available that would give a realistic or reliable cost of mechanical extraction in Burma. It is believed that mechanical extraction can in many areas be substituted for animal power with resulting savings. It is therefore urgent that a definite program be implemented for studying the possibility of expansion. Along with mechanization, consideration must be given to roadways that will be needed. The major considerations here must be the degree of permanency of the roads and the gross weights they will be required to carry (see also Chapter XIV).

d. Reserves

The annual extraction of 400,000 cubic tons of round logs of teak would require working approximately 160,000 acres of reserved forest areas. A larger market for semi-durables, non-durables, and others will make it advisable to extract these woods when extracting teak, thus permitting a larger volume of total extraction from each area. With due allowances, this would mean working approximately 200,000 acres or roughly 320 square miles.

e. Roads

It is almost impossible to estimate the mileage of roadways that may be required. By the expanded use of mechanical extraction it would be advantageous to do as much logging in the dry season as possible, requiring less wet weather roads to be built. The cost of the necessary roads for logging would have to be considered in the costs of mechanical extraction. It is estimated that the average cost of a mile of suitable roadway to withstand at least one wet season would be approximately K14,000.

f. Railways

In some reservation areas the use of a light railway line might be advantageous in that such a line can be operated during wet weather. This line could be built from used rails and materials. Such a light railway line could be constructed in extraction areas for the period of maximum extraction, then re-laid in other areas for working these until completion. In this manner, such railway materials can be used to the greatest advantage in conjunction with proper extraction cycles. It is estimated that by using 50-pound used rails and fittings, priced at 50% of the cost of new materials, a mile of such railway could be laid for about K70,600.

To these costs should be added the cost of suitable railway carriages to transport the logs as well as motive power to move them. About ten carriages priced at K30,000 each or a total of K3,00,000 would be required to transport the logs. The motive power for drawing these carriages is estimated to cost K1,00,000. If such a railway is to be used, these costs, like that of roadways, should be added to other costs of mechanization and charged against extraction.

g. Transport to Mill

The most important requisite for an economical and fully utilized timber processing operation is a continuous flow and adequate supply of logs from forests to sawmills. This supply must be uninterrupted and carried on in the most expeditious and economical manner. The location of the logs in the forests is quite distant from plants that process the logs into merchantable lumber. In many cases it is not practical to transport from forests to sawmills by railroad due to the inaccessibility of the forests. The most advantageous method of transportation for Burma may continue to be, as in the past, log raft flotation.

h. Stream Utilization

Agriculture and irrigation projects may affect future extraction and logging operations through the construction of storage dams. The economy of Burma as a whole must be taken into consideration when these stream uses are planned. Proposed dams are located on the following rivers: Mu (north of the existing diversion dam), Thitson, Sinthe, Yezin, Paunglaung, Nagalaik, and junction of Swe and Saing. The dams located on the Thitson and Yezin Rivers do not affect the logging facilities in any way.

The other dams would naturally affect the logging, and sluices should be constructed at the dams to facilitate the floating of logs. At some dams it may be necessary to have mechanical means of handling logs over the dam to permit log flotation.

3. POTENTIAL DEVELOPMENTS

a. Timber Treatment

An important factor affecting the supply of merchantable lumber is the extent to which non-durable and semi-durable woods are treated. In the light of findings of one of the largest chemical manufacturers of the United States, a company which has specialized in chemical treatment of woods, it is recommended that the semi-durable and non-durable woods of Burma be chemically treated so that a better utilization of these species can be achieved.

(1) Penta-WR, or its equivalent, is recommended for:

(a) Protection of wood against attack by decay, mold, mildew, termites and lyctus beetles.

(b) Effective control over dimensional changes such as swelling, warping, shrinking and grain raising, resulting from changes in moisture content of wood. This chemical can be obtained in concentrated form and made into ready-to-use solution by adding three or five parts by volume of naphtha, mineral spirits, or similar petroleum solvents.

The treatment of the wood can be performed by immersion in vats or tanks for a minimum of three minutes depending on the use that is going to be made of the wood. For lumber to be used under severe conditions of exposure, as in steps, porch floors, or wood continually exposed to the weather, a considerably longer soaking period and heavier absorption is recommended. Sills, joists and structural timber should be soaked in the solution until substantially all of the sapwood is penetrated.

The amount of solution for treatment of the woods will naturally vary in accordance with the sizes of the lumber and the amount of absorption required. It should be noted that gallons as herein referred to are on the basis of United States gallons. The dosage can vary between an estimated four gallons and ten gallons per cubic ton of converted lumber. From the prevailing costs of this chemical in the United States it is estimated the solution, mixed ready to use in Burma, would cost approximately 23 cents or K1.09 per gallon. This preservative material might therefore cost an average of perhaps 7 $\times$ K1.09 or K7.65 per cubic ton of lumber.

The prevailing cost f.o.b. Rangoon of average local merchantable teak is K500–800 per cubic ton; for average durables it is K475 per cubic ton; for semi-durables, K400 per cubic ton; and for non-durables K200 per cubic ton. From these figures the desirability of treatment of these other less merchantable woods can readily be seen.

(2) Penta preservative or its equivalent is recommended for:

(a) Protection of wood in soil contact or above ground in open exposure.

(b) Effective protection for wood poles and posts of all kinds and other totally exposed uses. Like the Penta-WR, this preservative can be purchased in concentrated form and diluted with up to ten parts by volume of a readily available solvent.

The treatment of woods with this preservative can be performed by dipping or in pressure vessels depending on the penetration and absorption of preservative required. The amount of solution that will be required will vary. It is estimated that the dosage will vary between 7 gallons and 17 gallons per cubic ton of timber. The prevailing costs of this material delivered in Burma, mixed ready to use, will be about 19 cents or K0·9 per gallon. The material would cost an average of perhaps 12 $\times$ K0·9, or K10·8 per gallon.

b. Standardization

Standardization of dimensional lumber would be a great stride forward in the lumber and construction industries and would expand effective markets. When standard dimensions are established all lumber can be produced to these measurements and stocked to be used as needed. Labor would be saved in wood framing by having nominal-sized pieces from all mills uniform. Floor joists, partition studs, roof rafters and similar elements could be assembled without the additional labor required when the pieces are not uniform. Under present procedures of sawing and marketing, the following are accepted practices: (1) "Full Cut" where the pieces are cut to plus one eighth inch of the dimensions as called for; (2) "Exact Cut" where pieces are cut to the exact dimensions as called for; (3) "Scant Cut" where the pieces are cut to minus one eighth inch to a quarter inch from dimensions as called for. Fixed standard dimensions should be set for domestic merchantable lumber graded as to species and quality.

4. SUMMARY

The reserves of timber were long ago recognized by the Government as essential to its economy, and controls and reservations for conserving these natural resources were set up as early as 1856. Burma has for many years depended on this industry for most of its construction material and for its exports of wood. Many surveys, investigations and reports have been made by the Forestry Department and the State Timber Board with plans and recommendations for improvements. The urgent need at present seems to be that some of these plans and recommendations be implemented as soon as possible.

Decisions and implementation are first required with respect to extraction: (a) in regard to animal versus mechanical power; (b) with respect to an expanded program for utilization of many species of woods other than teak; (c) with respect to the development of turpentine and resin extractions from pines of the Shan States; (d) with respect to the collection and proper processing of lac for both export and domestic use; (e) with respect to better utilization of mangrove by using the bark for tannin extractions and the remainder for a distillation plant to produce industrial charcoal and many other chemical by-products. These projects have been recommended under their different headings in the manufacturing section.

B. OTHER INDUSTRIES

Preceding chapters have presented plans for productive projects in mining, manufacturing, industry, irrigation, power, transportation, communication and agriculture, involving total expenditures of K2,950 million during the next seven years. The projects planned in agriculture will directly affect only a small part of that industry. Agriculture in general and small-scale industry have also been discussed, but without project proposals, since investment in these fields will in the main be unplanned private investment.

The term investment or capital formation is apt to create mental pictures of mining or manufacturing power or irrigation, transport or communication, since these are the fields in which large aggregations of physical capital are necessary. It is important to realize that investment only in these fields would leave the development program seriously incomplete; would leave it like a structure with foundation and supporting pillars and beams, but without walls or roof. In any economy, the services performed by other industries form an essential and quantitatively important part of the processes of production and consumption; and capital formation in them forms a large part of all capital formation.

It is worthwhile to enumerate the fields of economic activity not encompassed by the planned projects. They include cottage industry and a large part of agriculture. In transportation they include the operation on inland waterways of private boats, which in the aggregate probably haul twice the volume of freight hauled by the Inland Waterways Transport Board; and the operation of buses, trucks and carts. They include all wholesale and retail trade, that is, the entire distribution and sale of the country's production other than the part exported by state enterprises. They include the entire range of private, personal and business services, legal, technical, educational, the services of hotels, restaurants, barber shops and similar establishments, motion pictures and other entertainment, and repair and maintenance services of many kinds. They include community services such as water supply, sanitation, fire protection and street improvements; housing, a very large sector; and the social services provided by the Government, which in addition to public housing include education and health and medical services. In addition there are many minor occupations and industries.

How important are these fields in the aggregate in Burma? The year 1931 is the last date for which data giving this information are available. In that year, about 70% of the labor force were engaged in agriculture. About 10% were engaged in trade and professional and miscellaneous services; about 10% in small scale industry as the major occupation; not quite 3% in education, medicine and religious practice; and not more than about 7% in all other fields.

The proportion in agriculture is perhaps smaller now, because insecurity prevents full-scale cultivation; and the proportion in services maybe somewhat greater, because many workers have drifted into unremunerative services for want of other employment. When civil order has been fully restored, the proportion in agriculture will probably be as large as before the war, since employment opportunities in non-agricultural work have not increased more than in proportion to the increase in the population and labor force. The number in services will decrease as other opportunities for employment draw off the underemployed from petty service occupations. The 1930 ratios may be taken as roughly indicative of a present "normal" situation.

They indicate that in all of the non-agricultural fields in which planned projects have been proposed, less than 10% of the labor force will be employed in the near future. The irrigation and other planned projects will affect only a fairly small minority of the total labor force in agriculture. The significance of all of the planned projects is not in the total number of workers whom they will directly employ, but in their services to the entire economy, and in their steadily increasing share of the nation's output.

Rounded and balanced economic development must allow for a large volume of investment in the many fields other than those for which planned productive projects are appropriate. For this reason investment in planned projects of K2,950 million during the next seven years is recommended, a little less than 45% of the estimated net increase in the country's capital during the period. It is estimated that during the same period K3,650 million, or more than 55% of the total increase in the country's capital, will occur in unplanned productive projects and in community facilities and the social services.

The remainder of this chapter discusses briefly the sectors in which the 55% of total net investment will occur.

1. AGRICULTURE

In agriculture, unplanned investment will consist of construction or purchase of tools, machinery and carts, and in improvements in the land itself. To a larger extent than is commonly realized, agricultural land is the product of human labor; labor which clears the jungle and levels the land and constructs large and small embankments, roads and paths, and irrigation and drainage ditches. New agricultural methods, quite apart from sharp changes brought about by irrigation and large-scale mechanization, will involve a steady increase in the tools andmachines per worker. Such capital formation will go on throughout rural Burma; it will contribute to the nation's rising output.

2. SMALL-SCALE INDUSTRY AND UNPLANNED MANUFACTURING INDUSTRY

Whether small-scale industry will employ an increasing or decreasing proportion of the nation's labor force during the next several decades can hardly be foretold. Some production will shift from cottage to factory, but on the other hand, the increase in per capita income will increase the demand for handicraft products as well as other products. The net effect is uncertain, but it is certain that cottage industries will for an indefinitely long period play an important part in the nation's production. Here too improvements in methods will involve gradual increase in the equipment used per worker. This continuing investment must form an appreciable percentage of the nation's capital formation.

Unplanned investment in manufacturing industry will also be large. The planned manufacturing industry projects recommended will constitute only a fraction of total investment in this field; much more will be contributed by private manufacturing ventures.

3. UNPLANNED TRANSPORT, TRADE AND SERVICE

Perhaps 200,000 persons are engaged in transportation, in addition to those employed by the Burma Railways and the Inland Water Transport Board. They operate the large private freight boats and the smaller country boats on the rivers, the trucks, and buses and carts on the highways. About 600,000 are engaged in trade in foodstuffs, and an added 150,000 in other trade. These 950,000 persons vary in nature from the person who operates a small cart to a large trucker; from a streetside vendor to a large speculative holder of paddy or rice. The services which they perform include bringing the nation's locally grown food from farm or garden to the towns and cities; buying the staples, transporting them to market or storage points, storing them, and delivering them to urban retail markets; importing commodities not available domestically in sufficient quantity; wholesaling; buying from wholesalers, subdividing, displaying, selling in small quantities at retail. Without them economic activity would come to a halt.

The capital involved includes boats large and small, carts, buses, trucks, warehouses and retail stores. Individual establishments are small, but the total capital formation in the tens of thousands of them is large. Smaller in number, but important in the aggregate, are the establishments providing services to business and to consumers—lawyer's offices, barber shops, hotels, restaurants, motion picture theatres and a great variety of others.

The share of the labor force and productive facilities devoted to transport, trade and services, will not diminish as Burma's per capita income rises. On the contrary, as living standards rise, a higher proportion of consumer income will be spent for services and for commodities brought to the consumer by retail trade. A larger share of the labor force will become productively employed in service and trade industries. In the United States, at the other end of the world's per capita income scale from Burma, between 40% and 50% of all productive activity is in wholesale and retail trade, transportation other than rail and river transport, the social services, and the variety of other services referred to above. The long-term trend in employment will undoubtedly be a gradually diminishing proportion of the labor force in agriculture, and a gradually increasing proportion in manufacturing and in trades and services. The total capital formation required to expand unplanned transportation, trade and service facilities as the nation grows will be much in excess of that in any one group of the planned projects recommended in this Report.

4. COMMUNITY FACILITIES

The cities and towns of the country now suffer from inadequate water supply, below-standard sanitation, and lack of community facilities. In part this is because of destruction during war and insurrection, in part because of the influx from the countryside of refugees from civil disturbance. Some of these will return to the country, but there will undoubtedly remain in the towns a population considerably larger than that before the war, and one which will grow as urbanization proceeds. The capital formation needed to rehabilitate the towns and cities and keep pace thereafter with increasing population will be considerable in amount.

5. PRIVATE INVESTMENT IN HOUSING

Finally, housing and other social services will require as much investment as almost any industrial sector. There are more than 3,500,000 housing units in the country. An estimated one half of them (constituting of course much less than one half of total housing value) are of bamboo and thatch construction. They require replacement each three to five years so that annual investment of say one fourth of their value is needed merely to keep their number constant. Others are of mixed timber and bamboo construction. The housing problem is not merely to maintain the present number. The country's supply of houses is at least one tenth below the number required to provide even the prewar standard of housing. Many families are doubled up and large numbers are still living in crowded temporary shacks without proper sanitary facilities. Even if the Government made no expenditures to improve the quality of the nation's housing, gross investment in housing would necessarily be large. The Government is, however, taking vigorous steps to improve the quality of housing, which will increase total investment in this field.

6. SOCIAL SERVICES

The Government's program to improve the social services of the country will include large capital expenditures as well as large current expenditures. While this goal of increased welfare for the nation's citizenry can be achieved in large part through improved standards of living which will result from increased incomes generated by the development program, certain goods and services, particularly those required for housing and for such social services as education and health, will not be provided in sufficient quantities unless the Government takes positive steps to provide them.

During 1952–53 a large part of government capital formation took the form of social capital such as schools, housing and medical facilities. The 1953–54 economic budget provides for capital expenditures of K70 million for social services; an amount equal to about 12½% of the planned capital expenditures. In the construction of social services facilities, perhaps the greatest progress in 1952–53 was in public housing. Construction of schools and of hospitals and health facilities also progressed.

The need for expansion of the basic educational system as well as for programs for training the specialized manpower required to man the development program has been stressed in Chapter VII. At present between 800,000 and one million children of school age attend school. Of these less than 20% progress beyond the third standard. The schools are largely staffed by non-professional teachers and are short of text-books and other training equipment. The larger share of the students learn nothing more than the rudiments of reading, writing and arithmetic.

Even so, the average worker is better educated than in most parts of Asia. The fact that more than half of the adult male population is literate makes it possible to initiate programs for vocational training and adult education much more rapidly than with an illiterate population. The Mass Education Council, the Burma Translation Society, and the Adult Education University have made important progress in starting programs to effect cultural uplift of the population. The Technical Institute at Insein, the Artisan Training Centre in Rangoon, the Rehabilitation Brigade, the Lacquer School at Pagan and the Sanders Weaving Institute at Amarapura and other institutions described in Chapter VII have also made important contributions to the task of training manpower. The emphasis on vocational training and education in science which is being introduced into the school curriculum will prepare workers for participation in the development program. Work of all of these types on a greatly accelerated scale will be required if the personnel needs of the development program are to be met.

Similarly in the field of health the need for improvement is indicated by the high death rates and the widespread incidence of preventable diseases. Malaria affects about one half the population and is endemic in about three fourths of the country. Tuberculosis, which has ceased to be a major cause of death in most advanced countries is still one of the principal causes of death in Burma and an estimated 300,000 persons are in need of treatment. An estimated 100,000 persons are affected by leprosy. Infant and maternity death rates are five to ten times the rate in most advanced countries.

The Government plans for improving health conditions include programs for control of malaria, venereal diseases and tuberculosis, establishment of maternal and child health centers, expansion and improvement of hospital facilities, and improvement of sanitary facilities. With the technical assistance of the World Health Organization of the United Nations and the United States Technical Cooperation Administration, the Government has already initiated most of these programs and has made good progress.

As in other fields, expansion of social services will be limited by the shortage of specialized manpower and skilled workers. The 1931 census indicates that only 0·5% of the labor force was classified as medical practitioners (including unregistered healers) and only 0·3% as instructors. The present percentage is no doubt roughly the same. The number of trained doctors has probably declined since before the war as a result of the evacuation of many Indian doctors. Training of large numbers of doctors, nurses, school teachers, administrators and other professional workers will be required to carry through the currently planned program for social services.

Because investigation of the means of meeting needs for social services lies outside the scope of this Report, only this summary reference is presented here. Even cursory discussion, however, makes clear the large scope of the program which is desirable, and the fact that it must include a large amount of capital formation. It is estimated that of the K6,600 million of net increase in the nation's capital during the next seven years, K700 million, or more than 10%, should be in housing (public and private) and in other social services. The estimate is apt to prove too low rather than too high. The pressure for social services is more apt to cause them to encroach on the productive projects than to fall below goals set.

7. BALANCE AMONG FIELDS

Chapter II has referred to the need for balance among the various fields of investment, including balance between social service expenditures and others. Up to the present time the problem has been minor. Resources have been idle, and expenditure for one purpose did not need to involve less expenditure for another. But as the economy becomes more fully occupied, improved housing may mean less power plant construction; manning schools and hospitals may mean failing to provide skilled or professional workers for improved production to gain increased living standards. It will be necessary to balance the immediate benefit of better social services against the benefits of increased productivity which, if attained, will permit even better social services in the future. Fortunately the leaders of Burma are aware of the need for such choices, and are prepared to weigh one benefit against another in order to aim at maximum future welfare for the nation.

CHAPTER XXV

THE COORDINATED PLAN

A. SUPPORTING FUNCTIONS*

For the development plans and the operating functions of the Government of Burma to progress vigorously and successfully, they must be economically, administratively, and technically sound in both concept and execution.

1. ECONOMIC CRITERIA

Economic problems, economic policies, and procedures for budgeting and controlling the resources of the Union have been discussed at length in the opening chapters of this Report. Specific policies have been proposed relating to taxation, price control, the uses of foreign exchange, the provision of credit, and the functions of the Economic and Social Board, the Ministry of National Planning and Religious Affairs, and the operating ministries in refining and administering these policies.

The objectives of the economic policies and operations is to support and guide the investments of material wealth in such a way that increased productivity engenders an equitably distributed rise in living standards for the people as a whole, unmarred by the dislocations of inflation or depression. To achieve this objective will require constant vigilance, continuing analysis, and prompt adaptations to both domestic and foreign economic activity. The criteria for successful economic operations should be economic policies wisely adopted, wisely pursued, and wisely reviewed.

2. ADMINISTRATIVE CRITERIA

Administrative measures, policies and operations needed to insure the determined and imaginative execution of the development program have been outlined broadly in Chapters V through VII. Specific regroupings of organizations and improvements in management have been proposed also in the chapters dealing with communications, industry, transport, irrigation, power and agriculture. There remain to be emphasized a few administrative practices and services needed to support healthy progress in all areas of the program.

*The comments in this section are in part an extension of the discussion of Government administration in Chapter VI. They arise out of the materials of Chapters VIII-XXIV, prepared in main after Chapter VI had been completed.

a. Service Tradition

There should be instituted a carefully developed plan for establishing and maintaining pride in organization and traditions of service. There should be composed a code of civil service practices dealing both with relations between government employees and the public and with the relations between employees and their supervisors.

Code of Service

A code designed to promote efficient service, to improve public relations, and to strengthen the effectiveness of leadership might well be documented and distributed throughout the government service. Emphasis should be placed on a few fundamentals with illustrations of their application; for example:

Specimen Paragraphs for a Code of Service

(a) An employee of the Government of the Union of Burma is the agent of the people of Burma. His dealings with the public will be conducted in a spirit of courtesy, helpfulness, and pride in the services his organization can offer.

(b) An employee of the Union is constantly alert to find ways of improving and rendering more efficient the work of his organization.

(c) Supervisors are receptive to the suggestions of their subordinates, and are alert to reward demonstrated initiative and efficient performance by generous recognition and effective utilization of worthwhile ideas.

(d) Supervisors accept full responsibility for decisions and actions delegated to their subordinates and support the decisions and actions taken by these subordinates in discharging assigned duties.

(e) Employees in the service of the Union of Burma respect assigned channels of authority upward, recognizing that appeal to higher authority is always admissible for legitimate grievances; and downward, recognizing that to by-pass an intervening supervisor is to jeopardize the entire operation of the affected part of the organization.

(f) Corrections and improvements in the performance and operations of individuals and organizations in the Service of the Union of Burma are regularly effected by constructive suggestion, demonstration, and the provisions of needed assistance and support, but evident malingering or malfeasance in office are quickly submitted to action for dismissal by due process under the law.

Means should be provided for encouragement of adherence to the code. "Employee relations analysts" (rather than inspectors) should spot check existing conditions offering detailed and illustrated recommendations for improvement. Chronic disregard of the spirit of the code should be effectively dealt with.

An inescapable prerequisite to any program designed to build service tradition is fair and impersonal recognition of merit by promotion, added responsibility and commensurate advancements in pay. To achieve these, two conditions are necessary: one, adequate pay legislation and appropriations; and two, a corps of supervisors determined to secure for their subordinates the realization of earned advances.

General acceptance and recognition of a code of civil service practice will be facilitated by inviting representatives of the key government agencies to participate in its formulation. Each agency should also be charged with some measure of responsibility for promulgating the code and policing its practice within its own ranks.

b. Simplicity in Organizational Structure

Every governmental organization unit should have as clear-cut an assignment of functions as practicable. Its organizational structure should have few major sub-divisions in order to bring the activities within the genuine cognizance of the individual supervisor. The present large number of ministries is in itself unwieldy. When expediency permits, considerable efficiency could be gained by grouping the present number into half a dozen to ten major ministries.

c. Institutional Aids to Administration

Three institutional aids to good administration merit special mention here.

(1) Library Services

Understood to be already under consideration, a Union of Burma public library would prove invaluable to the country as a whole. Such a library located in the capital city would serve as the focal point for literary and scientific reference work, would complement the facilities of the University, would eventually provide inter-library loan services to other parts of Burma, and would be a repository for works copyrighted in Burma.

Among the many special services the library could perform, a Union Government Reference Service would contribute most directly to good administration of the development program by quickly making available books and documents on any subject from all parts of the world. For the study of mines, irrigation pumps, model making, or any of the innumerable problems that will arise in the course of diversifying industry and improving production methods in Burma, the reference service would provide selected bibliographies to officials and employees of the Government. Whether or not the Union library project is implemented, a technical reference service with broad resources should be made available to all agencies participating in the development activities.

(2) Public Information Service

The need for such a service has been mentioned previously. To provide business and industry with current information on the policies and activities of the Government would go far toward assisting private citizens as well as private enterprise in discovering required procedures for licensing, regulatory limitations, or government services applicable to their interests. As the Economic and Social Board will be in touch with all activities of the Government, affiliation of the service with that agency might be desirable.

(3) Research and Extension Foundation

Research and training in the new methods serve both the technical and administrative needs of development. Their importance has been emphasized repeatedly throughout this Report. Research is the means of bringing new methods into Burma; extension training the means of demonstrating them and their effectiveness to producers throughout the country. A central institution, furnishing stimulus and technical leadership of the highest order for research and extension in many fields, can be a focal point for elevating the goals of scientific training, insuring the availability of workers trained in original and creative thought, and assuring the steady assumption by Burma of leadership in fields appropriate to Burma's resources. One center is recommended, for even a single gifted leader at such a center can furnish stimulus in a number of fields. A study should be made of the detailed requirements for such a center, and liberal provision made for it in a future budget.

The work of such an institution might well include the following major divisions:

(*a*) *Research in physical sciences.* Pure and applied physics, chemistry, biology, mathematics, structural, hydraulic, soil mechanics, mechanical and electrical engineering; industrial development.

(*b*) *Research in social sciences.* Economics, the social services, public administration, others.

(*c*) *Extension services.* Special curricula for accelerated training, training aids for extension and in-service training; sponsorship of vocational training programs; adult education including field services in a number of fields.

An institution of this kind would provide facilities for both the short-range accelerated training so urgently needed and the long-range background of high scholarship needed to preserve the standards of attainment. The Center for Training Aids (previously referred to in Chapter VII) would assist in preparing curricula for accelerated training and course materials, slides, subject matter information and information on new methods for the use of institution lecturers, personnel of the operating ministries and others in conducting in-service training or extension work.

Engineering research laboratories would provide facilities for materials testing, river studies, structural analysis, earth-work and foundation testing, cement technology, metals and mineralogical investigations, and innumerable other studies and services. The institute for industrial research referred to in Chapter XXIV would be comprehended in this phase of the Foundation's work.

Social science research would provide information concerning modern statistical, economic and survey techniques in studying the operation of the social and economic system. It is possible, too, that accelerated training could be provided to personnel of some of the ministries in preparation for tasks of new responsibility.

The possibility should also be considered of combining into one organization the research establishments already existing or under study to facilitate the interchange of ideas and make the widest possible use of the available technical talent.

3. TECHNICAL CRITERIA

While many technical projects have been discussed in the preceding pages of this Report, little has been said of the broad criteria for insuring the technical soundness of both the development projects and the continuing productive and service activities of the Government of Burma. There are at least five requirements which must be met in this regard: adequate study, competent construction or procurement, adequate supervision, competent operation and adequate maintenance.

a. Adequate Study

The initiation and conduct of industrial, agricultural, communications and engineering activities (the extractive and productive aspects of the economy), to be successful, must be preceded by thorough and competent studies. Such studies normally entail field investigations, preliminary or master plans (such as this Report), and detailed plans, designs and specifications.

Preliminary plans and master plans (sometimes called simply "plans" in distinction from designs and specifications) should usually be sufficiently complete to determine feasibility or perhaps only to determine whether or not further expenditures for investigation are warranted. Preliminary plans are often based on fragmentary and incomplete field data, reconnaissance surveys, or partial statistical studies. Rarely, if ever, can preliminary or master plans be used as a basis for construction, procurement or operation.

Designs and specifications for construction or purchase should be the product of thorough field exploration, thorough statistical and economic determinations, thorough and scientific structural, process and equipment analyses, and thorough and accurately edited presentation. The information on which the design and specifications are based should leave no margin of doubt as to conditions affecting the location, safety, adequacy or success of the undertaking.

The finished documents, drawings and narrative specifications, though subject to revision and refinement as the work develops, should be explicit, free from ambiguity, and complete as to every feature of the work to be undertaken or equipment to be furnished.

Equipment should not be purchased without an analysis of the quantities, rates, tasks, costs and quality of work to be performed. Equipment should not be specified by vendors but by disinterested specialists in the desired operations.

As construction proceeds on a large engineering project, additional field data are gathered, designs are revised and amplified, and some additional details furnished.

b. Competent Construction and Procurement

To meet this requirement there must be, in addition to proper designs and specifications, insurance of delivery by a qualified organization. If work is to be undertaken by the Government, it must allocate time and funds to the thorough staffing and training of its organization.

For the more usual contract procedures, there must be means of selecting or qualifying bidders or candidates; there must be contract forms explicit in their references to specifications and binding as to deliveries, workmanship and performance, with bonuses or penalties where appropriate.

c. Adequate Supervision

Performance of technical operations by contractors cannot be left to the contractors' judgement. The best of specifications leave room for misinterpretation. The best of contractors' construction or organizations will favor their own convenience and profit when in doubt. Modern construction operations are therefore undertaken with an engineer organization at the site to represent the owner; to interpret the meaning and function of features and details of the work; to require compliance with the specifications; to locate, survey and measure the work; and to provide laboratory and field test services required to control the construction as it progresses.

Equipment purchases require supervision in the sense of inspection at factory, dock or site. Equipment installed may also require performance and acceptance tests. For example, a crew of four or five engineers and as many sub-professional technicians may be required to check turbine and generator performance for the acceptance of small power plant installations.

Supervision of operating activities is the implicit function of the operating organization. In general, good supervision means trained and efficient management. However, the owner or the government official responsible for the operation may find personal inspection and occasional analyses by disinterested teams of specialists necessary to evaluate or modify the performance of an operating agency.

d. Competent Operation

Depending upon the nature of the task, competent operation requires competent operating personnel and organization supported by the necessary flow of resources, adequate authority and adequate funds. The operating personnel should be qualified in their work, and should be led by supervisors who keep abreast of technical changes and are constantly seeking to improve the service while at the same time able to recognize and retain procedures and equipment of optimum value.

e. Adequate Maintenance

Too often neglected, the functions of maintenance and rehabilitation should be recognized as vital and permanent responsibilities associated with any productive activity. "Wear and tear," obsolescence, breakage, and losses are inescapable. Their rates can be statistically approximated for most activities, and proper organizations established to carry on repairs and maintain the needed flow of materials, equipment and spare parts.

In connection with such activities as highways, airports, communications and irrigation systems maintenance work assumes the proportion of major construction enterprise. It is a well-demonstrated but seldom-recognized characteristic of maintenance requirements that the constant demand for unforeseen improvements beyond the scope of literal maintenance of existing facilities imposes on the maintenance organization a continuing burden of expansion and new construction sometimes exceeding the scope of the original installation. Such requirements should be anticipated, accepted, and met by adequate staffing and appropriate equipment.

f. Ministry of Engineering Services

The library services and the Research and Extension Foundation previously mentioned would be invaluable institutional aids to the technical and functional competence of the development and operating activities of the Union. Expanded agricultural and industrial extension services mentioned in related chapters are other examples. An important long-range requirement is a greatly expanded general education program from which to draw both the specialists required to sustain an industrial economy and the informed citizenry to appreciate and defend the advantages of new and improved products.

As an additional aid to insuring adequate technical competence of the program, it is proposed that many of the civil, electrical, mechanical, mining and industrial engineering functions of the Government be grouped together in a Ministry of Engineering Services. Such a ministry should eventually be headed by an engineer of demonstrated administrative ability.

It would have the advantage of bringing together in one organization many of the varied technical talents whose combined contributions would be required on many construction projects, both large and small. It would permit the concentration, standardization, and perfection of field exploration and investigative procedures, the preparation of designs and specifications, the contracting and purchasing methods for heavy construction, mapping and hydrologic services, supervision of construction, and operating and maintenance functions of some activities.

Many types of engineering talent required in the execution of projects in one ministry are similar if not identical to those required in others. Bridge engineers are needed for irrigation, hydroelectric, industrial, mineral and communications activities. Examples can be multiplied. Their association in one organization would avoid much duplication, and would effect a vital economy in an essential area of specialized training.

An exact delineation of functions for such a ministry should be made the subject of further study. However, the following organizational groupings are suggested for initial consideration:

(1) *Department of Exploration and Surveys*

(*a*) *Mapping section.* General mapping surveys, preparation and distribution of maps, aerial mapping and photogrammetry, hydrography, hydrographic charts.

(*b*) *Hydrology and meteorology.* Stream gauging, water resources studies, runoff and flow forecasts, flood forecasts, groundwater measurements and records, reservoir routing, water allocations, rain gauging, thermal recordings, meteorology.

(c) *Geological survey*. Geological mapping and surveys, geological exploration for structure sites, petrographic laboratory.
(d) *Earthwork and foundations*. Site exploration, earth laboratory and testing, field laboratories during construction.

(2) *Department of Designs and Specifications*
(a) Electrical
(b) Mechanical
(c) Highway
(d) Industrial
(e) Structural
(f) Dams
(g) Municipal
(h) Specifications and contracts.

(3) *Department of Construction*
(a) Inspection
(b) Contract adjustments
(c) Field service.

(4) *Department of Operations and Maintenance*
(a) Highways
(b) Irrigation
(c) Power
(d) Communications.

It is recommended that a more detailed examination be made of the possible economies and improvements afforded by a Ministry of Engineering Services as a means of materially facilitating the implementation of the development program.

g. Aerial Surveys

As an example of a detailed report on a segment of the organization that would be included in a Ministry of Engineering Services, there follows a discussion of the present and recommended status of the program for aerial mapping.

(1) The Preliminary Report

In initiating the resource inventory of Burma it was realized that aerial photography of potential development sites would be essential to provide basic data for investigative studies. Further, it was recognized that agricultural studies, including land use and soil capability surveys, could efficiently be made of extensive areas only by employing aerial photography.

Accordingly the Preliminary Report recommended "the complete aerial photo coverage of the agricultural land of the country." Additionally, in connection with ports and waterways surveys, the Preliminary Report recommended that "aerial photographs should be made during the low water season to determine the present conditions on the principal waterways."

(2) Related Aerial Survey Needs

With the realization that appropriate aerial photography would facilitate investigative or development studies in connection with many other activities, government agencies were contacted, needs were considered and, as a result, requests for aerial photography were made by nine agencies aggregating more than 200,000 square miles.

To satisfy this obvious need an aerial survey program was planned.

(3) The Aerial Survey Program (Project Proposal No. 73)

The comprehensive aerial survey program for Burma was evolved early in 1952. The proposal (Project Proposal No. 73) was approved by the Burma Economic Aid Council on April 30, 1952, and forwarded through TCA/Burma to Washington where it was subsequently approved. In Washington, TCA funds in the amount of $1,100,000.00 were allocated to the program and plans were made for implementation.

The planned objective of the aerial survey program is:

(a) To secure aerial photography of the whole of Burma at such scales as to be suitable for various uses, together with mosaics and topographic maps of specific selected areas, and to organize, equip and train a nucleus organization of a permanent unit for operations essential to the effective use of the aerial photography and the preparation of multiple purpose maps.

(b) To secure magnetometer surveys, comprised of the necessary aerial photography, airborne magnetometer data, and the resulting geophysical maps suitable for mineral location and development studies in specifically designated areas.

The original program proposed that all of Burma would be photographed within five years although it was acknowledged that the rate of coverage would be governed by the urgency of need, and that considerably more time might lapse before photography of some of the more remote areas could be justified. During the first year (fiscal year 1953) it was proposed to photograph approximately 50,000 square miles and to secure magnetometer surveys of approximately 12,000 miles.

(4) Uses

(a) Photography. Exclusive of the many possible military uses of the aerial photography which will not be discussed here, the photography procured under this program will be used specifically:

(1) *As a library*

In the use of reference photography it is not uncommon to plan a systematic stereoscopic study of photography covering extensive areas with a view to observing and cataloging any anomalies encountered, terrain types, cover, geological features, erosion or flood conditions, transportation possibilities, unusual population conditions, obvious industries, and numerous other matters.

(2) *For multiple-purpose topographic and cadastral maps*

Strictly modern mapping, ranging from the large-scale, two-foot contour interval map of industrial area, factory site, or intricate urban development to small-scale maps of large or remote areas of difficult access, employs and is admittedly dependent upon aerial photography as the only source of comprehensive detail susceptible of accurate assembly by photogrammetric techniques. Common practice in many countries has made the procedure for procuring aerial photography and the related ground control routine as the first step in any mapping program.

(3) *For agricultural development programs*

A major part of the area of the United States has been photographed for use in connection with agricultural programs. Generally enlargements at scales of 1,000 or 1,320 ft. to an inch are taken to the field for the correlation of data on soil studies, land use, crop control and field areas. The use of the photography in this way has become such an accepted practice that entirely new procedures would have to be developed if aerial photographs were not available. It is inevitable that available aerial photography will fit equally well into any development studies in connection with Burma agriculture.

(4) *For surveys and control of soil erosion*

The Shan States Erosion Control has urged that aerial photography be furnished for use in combating soil erosion. This is in line with modern practice. Erosion control requirements and possibilities are apparent in the bird's-eye view provided by aerial photography, which shows the extent of damage and sometimes the cause.

(5) *For the study of surface geology*

Interpretation of surface geology from aerial photography is the work of a specialist. Geologists practiced in stereoscopic study are frequently able to make valuable surface studies of a reconnaissance nature. The interpretation possibilities vary with the type of terrain, amount of cover, depth of overburden, and prominence of the geological structure. It is, however, sometimes possible to trace faults, strikes, or outcrops even in areas of heavy jungle cover where evidence on the ground might be discovered only by accident or at the expense of great time and effort. An important feature in the study of surface geology by aerial photography is the possibility of eliminating large areas from further consideration. Conversely, the photographic study may point to definite potentialities justifying additional exploration on the ground.

(6) *For the inventory of forest resources for stock maps*

The Department of Forests of Burma has for years made use of any available photography in connection with forest administration. Timber typing and assessment of forest products from aerial photography is now a well-developed technique. Accordingly, the foresters view the aerial survey program as a welcome means of supplementing the basic forest data.

(7) *For route reconnaissance*

Preliminary location surveys for highway, railroad, transmission line and pipeline alignments, particularly problems involving alternative possibilities, long distances, remote areas, or difficult time schedules, are now commonly made by use of aerial photography. Depending on the objective, location procedures for any of these may require only simple stereoscopic study to assess the comparative advantages of possible locations. In some cases actual preliminary location may be made in the field directly from aerial photography as in the case of the survey for a large oil pipeline made recently through more than 600 miles of western Canada mountains. Not infrequently, actual topographic strip maps are made by photogrammetric methods to such accuracy that locations are projected, quantities computed, costs estimated, and comparative advantages of alternative locations measured in terms of ultimate cost.

(8) *To facilitate waterway studies*

It is not contended that hydrography can be obtained from aerial photography. However, the base map upon which the waterway hydrography is indicated is frequently an expensive and time consuming job by ground methods. Tracing the sinuosities of channels, inlets, tide flats and bars is routine in mapping by photogrammetric methods, and in addition, the photography provides stereoscopic study for waterways investigations. Shoals, intricate channels, cutting action, old channels, tendencies toward channel changes, all are evident in detail, and permit an estimate of causes of destructive water action and the planning of corrective measures.

(9) *For urban planning*

For the construction of freeways, extension of railroads, widening of thoroughfares, or rerouting of bus services, the planner needs a broad perspective of the urban area to judge the advantages of various possibilities and probable effects of proposed action. In determining the most suitable location for public parks, schools and playgrounds, it is important to consider the distribution of the residential zones and the approximate population density within each zone. An additional determining factor is the location and topography of the open spaces in which schools, parks or playgrounds might be located. It has been demonstrated that aerial photographic interpretation supplemented by necessary information derivable only from ground study, provides an economical means of obtaining the comprehensive data necessary for locating the facilities in question.

When aerial photography is used to solve development problems, speculators and the general public are not aware that an inventory of conditions is being made. When such surveys are made by ground methods so much interest is frequently aroused that property values may be unduly inflated or political pressure aroused, for or against, the project without regard to its merits.

Since aerial photographs do not show locations of subterranean structures such as subways, sewers, storm drains, or communications cables, they do not take the place of maps. However, because of the wealth of detail available, annotated aerial photographs will in many cases be of much more use than the best of maps.

(10) *For special purpose maps*

As the source of data for special purpose maps, aerial photography is recognized as essential in many present-day heavy construction projects. By employing modern photogrammetric techniques the high-accuracy large-scale topographic maps needed for areas of construction-site importance can usually be made more economically and very much more rapidly than by conventional ground methods.

(11) *Not as map substitutes*

Much has been written recently about the use of aerial photographs as map substitutes for portraying features of the earth's surface. However, it should be emphasized that a single pair of aerial photographs in the hands of a competent interpreter reveals far more information than a map can show relative to such diversified fields as geology, forestry, agriculture, engineering and geography. Furthermore, the aerial photograph portrays this wealth of information regarding the earth's surface in a completely unbiased fashion and in conformity with well-known mathematical and physical laws. For these reasons, perhaps aerial photographs should not be considered as a *substitute* for anything—not even a map.

(b) Magnetometer surveys. In Burma, as in many other tropical to subtropical countries, ground geological exploration is handicapped by physical conditions which render the routine methods of the past backward, time consuming, and insufficiently productive except where comparatively small areas are to be explored. Because of topography which renders access very difficult, forest and jungle-covered terrain, thick overburden, and other physical conditions which conceal outcrops and ore indications, many areas which might contain valuable ore deposits have never been reconnoitered.

It is under such conditions that aerial photography and new geophysical methods make prospecting of certain areas not only possible, but economical, expeditious and revealing. Of the various methods available, the airborne magnetometer reconnaissance survey has been considered potentially the most productive for initial use in Burma. With properly planned survey, the data obtained with the magnetometer will permit geological and geophysical ground examinations, drilling, and other exploratory work.

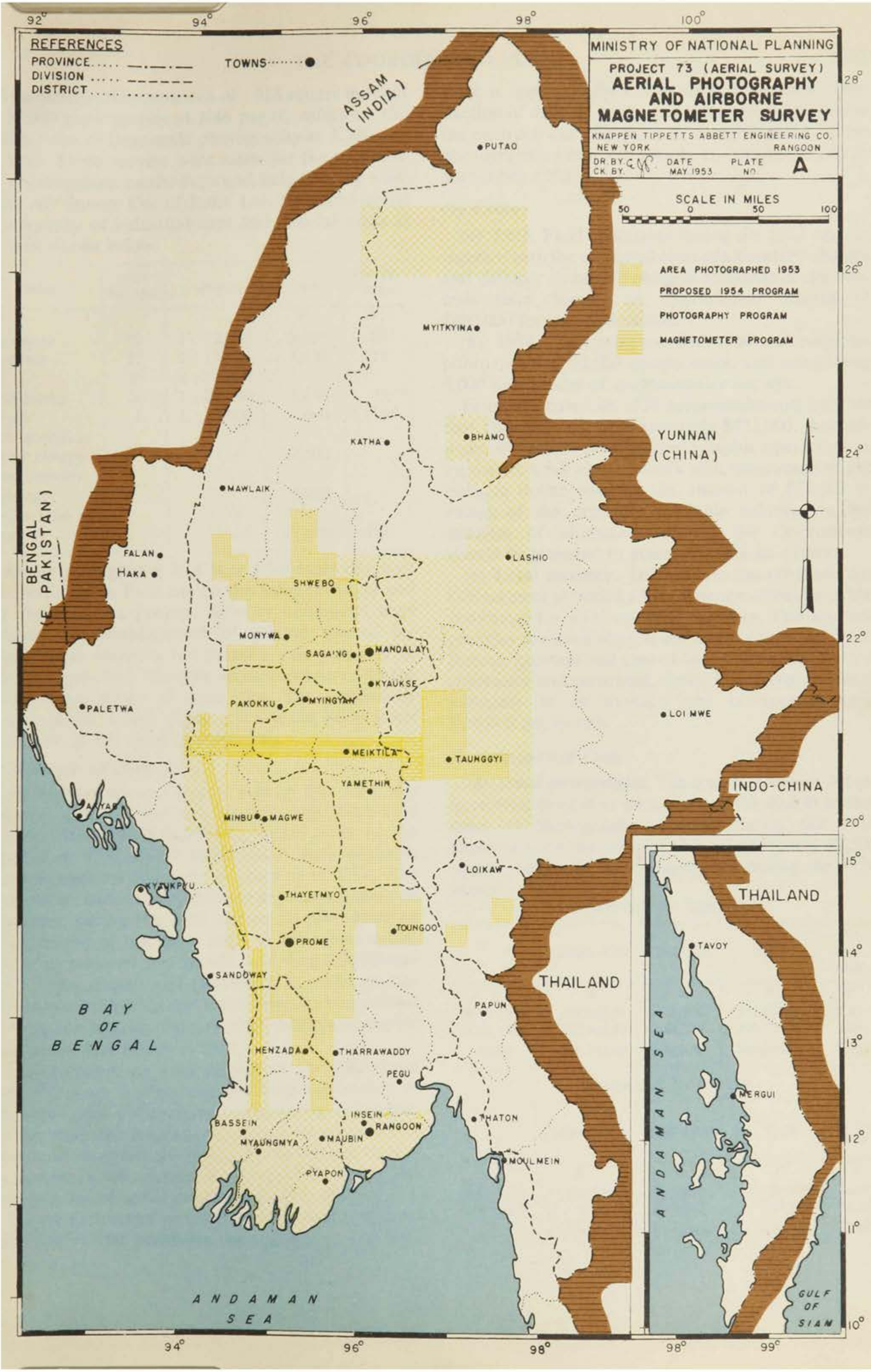
In Burma, where such large sections of the country are unexplored, and where the deposits which have been so advantageously exploited indicate a good expectancy for further discoveries, it is almost impossible to overemphasize the economic value of aerial photography and magnetometer reconnaissance surveys as first measures in securing the rapid and efficient development of mineral resources.

(5) Related Supplemental Projects

While Project Proposal 73 was being initiated, contracts were made with Hunting Aero Surveys of London, and with Air Survey Company of India Ltd. for the procurement of urgently needed aerial photography of various small areas to facilitate immediate studies of proposed projects.

(a) By contract with Hunting Aero Surveys, aerial photography of five proposed hydroelectric sites was procured. Catchment and reservoir areas were photographed at an average scale of 1 : 24,000 supplemented by photo-coverage of possible dam sites at approximately 1 : 12,000. The following tabulation shows the cost of this work.

Item	*Area Sq. Mile*	*Scale*	*Cost*	*Per Sq. Mile*
			K	*K*
Pegu	317	1 : 24,000	10,206	32
,,	44	1 : 7,920	11,586	263
Mon	260	1 : 24,000	9,510	37
,,	43	1 : 12,000	8,493	193
Lampha	76	1 : 24,000	5,117	67
,,	14	1 : 12,000	5,018	358
Namtu	160	1 : 24,000	9,363	58
,,	34	1 : 12,000	10,197	300
Balu	102	1 : 24,000	7,834	77
,,	18	1 : 12,000	7,636	420


MINISTRY OF NATIONAL PLANNING
PROJECT 73 (AERIAL SURVEY)
AERIAL PHOTOGRAPHY AND AIRBORNE MAGNETOMETER SURVEY
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK RANGOON
DR. BY
CK. BY
DATE MAY 1953
PLATE NO. A
SCALE IN MILES
50 0 50 100
AREA PHOTOGRAPHED 1953
PROPOSED 1954 PROGRAM
PHOTOGRAPHY PROGRAM
MAGNETOMETER PROGRAM
REFERENCES
PROVINCE
DIVISION
DISTRICT
TOWNS
ASSAM (INDIA)
BENGAL (E. PAKISTAN)
YUNNAN (CHINA)
INDO-CHINA
THAILAND
BAY OF BENGAL
ANDAMAN SEA
GULF OF SIAM
PUTAO
MYITKYINA
BHAMO
KATHA
MAWLAIK
FALAN
HAKA
LASHIO
SHWEBO
MONYWA
SAGAING
MANDALAY
KYAUKSE
PAKOKKU
MYINGYAN
PALETWA
LOI MWE
MEIKTILA
TAUNGGYI
YAMETHIN
MINBU
MAGWE
KYAUKPYU
LOIKAW
THAYETMYO
TOUNGOO
PROME
SANDOWAY
PAPUN
HENZADA
THARRAWADDY
PEGU
INSEIN
RANGOON
BASSEIN
MYAUNGMYA
MAUBIN
THATON
PYAPON
MOULMEIN
TAVOY
MERGUI
92° 94° 96° 98° 100°
28° 26° 24° 22° 20°
15° 14° 13° 12° 11° 10°
99°

In summary, this consisted of : 915 square miles of 1 : 24,000 photography at K46 per sq. mile and 153 square miles of large-scale photography at K280 per sq. mile. These surveys were made for the preliminary investigations on the Pegu and Balu Chaung sites.

(b) Air Survey Co. of India Ltd. furnished aerial photography of industrial sites and mineral areas at the cost shown below:

Item	*Area Sq. Mile*	*Scale*	*Cost*	*Per Sq. Mile*
			K	K
Myingyan	70	1 : 12,000	5,600	80
Monywa	15	1 : 12,000	1,650	110
,,	25	1 : 12,000		
Loughkeng	50	1 : 24,000	3,250	43
Akyab	6	1 : 12,000	660	110
Plus mobilization charge			1,500	
Plus standby charge			5,000	
Totals (166 sq. miles)			17,660	106

Aerial photography had been previously obtained for the Saingdin Falls site on the Saingdin River and for the Bawgata project. Security conditions have delayed the establishment of ground control for topographic mapping but mosaics were prepared of the Myingyan and Monywa areas which serve for the initial investigation of these sites. The preliminary studies of the Akyab paper mill site are being made largely from the aerial photographs.

(6) Synopsis of Operations

To initiate aerial surveys during the 1953 dry season a contract was entered into with Worldwide Surveys Inc., of Philadelphia, dollar costs in the amount of $735,000·00 having been made available through issuance of a letter of guaranty by TCA. The contract provided for operations for two seasons and proposed, during the 1953 season, to procure aerial photography of not more than 60,000 square miles, and magnetometer surveys not exceeding 6,000 linear miles. Two aircraft and photographic crews, photo-laboratory equipment and technicians were mobilized at Rangoon in early January 1953, and photographic operations were begun at once.

Initial operations were conducted from Rangoon until February 7, when the field base was moved to Meiktila, and photographic operations continued. On April 20, the aerial photographic crews were inter-seasonally demobilized having accomplished, during the preceding 106 calendar days, approximately 40,000 square miles of aerial photography (see Plate A).

No magnetometer surveys were obtained during the 1953 season but provisions were made to give this work a high priority during 1954 operations. Production of delivery prints and indices required under the contract was started upon demobilization of the photographic crew and should be completed late in September 1953.

(7) Costs

(a) 1953. Field operations during the 1953 season, together with the estimated costs of laboratory charges and delivery items will obligate $333,000 of the contract fund, leaving an approximate balance of $402,000 for the 1954 season.

(b) 1954. The program for 1954 contemplates photographing 52,500 square miles, and completing 6,000 linear miles of magnetometer surveys.

Estimates based on 1953 accomplishments indicate that this will cost approximately $475,000. Accordingly, if weather permits photographic operations as estimated, a full season's work with two aircraft might obligate dollar costs in the amount of $73,000 in excess of the presently available balance. In the interests of ultimate economy, the Government should be prepared to guarantee such an overrun.

(c) Local currency. To facilitate the program, the Government provided a kyat account to reimburse the contractor for local currency expenses. This account provides for laboratory space and facilities, travel in Burma, quarters and cost-of-living allowance for the contractor and personnel, clerks, interpreter and local assistants at an average cost of approximately K30,000 per month.

(8) Summary of Costs

(a) Aerial photography. The cost data shown below have been computed on a basis of the 40,000 square miles of photography obtained during the 1953 season and on the premise that an additional 52,500 square miles will be photographed during the 1954 season.

SUMMARY IN DOLLARS

	Dollar Cost	*Kyat Cost*	*Total*	*Per Sq. Mile*
	$	$	$	$
F.Y. 1953	332,826.51	44,210	377,036.51	9.43
F.Y. 1954	327,965.89	44,210	372,175.89	7.09
Total	660,792.40	88,420	749,212.40	8.10

SUMMARY IN KYATS

	Dollar Cost	*Kyat Cost*	*Total*	*Per Sq. Mile*
	K	K	K	K
F.Y. 1953	15,80,926	2,10,000	17,90,926	44.77
F.Y. 1954	15,57,838	2,10,000	17,67,838	33.67
Total	31,38,764	4,20,000	35,58,764	38.49

(9) Fiscal Year 1954 Aerial Photography Program

(a) Re-flights. Approximately one third of the re-flights required in connection with the 1953 operations were incomplete at the end of the photographic season. In line with orderly prosecution of the work, to permit completion of the affected quadrangle indices, and to complete the affected units with as little difference in date of photography as possible, one aircraft and crew will be assigned to the task of completing ordered re-flights. This involves widely scattered flight strips aggregating approximately 3,000 square miles of photo-coverage.

(b) Photography for magnetometer areas. Photography has been considered necessary in order to obtain the magnetic profiles, it being reported by the contractor that the conventional one inch to one mile maps do not contain sufficient detail to permit following a predetermined flight line when flying at low altitudes.

Accordingly, since magnetometer surveys will be given a high priority in the 1954 season, one plane will be assigned the task of securing photography of any areas scheduled for magnetometer surveys which have not yet been photographed. On a basis of the presently proposed magnetometer surveys this will involve photography of approximately 6,000 square miles.

(c) Continuation of the blanket coverage program. The areas to be photographed and the priorities of operations will be designated by the Government; however, the selection areas and priorities will be governed by the indicated needs of the various using agencies which have been requested to submit their considered requests for aerial photography. In line with the plan to obtain blanket coverage of the country, the various items will be laid out in as large blocks as practicable, governed, however, by the number and urgency of requests for specific areas. It is estimated that completion of the F.Y. 1954 program will account for an aggregate total of 92,500 square miles or approximately 35% of the area of Burma.

(10) The Related Photogrammetric Training Program

The original aerial survey program proposed to train the nucleus of a photogrammetric engineering force to the end that the aerial survey unit can function efficiently as a permanent service organization in the compilation of base maps from aerial photography for either general or specific purposes. In addition, it proposed training the unit in the graphic techniques incidental to the making of mosaics, planimetric maps, or other special purpose photogrammetric operations.

To make this training possible, modern photogrammetric and laboratory equipment has been ordered through the cooperation of TCA at an estimated expense of $68,000.00 (K3,23,000.00). One photogrammetrist has been provided through TCA for a period of two years to instruct trainees in photogrammetric techniques on actual production problems. He will be assisted by two technicians from the Survey Department who have been undergoing an intensive course in photogrammetry in London during the past year.

In addition, a laboratory technician is being provided for instructing trainees in the various related laboratory operations, and it is probable that the services of three photo-interpretation experts will be made available to assist in training in the application of aerial photography in the fields of geology, agriculture, and urban planning. Actual implementation of the training program in basic photogrammetry and graphic techniques is only awaiting availability of suitable space.

(11) Recommendations

(a) Aerial photography. Generally one use is sufficient justification for procurement of aerial photography. Here there are 12 agencies submitting overlapping requests for aerial photography based on their considered needs. With the knowledge that the economy of securing photography for resource inventory and for demonstrated needs is sound, it is recommended that the program of securing aerial photography of all of Burma be continued with the target of completing the coverage within the next seven years.

Because the demand for photography of some of the more remote areas will not be immediate, the yearly program will fluctuate. However, in the interests of operational economy, it is suggested that an effort be made to program 30,000 50,000 square miles per year.

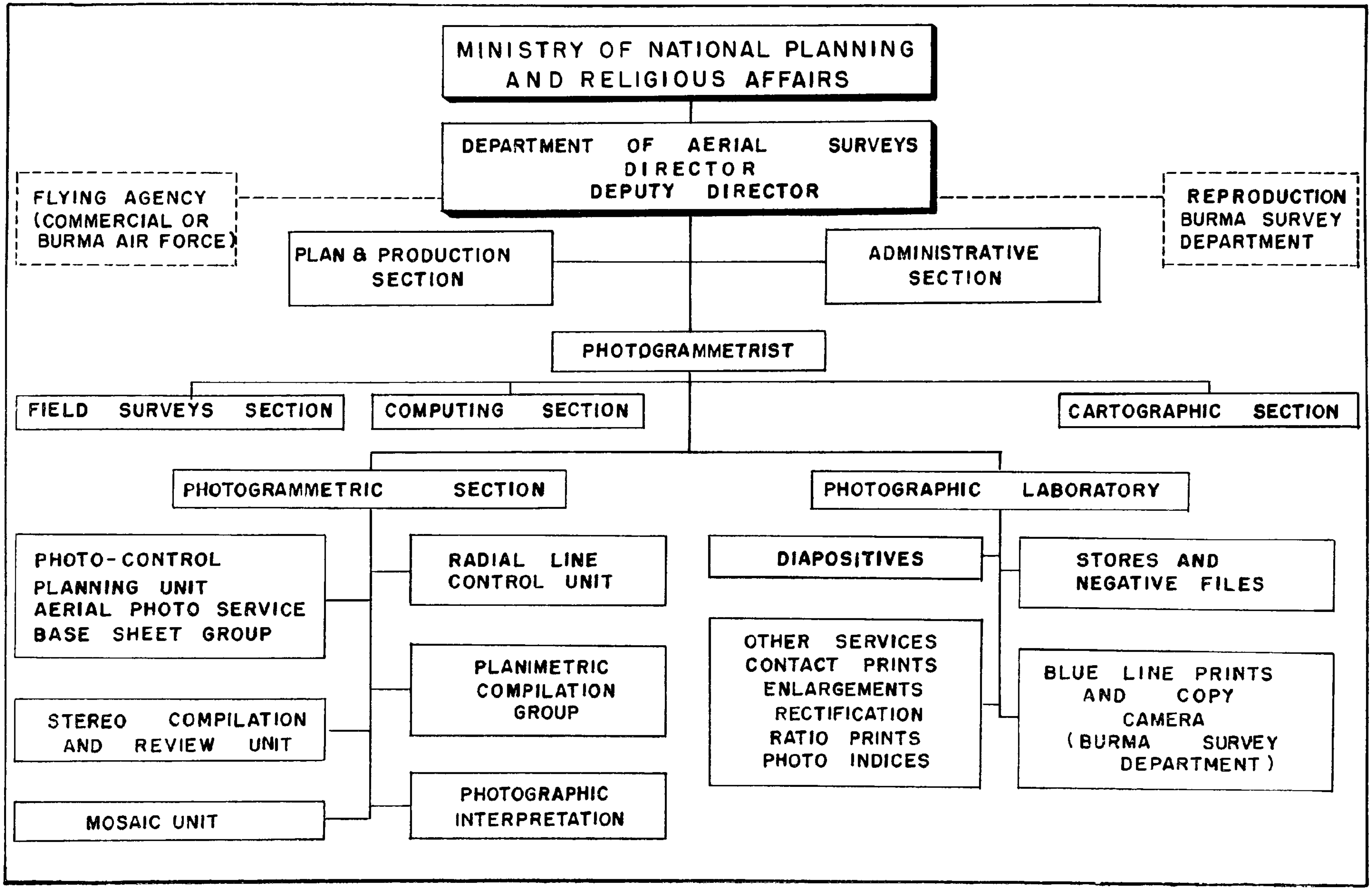
(b) Airborne magnetometer surveys. The results of magnetometer surveys cannot immediately be evaluated, since the data thus assembled must be correlated with the geology of the area. Accordingly continuance of the magnetometer surveys must be governed by the results obtained during the 1954 program. Additional magnetometer surveys are not recommended at this time.

(c) The photogrammetric organization. Governments normally provide the various special purpose maps required by their agencies and public. Because speed of compilation and accuracy of portrayal are important, an adequate photogrammetric unit is indispensable.

Accordingly it is recommended:

(1) That adequate quarters be made available, comprising not less than 10,000 sq. ft. initially,

PLATE B


MINISTRY OF NATIONAL PLANNING AND RELIGIOUS AFFAIRS
DEPARTMENT OF AERIAL SURVEYS DIRECTOR DEPUTY DIRECTOR
FLYING AGENCY (COMMERCIAL OR BURMA AIR FORCE)
REPRODUCTION BURMA SURVEY DEPARTMENT
PLAN & PRODUCTION SECTION
ADMINISTRATIVE SECTION
PHOTOGRAMMETRIST
FIELD SURVEYS SECTION
COMPUTING SECTION
CARTOGRAPHIC SECTION
PHOTOGRAMMETRIC SECTION
PHOTOGRAPHIC LABORATORY
PHOTO-CONTROL PLANNING UNIT AERIAL PHOTO SERVICE BASE SHEET GROUP
STEREO COMPILATION AND REVIEW UNIT
MOSAIC UNIT
RADIAL LINE CONTROL UNIT
PLANIMETRIC COMPILATION GROUP
PHOTOGRAPHIC INTERPRETATION
DIAPOSITIVES
OTHER SERVICES CONTACT PRINTS ENLARGEMENTS RECTIFICATION RATIO PRINTS PHOTO INDICES
STORES AND NEGATIVE FILES
BLUE LINE PRINTS AND COPY CAMERA (BURMA SURVEY DEPARTMENT)

suitable for housing delicate scientific instruments and related mapping operations.

(2) That personnel be selected on the basis of aptitude tests to staff the organization outlined on the organization chart (Plate B).

(3) That production-training be initiated without delay to include basic fundamentals, photo interpretation, graphic techniques, ground control, stereoscopic plotting, map compilation, and the related laboratory operations.

(4) That serious consideration be given to organizing, equipping and training one or more aerial photographic crews.

(5) That the operations of the photogrammetric unit be conducted in closest cooperation with the Burma Survey Department with view to merging with that Department at the end of an appropriate training period, tentatively set at two years, to complete the modernization of a service organization for the capable handling of surveying, mapping and related activities, for the Government of the Union of Burma.

B. THE COMBINED PROGRAM

1. PROGRESS RATES

The goal of the development program is to raise the gross national product from K465 crores per year in 1952–53 to K700 crores in 1959–60. To accomplish this increase it is estimated that approximately K660 crores, in addition to expenditures already made in 1952 and 1953, will be spent on rehabilitating existing and developing new cultural and physical assets in the intervening period of seven years. The program does not start from zero and end at the predetermined goal, for advances are being made now, and will continue after the projects outlined in this Report have been completed. The program proposed herein should be considered as superimposed on the normal rate of development as a means of accelerating the attainment of an improved standard of living. Economic conditions that govern the welfare of society are never static; they progress in proportion to the collective efforts of individuals and nations to improve, and retrogress when the effort is lacking.

2. DIRECT AND INDIRECT RETURNS

The program includes projects for which the returns may be measured by increased Union income and those for which the returns are just as important but are not susceptible to measurement in monetary values. In the first category is the development of the agricultural, mineral and water resources of the country, and the improvement of means of transportation and communication. In the second category are public health and welfare, education and other cultural activities. The activities included in the two categories are interdependent. One cannot progress without progress being made by the other.

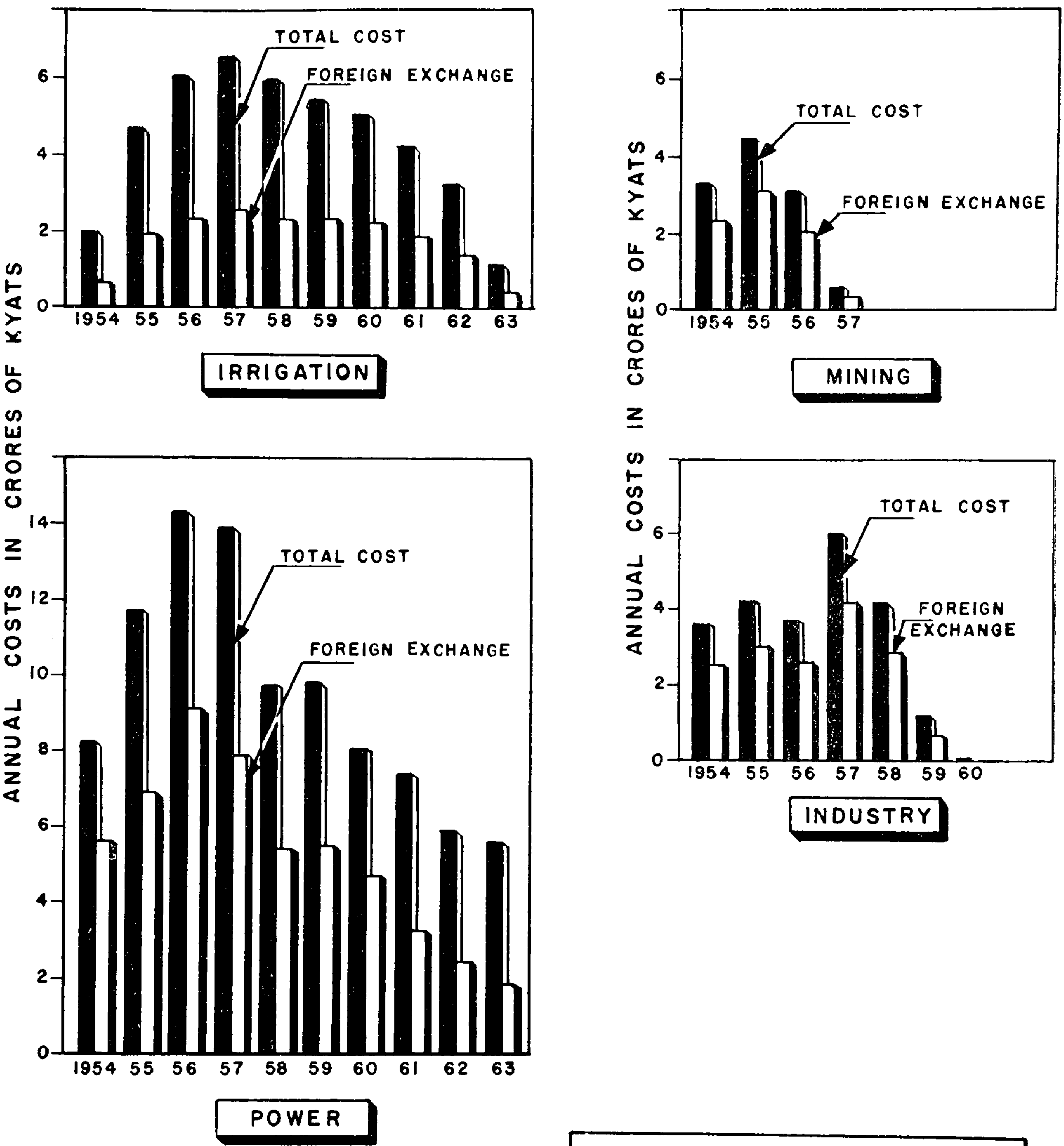
3. ECONOMIC AND MANPOWER BALANCE

The estimated expenditure on specific projects in the first category of the program is approximately K350 crores during the seven-year period. It is essential that these projects be carefully scheduled and that the schedule be followed in order to keep the program in balance.

In Table XXV–1 (*see p.* 836) are shown the estimated costs and the distribution of expenditures for all the specific projects through the years 1953 to 1960. The totals are shown graphically on Plates 1A, 1B, and 2. The manpower requirement is also shown on Plate 2. The peaks of both expenditures and manpower utilization occur in the years 1956, 1957 and 1958.

It would be unrealistic to ignore slippage in programmed execution. Based on experience elsewhere, a slippage factor of 50% in the initial years would not be unreasonable to expect. Such a slippage would tend to flatten and displace the peaks toward later years. Practical considerations therefore lead to the conclusion that manpower shortages will not, in fact, develop.

In conclusion, it should be emphasized that whereas the combined program is almost infinitely flexible, certain projects and groups of projects are closely interdependent. The inevitable dislocations arising from both human error and physical failures should be carefully studied and countered to prevent the possibility that any supporting project might fail to be completed in time to service another project which may be dependent upon it.



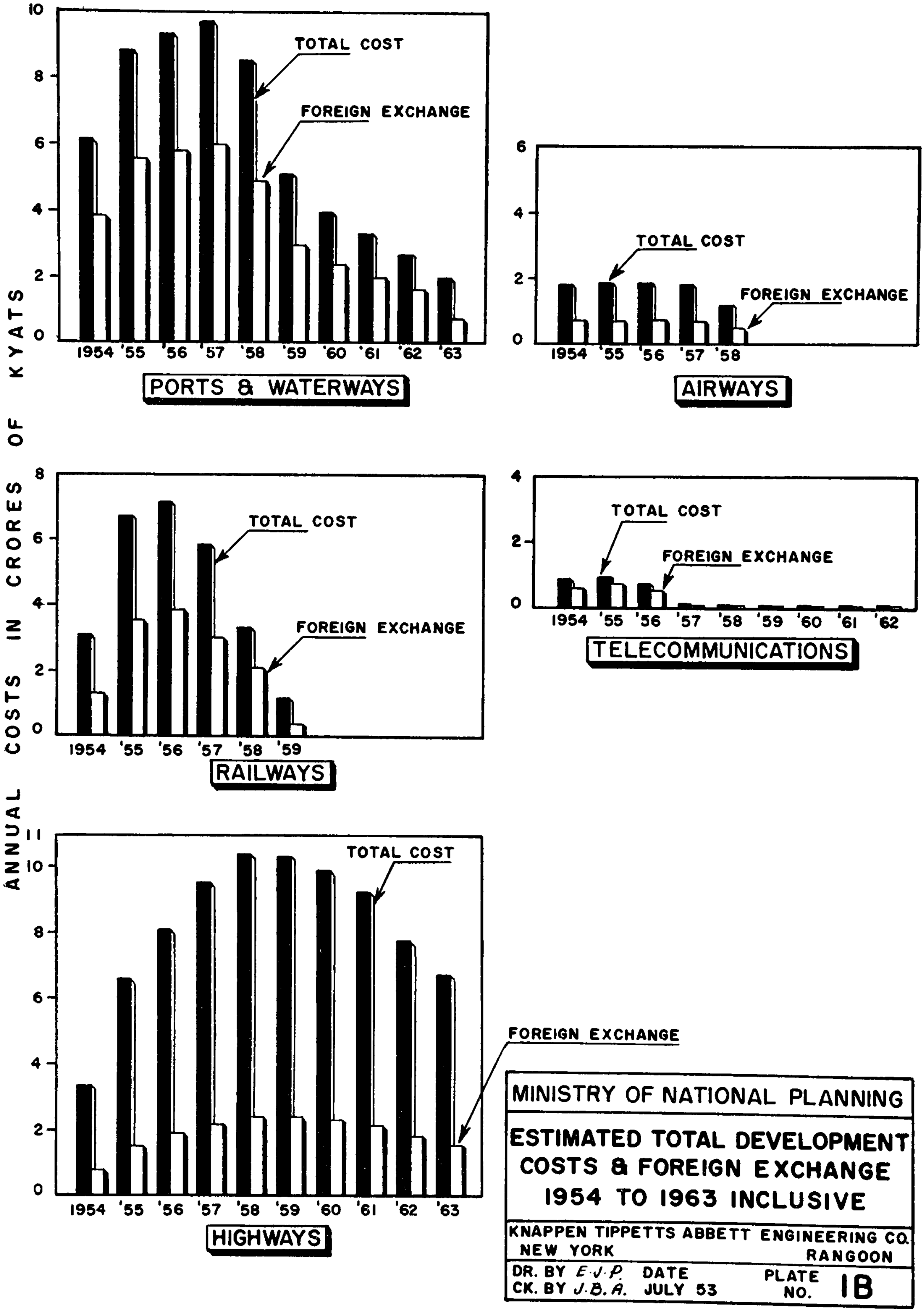
MINISTRY OF NATIONAL PLANNING

ESTIMATED TOTAL DEVELOPMENT COSTS & FOREIGN EXCHANGE 1954 TO 1963 INCLUSIVE

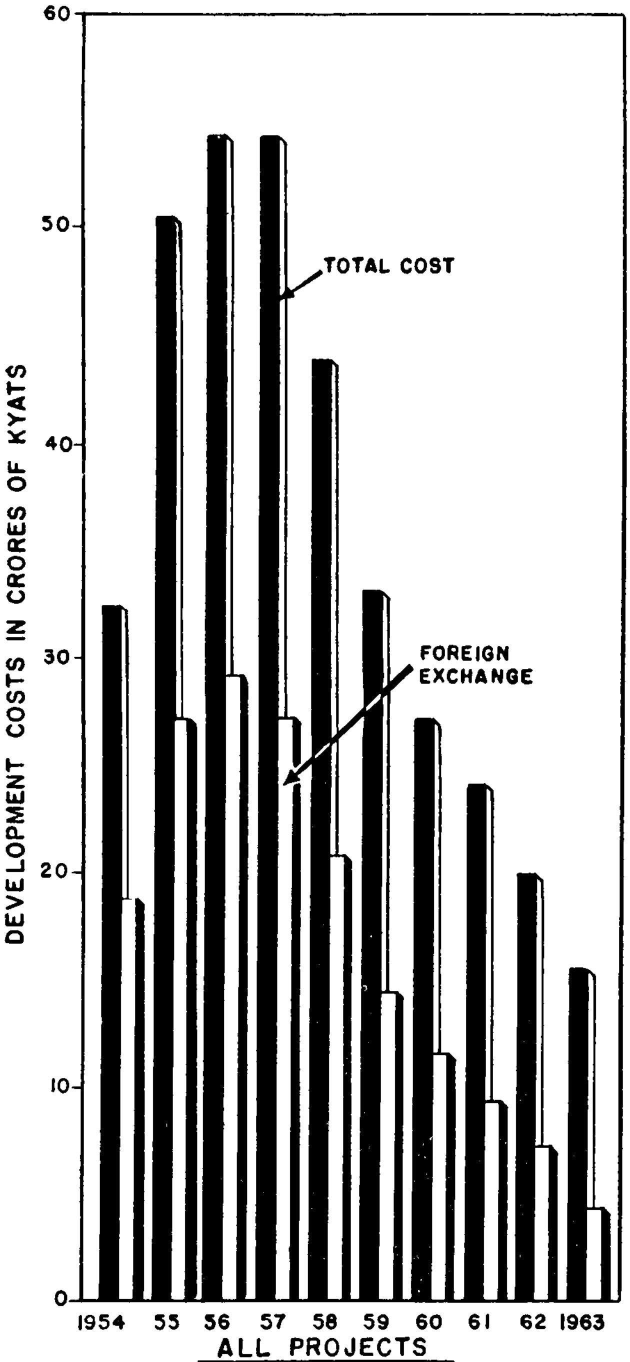
KNAPPEN TIPPETTS ABBETT ENGINEERING CO
NEW YORK RANGOON

DR. BY. E J P DATE
CK. BY. J B A JULY. 53

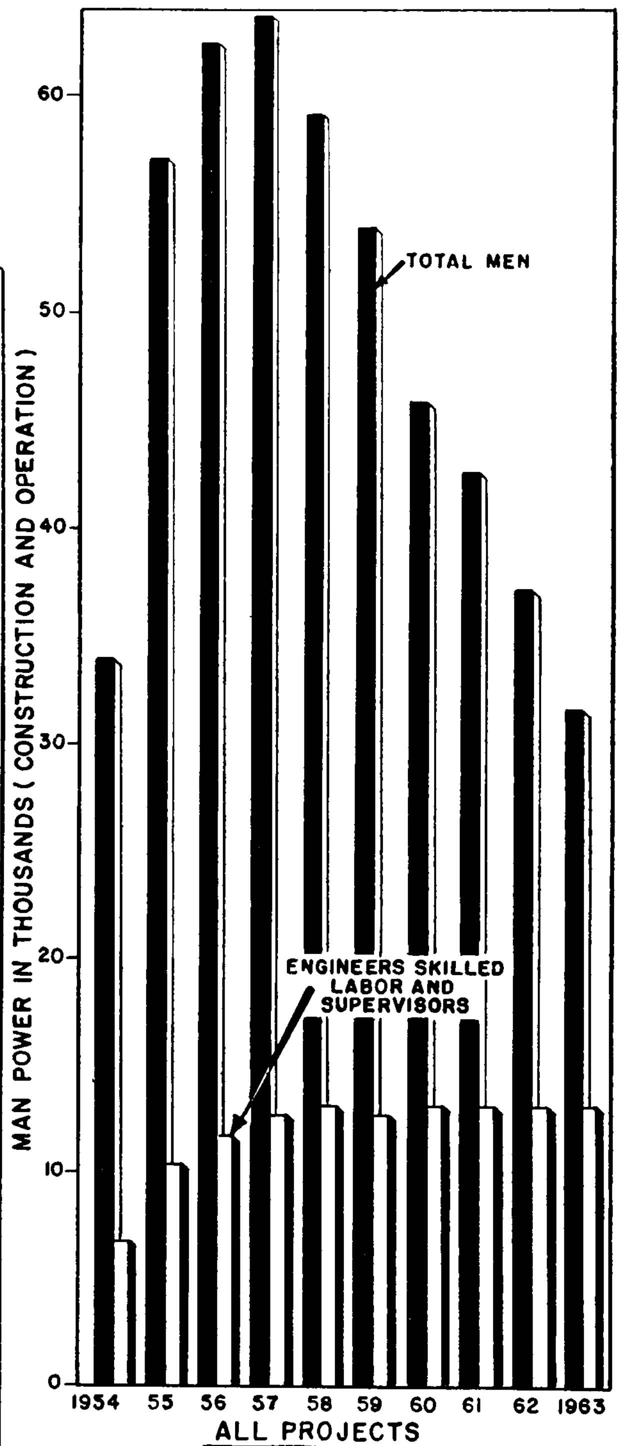
PLATE NO. 1A.



ANNUAL COSTS IN CRORES OF KYATS
TOTAL COST
FOREIGN EXCHANGE
1954 '55 '56 '57 '58 '59 '60 '61 '62 '63
PORTS & WATERWAYS
1954 '55 '56 '57 '58
AIRWAYS
1954 '55 '56 '57 '58 '59
RAILWAYS
1954 '55 '56 '57 '58 '59 '60 '61 '62
TELECOMMUNICATIONS
1954 '55 '56 '57 '58 '59 '60 '61 '62 '63
HIGHWAYS
MINISTRY OF NATIONAL PLANNING
ESTIMATED TOTAL DEVELOPMENT COSTS & FOREIGN EXCHANGE 1954 TO 1963 INCLUSIVE
KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
NEW YORK
RANGOON
DR. BY E.J.P. DATE
CK. BY J.B.A. JULY 53
PLATE NO. IB



DEVELOPMENT COSTS AND FOREIGN EXCHANGE



NEW JOBS ON CONSTRUCTION AND OPERATION OF THE RECOMMENDED PROJECTS

MINISTRY OF NATIONAL PLANNING
ESTIMATED DEVELOPMENT COSTS AND MANPOWER NEEDS 1954 TO 1963 INCL.
KNAPPEN TIPPETTS ABBETT ENGINEERING CO NEW YORK. RANGOON
DR BY. E.J.P. DATE CK BY. J.B.R. JULY 53 PLATE NO 2

TABLE

SCHEDULE OF PROJECTS IN

(*Costs in*

	*Estimated Total Cost**	*1953–54*	*1954–55*	*1955–56*
POWER DEVELOPMENT				
Diesel Electric Plants	11,93,13	2,37,00	4,00,00	4,56,13
Pegu Power Project	18,90,70	2,45,00	3,20,00	3,80,00
Myingyan Steam Plant	9,23,90	1,23,00	1,22,00	1,74,00
Saingdin Falls Project	15,48,30	2,37,00	3,14,00	3,09,00
Kalewa Steam Plant	39,91	3,67	6,00	6,00
Paunglaung Power Project	15,59,00	—	—	—
Balu Chaung (Loikaw)	2,05,50	—	5,50	40,00
Lampha Chaung (Moulmein)	5,20,00	—	25,00	90,00
Mu River Power Project	6,70,00	—	—	—
Magwe Transmission Line	1,94,00	—	—	—
Prome Transmission Line	2,02,50	—	—	—
Bassein Transmission Line	2,32,50	—	—	—
Thaton-Tavoy Transmission Line	2,29,00	—	—	—
Lashio Transmission Line	1,05,50	—	—	—
Outlying Diesel Plants	1,21,00	—	—	—
Total	96,34,94	8,45,67	11,92,50	14,55,13
IRRIGATION				
Mu River Storage Dam	4,34,11	35,00	1,05,13	1,81,62
Sinthe Chaung Dams Canal	4,09,54	66,93	1,14,95	1,26,43
Sinthe Chaung Pump System	1,53,76	53,73	21,18	23,46
Thitson Chaung System	2,24,21	9,77	64,24	85,64
Yamethin Well Irrigation	1,53,69	4,50	14,09	14,11
Kandaw Village Irrigation	75,45	27,97	47,48	—
Loikaw Area Irrigation	74,01	6,62	14,02	14,85
Mu Diversion and Old Canal	4,31,38	—	78,39	98,64
Seikpyu Pumping Installation	21,92	—	21,92	—
Irrawaddy Pumping Installation	1,83,39	—	—	32,49
Chindwin Pumping Installation	2,20,87	—	—	43,54
Westside Canal System	4,59,83	—	—	—
Yezin Chaung Irrigation System	2,21,19	—	—	—
Paunglaung Yezin System	93,51	—	—	—
Ngalaik Chaung Irrigation System	3,66,64	—	—	—
Paunglaung Pumping System	1,48,55	—	—	—
Swa and Saing Irrigation System	8,42,82	—	—	—
Total	45,14,87	2,04,52	4,81,40	6,20,78
PORTS AND WATERWAYS				
Port of Rangoon	27,11,40	1,89,60	3,83,40	4,04,20
Outports	1,98,50	73,75	71,75	23,00
Shipping Board	5,00,00	1,50,00	1,17,00	1,17,00
Inland Waterways	22,70,32	1,64,83	2,76,73	3,59,00
Total	56,80,22	5,78,18	8,48,88	9,03,20

*Estimated total cost, in some instances, includes costs beyond 1960.

XXV - 1

DEVELOPMENT PROGRAM
Thousands of Kyats)

1956–57	*1957–58*	*1958–59*	*1959–60*	*Remarks*
1,00,00	—	—	—	
4,02,50	1,63,50	1,68,40	57,00	
1,71,40	71,40	74,10	74,10	Last unit to be in operation in 1959. Continuing work on transmission and distribution system after 1960
2,48,80	78,90	78,90	78,90	
3,56	3,56	3,56	3,56	
1,79,00	2,90,00	2,70,00	2,50,00	Project to be completed in 1963
40,00	20,00	20,00	20,00	Continuing work on Trans. and Dis. after 1960
90,00	90,00	45,00	45,00	,, ,, ,, ,, ,, ,, ,, ,,
70,00	1,00,00	1,00,00	1,00,00	,, ,, ,, ,, ,, ,, ,, ,,
34,00	40,00	40,00	20,00	,, ,, ,, ,, ,, ,, ,, ,,
42,50	50,00	50,00	15,00	,, ,, ,, ,, ,, ,, ,, ,,
22,50	40,00	40,00	40,00	,, ,, ,, ,, ,, ,, ,, ,,
—	19,00	60,00	60,00	,, ,, ,, ,, ,, ,, ,, ,,
—	—	25,50	30,00	,, ,, ,, ,, ,, ,, ,, ,,
11,00	25,00	25,00	25,00	Continuing work after 1960
14,15,26	9,91,36	10,00,46	8,18,56	
1,12,36	—	—	—	
1,01,23	—	—	—	
27,87	27,52	—	—	
64,56	—	—	—	
14,61	17,55	17,55	17,55	Project to be completed in 1963
—	—	—	—	
19,30	19,22	—	—	
1,12,25	1,42,10	—	—	
—	—	—	—	
37,70	39,70	36,75	36,75	
47,38	66,73	63,22	—	
57,30	70,45	1,85,15	1,46,93	
73,80	1,47,39	—	—	
—	39,51	54,00	—	
—	45,77	1,63,47	93,67	Project to be completed in 1961
—	—	32,62	34,51	,, ,, ,, ,, ,, 1963
—	—	—	1,73,39	,, ,, ,, ,, ,, 1963
6,68,35	6,15,94	5,52,76	5,02,80	
4,37,50	4,46,70	2,19,00	1,97,30	Improvements to continue after 1960
15,00	15,00	—	—	
1,16,00	—	—	—	
3,57,00	3,49,59	2,59,87	1,86,00	Improvements to continue after 1960
9,25,50	8,11,29	4,78,87	3,83,30	

[*continued*

TABLE

SCHEDULE OF PROJECTS IN

(Costs in

	*Estimated Total Cost**	*1953–54*	*1954–55*	*1955–56*
RAILWAYS				
Civil Engineering Works	17,61,69	2,62,00	4,27,00	4,34,00
Mechanical Works	6,32,22	46,96	1,92,00	1,70,00
Equipment for Rail Laying, Ballast, etc.	41,00	—	11,00	30,00
Heavy Construction Equipment	30,00	—	30,00	—
Maintenance Equipment	19,00	—	11,00	8,00
General Office Changes	4,00	—	2,00	2,00
9 Diesel-electric Shunters	35,10	—	—	20,00
25 Diesel-electric Road Engines	2,07,50	—	—	—
Total	27,30,51	3,08,96	6,73,00	6,64,00
HIGHWAYS	81,95,00	3,32,00	7,10,00	8,78,00
AIRWAYS				
Improvement to Airports	4,89,64	1,19,64	1,25,00	1,25,00
New Aircraft	1,35,00	60,00	25,00	25,00
Additional Airport Improvements	1,25,00	30,00	25,00	25,00
Total	7,49,64	2,09,64	1,75,00	1,75,00
TELECOMMUNICATIONS				
Regulating Communications and Training	2,70	70	1,30	70
Central Telegraph Offices	1,86	1,86	—	—
International Radio Telephone Line	5,00	5,00	—	—
Delta UHF–VHF Circuits	16,50	8,00	8,50	—
Rangoon–Mandalay Trunk	18,30	5,00	7,00	6,30
Radio Transmission and Receiving Centers	21,00	10,00	11,00	—
Trunk Line Rehabilitation	20,00	2,00	5,00	5,00
District C–B Exchanges	71,50	7,50	8,00	8,00
Rangoon Auto Exchange	1,43,00	43,00	50,00	50,00
Total	2,99,86	83,06	90,80	70,00
MINERAL INDUSTRY				
Kalewa Coal Project	7,26,12	3,07,30	2,94,43	1,24,39
Myingyan Zinc Project	3,68,12	20,66	1,30,00	1,57,46
Lough Keng Exploration	1,65	56	1,09	—
Lough Keng Development	51,42	7,00	21,00	23,42
Total	11,47,31	3,35,52	4,46,52	3,05,27

*Estimated total cost, in some instances, includes costs beyond 1960.

XXV – 1 (*contd*)

DEVELOPMENT PROGRAM
Thousands of Kyats)

1956–57	*1957–58*	*1958–59*	*1959–60*	*Remarks*
3,75,00	1,58,94	1,04,75	—	
1,20,00	90,00	13,26	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
15,10	—	—	—	
50,00	75,00	82,50	—	
5,60,10	3,23,94	2,00,51	—	
9,96,00	10,41,00	9,91,00	9,92,00	Program to continue after 1960
1,20,00	—	—	—	
25,00	—	—	—	
25,00	20,00	—	—	
1,70,00	20,00	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
5,00	3,00	—	—	
8,00	8,00	8,00	8,00	Program to continue after 1960
—	—	—	—	
13,00	11,00	8,00	8,00	
—	—	—	—	
60,00	—	—	—	
—	—	—	—	
—	—	—	—	
60,00	—	—	—	

[*continued*

TABLE

SCHEDULE OF PROJECTS IN
(*Costs in*

	*Estimated Total Cost**	*1953–54*	*1954–55*	*1955–56*
MANUFACTURING				
Bamboo Pulp and Paper Mill	5,92,00	1,68,41	1,80,00	1,23,59
Steel Products Plant	4,21,40	1,10,66	1,00,00	1,00,74
Jute Bag and Twine Mill	74,68	20,90	39,80	13,98
Rice Bran Oil Plant	35,22	5,22	25,00	5,00
Asbestos Cement Plant	21,24	11,00	10,24	—
Additional Cement Capacity	59,00	2,20	54,00	2,80
Sulphuric Acid Plant	1,51,50	—	—	11,50
Joinery Plant	27,69	27,69	—	—
Plywood Plant	27,62	15,00	12,62	—
Wallboard Plant	53,20	—	—	—
Saw Mill	48,30	—	2,00	35,00
Furniture Factory	14,18	—	8,09	6,09
Fertilizer Factory	7,00,00	—	—	72,80
Other Plants	73,47	—	—	—
Total	22,99,50	3,61,08	4,31,75	3,71,50
SUMMARY				
Power	96,34,94	8,45,67	11,92,50	14,55,13
Irrigation	45,14,87	2,04,52	4,81,40	6,20,78
Ports and Waterways	56,80,22	5,78,18	8,48,88	9,03,20
Railways	27,30,51	3,08,96	6,73,00	6,64,00
Highways	81,95,00	3,32,00	7,10,00	8,78,00
Airways	7,49,64	2,09,64	1,75,00	1,75,00
Telecommunications	2,99,86	83,06	90,80	70,00
Mineral Industry	11,47,31	3,35,52	4,46,52	3,05,27
Manufacturing	22,99,50	3,61,08	4,31,75	3,71,50
Total	3,52,51,85	32,58,63	50,49,85	54,42,88

*Estimated total cost, in some instances, includes costs beyond 1960.

XXV – 1 (*contd*)

DEVELOPMENT PROGRAM
Thousands of Kyats)

1956–57	*1957–58*	*1958–59*	*1959–60*	*Remarks*
1,20,00	—	—	—	
1,10,00	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
70,00	70,00	—	—	
—	—	—	—	
—	—	—	—	
—	28,00	16,00	9,20	
11,30	—	—	—	
—	—	—	—	
2,87,70	2,75,00	64,50	—	
—	47,00	26,47	—	
5,99,00	4,20,00	1,06,97	9,20	
14,15,26	9,91,36	10,00,46	8,18,56	
6,68,35	6,15,94	5,52,76	5,02,80	
9,25,50	8,11,29	4,78,87	3,83,30	
5,60,10	3,23,94	2,00,51	—	
9,96,00	10,41,00	9,91,00	9,92,00	
1,70,00	20,00	—	—	
13,00	11,00	8,00	8,00	
60,00	—	—	—	
5,99,00	4,20,00	1,06,97	9,20	
54,07,21	42,34,53	33,38,57	27,13,86	