LOGGING IN THE ANDAMANS

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SUMMARY

The article gives an account of the various logging operations employed in the past and in the present days for extraction of timber from these islands. The quantity of timber in the early days extracted from these islands was negligible and could be easily extracted with the help of buffaloes and a few labourers. As the demand for Andaman timbers grew, tapping of large areas with better means of exploitation became a necessity. The scattered fellings were replaced by well-organized concentrated fellings and buffalo extraction by elephant extraction and finally by the present day elephant-cum-mechanical extraction. The use of machinery for extraction of timber has greatly increased the outturn. Today the annual production of timber from these islands is between 90,000 to 1,00,000 tons as against about 3,000 tons in 1884–85.

The various factors affecting the logging methods such as nature of the country, climate, composition and type of forests, management, etc., are also described.

I. NATURE OF THE COUNTRY

The Andaman and Nicobar Islands, as the name suggests, consist of two groups of Islands – Andaman and Nicobar – and lie in the Bay of Bengal in the form of an arc. Geographically the islands of the Andaman group are situated between the latitudes of 10° 30′ and 13° 40′ North and the longitudes of 92° 11′ and 93° 7′ East. The Andaman Islands, large and small numbering about 204, cover a land area of about 25,00 square miles. They are lying in a general North-South direction stretching from Landfall Island in the North, about 560 miles from the Hooghly mouth, to the Little Andaman in the South. The Islands are widely separated by sea passages in some places but mostly lie close to each other, being separated by narrow but usually deep mangrove-fringed salt water streams known as creeks subject to the influence of tidal currents.

The coast line is geneally irregular and deeply indented, at places forming spacious, deep, wellsheltered harbours. Mainly, however, the bays along the coast are open to the influence of monsoon winds and are of not much use.

Topographically, the islands are irregular and much broken. They are more or less hilly. The main ranges of hills run in a North-South direction rising to a maximum height of 2,402 feet at Saddle Peak in North Andamans. From there, the spurs and ridges run in a confused manner, enclosing narrow valleys. Level lands are rare and are met with only alongside creeks or river banks and in narrow broken strips along the sea-coast.

II. CLIMATE

The climate is warm and equable, the mean temperature in the shade varying from 65°F. to 95°F. with a perceptible touch of cold during December and January when low mists are common at night with subsequent heavy dew-fall. The islands are visited by both the South-West and North-East monsoons. They blow regularly from May to September and from November to January respectively. These monsoons greatly affect exploitation. At

the beginning of the South-West monsoon the West coast and during North-East monsoons, the East coast becomes dangerous and difficult to land and work. The rainy season starts with the onset of South-West monsoon which accounts for major portion of the annual rainfall and extends to about 9 months of the year. The mean annual rainfall is about 120 inches. The months of February, March and April are hot and dry except for occasional light showers. Stormy weather usually occurs at the onset and change of monsoons; cyclones rarely pass across these islands.

III. SOIL

The soil is usually soft, loose and deep sandy loam varying from the fine texture of the alluvial flats to the gravel strewn soil of the low hills with frequent rocky outcrops. The higher hills consist of stiff clayey soil, overlying micaceous sandstone formation and conglomerates.

IV. COMPOSITION OF THE FORESTS

'With the exception of the land area cleared for settlement, the whole area of these islands from water's edge to the summit of the highest hill is covered with a thick luxuriant forest growth characteristic of a region of warm climate, heavy rainfall and high atmospheric humidity'. According to Champion's Classification 'Forest types of India and Burma' the forests of the Andaman Islands may be divided into :—

A. *Primary Moist Tropical Forests* (Seral types) :—

1. Mangrove forests.
2. Beach forests.
3. Southern tropical semi-evergreen riverain forests (locally known as "Low-level evergreen forests").

B. *Subsidiary Edaphic Types of Moist Tropical Forests* (Padauk type) :—

4. Andaman Moist Deciduous.

C. *Moist Tropical Forests* (Climax types) :—

5. Wet evergreen forests (Hill or high level evergreen forests).

From the timber resources point of view only the following types are of importance.

1. Riverain forests (Low-land evergreen forests),
2. Moist deciduous forests (Padauk type),
3. Wet evergreen forests (High level evergreen forests).

These forests are briefly described below :—

1. *Riverain forests*—The type is usually confined to alluvial flats which forms the banks of streams and inner extensions of tidal flats. Climbers and cane brakes are very heavy and dense. The usual tree species are *Dipterocarpus alatus* (Syn. *D. incanus*) (gurjan) with its associates, viz., *D. gracilis* (Syn. *D. turbinatus*) (gurjan), *Sterculia campanulata* (*papita*), *Pterygota alata* (*letkok*), *Terminalia bialata* (white *chuglam*), *Artocarpus chaplasha* (*taung peinne*), *Parishia insignis* (red *dhup*) which occur in the topmost canopy level of 100 feet and over and grow to gigantic sizes in deep alluvium. Below this, forming the second storey are *Lagerstroemia hypoleuca* (*pyinma*), *Dillenia species* (*zambium*), *Pometia pinnata* (*thitkandu*), *Pisonia excelsa* (*bania*), *Myristica* spp. (*jaiphal*), etc. and many other species of lesser importance. The largest trees are of *Dipterocarpus alatus* (gurjan) which grow tall, straight and clean boled up to 150 feet height and 30 feet in girth at breast height (4' 6" from

ground level). Trees of 15 to 20 feet girth are of quite frequent occurrence in such forests and present a unique problem in timber extraction on account of enormous sizes. This area is very small and does not exceed 7 to 8 per cent of the whole area.

2. *Moist Deciduous forests*—Covering the undulations beyond the alluvial flats and extending up to elevations 300 to 500 feet up the hills and ridges, these forests, locally called Padauk type, constitute the most important resources of timber wealth in these islands.

Pterocarpus dalbergioides (padauk) is the most valuable and naturally durable timber species of these islands. It occurs in the Moist Deciduous forests along with its associates *Terminalia bialata* (white *chuglam*), *Terminalia procera* (*badam*), *Terminalia manii* (black *chuglam*), *Canarium euphyllum* (white *dhup*), *Sterculia campanulata* (*papita*), *Bombax insigne* (*didu* or *semul*), *Lagerstroemia hypoleuca* (*pyinma*), *Albizzia lebbek* (*koko*) and sometimes on moist locations *Dipterocarpus alatus* (gurjan), *Parishia insignis* (red *dhup*), *Artocarpus chaplasha* (*toung peinne*) and *Madhuca butyracea* (*mohwa*). These form the topmost canopy of over 100 feet in height and are heavily buttressed and of large size. The second storey is made up of species such as *Adenanthera pavonina* (*ywegi*), *Lannea grandis* (*nabbe*), *Sterculia villosa* (*lalchilka*), *Aglaia andamanica* (*letauk*), *Sageraea elliptica* (*chooi*), *Diospyros marmorata* (marblewood), *Miliusa tectona* (*jungli sagwan*), *Cratoxylon formosum* (*ye padauk*) and many other species of lesser importance.

These forests usually lie far inland from the sea or creeks at distances exceeding 1 to 2 miles and present problems of long distance haulage of logs. The trees themselves are not of very large size and rarely exceeded 15 to 18 feet in girth though clear boles of 80 feet and over are common.

3. *Tropical Wet Evergreen Forests* (High level evergreen forests)—These forests are typical of the climax type of forests to be expected under tropical conditions. They are confined to the hills and ridges above a general elevation of 500 feet and are therefore termed as "high level evergreen forests". The most luxuriant growth of vegetation is seen in these forests. The principal species of these forests are *Dipterocarpus grandiflorus* (Syn. *D. griffithii*), *Dipterocarpus kerii* (gurjan), *Dipterocarpus gracilis* (gurjan). Together with their associates such as *Artocarpus chaplasha* (*toung-peinne*), *Artocarpus gomeziana* (*kala takuch*), *Calophyllum spectabile* (*poon*), *Planchonia valida* (Syn. *P. andamanica*), (red *bombway*), *Hopea odorata* (*thingan*), *Endospermum chinense* (Syn. *E. malaccense*) (*bakota*), *Sideroxylon longepetiolatum* (*lambapathi*), *Pterygota alata* (Syn. *Sterculia alata*) (*letkok*), *Sterculia campanulata* (*papita*) occasionally *Canarium euphyllum* (white *dhup*) and *Terminalia bialata* (white *chuglam*) they form the top storey. Below these, forming the second storey between 50 to 100 feet are found *Mesua ferrea* (*gangaw*), *Pometia pinnata* (*thitkandu*), *Baccaurea sapida* (*kataphal*), *Podocarpus neriifolia* (*thitmin*), *Myristica* spp. (*jaiphal*), etc.

The trees grow clear boled and to large girths of 15 to 20 feet at breast height. Most of these forests are situated far inland from the sea or creeks and in difficult country on high hills and steep slopes. Conventional methods of timber extraction are inadequate to deal with such topography and it has been found necessary to evolve special means of exploitation of such difficult areas.

It may be mentioned that all these types are met with in almost all the islands and with the exception of tidal forests, they all merge into one another imperceptibly and form an homogeneous mass. It is impossible to draw any sharp demarcation line between any of the forest types.

V. TIMBER RESOURCES

Unfortunately no detailed stock mapping has been carried out so far. However, it is estimated that out of about 1,400 square miles of exploitable forests about 600 square miles are covered by deciduous and about 800 square miles by evergreen forests.

Stocking of commercial species in the virgin forests is poor. It ranges from 6 to 8 tons per acre in the deciduous forests and 10 to 15 tons per acre in evergreen forests.

It is interesting to note that there was not much demand for Andaman timbers before World War II. Only a few well known species such as padauk, gurjan and silvergrey, etc., were sold in the market. The other species such as *badam*, white *chuglam*, white *dhup*, red *dhup*, *bakota*, black *chuglam*, *jhingan*, etc., were almost unknown both in the Indian and foreign market. This was mostly due to the fact that Andaman timbers unlike the mainland species such as sal, deodar and teak which were also plentifully available to meet the then existing market demands, are not naturally durable. With the termination of World War II, a large demand for timber grew, which could not be easily met with from the naturally durable timbers which had already badly worn the brunt of war. Consequently the secondary timber species were lime-lighted. Their utilization gained further momentum with the development and enhanced use of wood preservatives. Now almost all the timber species with the exception of a few, which occur in any appreciable quantity in these islands, are in great demand both in the Indian mainland and foreign countries.

The important timber species of these islands are as follows :

(*a*) *Ornamental timbers*—

(1) Padauk (*Pterocarpus dalbergioides*).
(2) Silvergrey (*Terminalia bialata*).
(3) Marblewood (*Diospyros marmorata*).
(4) *Chooi* (*Sageraea elliptica*).

(*b*) *Plywoods*—

(1) Gurjan (*Dipterocarpus* spp.).
(2) Red *dhup* (*Parishia insignis*).
(3) White *chuglam* (*Terminalia bialata*).
(4) *Badam* (*Terminalia procera*).
(5) *Lalchini* (*Amoora wallichii*).
(6) *Toung-peinne* (*Artocarpus chaplasha*).

(*c*) *Matchwoods*—

(1) White *dhup* (*Canarium euphyllum*).
(2) *Papita* (*Sterculia campanulata*).
(3) *Bakota* (*Endospermum chinense*) (Syn. *E. malaccense*).
(4) *Lambapathi* (*Sideroxylon longepetiolatum*).
(5) *Kadam* (*Anthocephalus cadamba*).
(6) *Didu* (*Salmalia insigne*) (Syn. *Bombax insigne*).

(*d*) *Hardwoods*—

(1) *Nabbe* (*Lannea grandis*).
(2) *Jhingam* (*Pajanelia longifolia*) (Syn. *P. rheedii*).
(3) *Thitkandu* (*Pometia pinnata*).
(4) Red *bombway* (*Planchonia valida*) (Syn. *P. andamanica*).
(5) Black *chuglam* (*Terminalia manii*).
(6) *Pyinma* (*Lagerstromia hypoleuca*).
(7) *Ywegi* (*Adenanthera pavonina*).
(8) Sea *mohwa* (*Manilkara littoralis*) (Syn. *Mimusops littoralis*).
(9) *Gangaw* (*Mesua ferrea*).
(10) Hill *mohwa* (*Madhuca butyracea*).
(11) *Koko* (*Albizzia lebbek*).
(12) *Thingan* (*Hopea odorata*).

This classification is purely arbitrary and is based on the use to which the various species are mainly put. Almost all the species given under plywoods and padauk are also being used as general purpose hardwoods. Regarding the matchwoods also, when they do not conform to the matchwood specifications, they are used as packing case timber.

An idea of the relative occurrence of the various species in these forests will be obtained from the subjoined table.

Kind of wood	Approximate annual timber yield (South and Middle Andamans only)		
	tons	%	
(*a*) Ornamental woods ..	3,000	5	
(*b*) Plywoods ..	24,000	40	
(*c*) Matchwoods ..	12,000	20	
(*d*) Hardwoods ..	15,000	25	
(*e*) Packing case timber ..	6,000	10	(This constitutes mostly the rejected matchwoods).
TOTAL ..	60,000		

VI. MANAGEMENT

There are three territorial Divisions, North, Middle and South Andamans. They were formed during the year 1952–53 under Chengappa's Working Plan. Each of the Division is placed under the charge of a Deputy Conservator of Forests and managed under the direction of the Chief Conservator of Forests. The forests of North Andaman Division are worked by Messrs. P. C. Ray and Co. (India), Private Ltd., to whom the right of exploitation on payment of royalty has been leased out for a period of 25 years. All the operations starting from extraction to shipment and marketing are done by the Licencee under the control of the Government.

The forests of Middle and South Andaman Divisions are worked departmentally. Extraction on a very limited scale is also carried out from these forests through Contractor's agency, but all subsequent operations such as shipment and marketing, etc., are carried out departmentally.

The current working plan was completed only in 1952. This is the third and most comprehensive working plan for these islands. But due to compulsory colonization fellings which started in 1953, its prescriptions could not be fully brought into application. The prescriptions of this Working Plan are therefore now broadly followed with such departures as necessitated by the circumstances.

As laid down in the Working Plan, the paramount object of forest management in the Andamans is the conversion of the existing relatively less valuable and understocked forest, into uniform and fully stocked forest, while at the same time ensuring the production of a sustained yield from the forests. In general the forests are managed under two silvicultural systems – (*a*) Shelterwood System with adjustment of canopy and concentrated natural regeneration (Andaman Canopy Lifting Shelterwood System) and (*b*) Subsidiary or Selection Fellings with improvement fellings to aid advance growth of regeneration.

The former system is worked on a rotation of 75 years for softwoods (or light hardwoods) and 150 years for hardwoods (or heavy hardwoods) ; the latter on a felling cycle of 30 years.

VII. LABOUR FOR LOGGING

There is no labour locally available except a few refugee settlers in colonization areas who are also available only during the non-cultivation season. The labour has thus to be imported from the mainland. A large section of them comes from the Ranchi and round about districts of Bihar. They are recruited through a recruiting Agency at Ranchi in Bihar on two years agreement. They are known as Ranchi labourers. After completion of the term, they are repatriated and new batches are recruited. A few of them sometimes also stay back. Some labourers also come on their own from the mainland in search of jobs. They are mostly from Southern India. Invariably when the labourers join the department, they are not skilled in the various forest operations such as felling, logging, etc., but through constant practice and careful instructions they pick up the work and in due course become quite skilled.

VIII. TIMBER EXTRACTION – RELATED PROBLEMS

The forests areas managed under the Shelterwood System have been demarcated into annual felling coupes. The coupes are usually large valley units with or without direct approach from the sea or creeks. Each of the coupe measures about 2 to 3 square miles. Except for mother trees which are retained as seed-bearers for subsequent regeneration operations, all commercially important species of exploitable size (4 feet B.H.G.) are to be felled and removed from the area. The forests areas worked under the Selection Felling System cover the rest of the blocks not allotted to any Periodic Block. These areas contain mature and over-mature trees that will not stand for a rotation (150 years). Hence they are to be removed as early as possible to prevent them from becoming a total loss by death and decay. In such areas commercially important species beyond a certain size limit are felled and extracted. The exploitable girth fixed for various species in selection felling areas is as follows :—

(1) Padauk – 9 feet.

(2) Low-level gurjan (*Dipterocarpus alatus*) – 10 feet.

(3) White *dhup* (*Canarium euphyllum*) and *papita* (*Sterculia campanulata*) – 6 feet.

(4) Hill *gurjan* (*Dipterocarpus gracilis* and *D. grandiflorus*) and all other species – 7 feet.

Usually the selection areas are situated at locations where the country is comparatively difficult and sometimes not easily accessible.

There are no roads. Though the annual coupes have been selected in such a way, that most of them are not far off from the sea or the creeks, they require 2 to 8 or more miles of tramlines for their complete exploitation. Due to broken, difficult country and non-existence of any sort of communications, Andamans, therefore, offer unique extraction problems in the whole of Indian Union. The same factors are also to a great extent responsible for mechanized extraction in these islands.

In addition to the fellings in the Clear felling and Selection felling coupes, fellings are also carried out in the colonization areas. The first colonization fellings were started in 1953 in the Rangat Valley in Middle Andamans. The flat areas are cleared of all the forest growth. The clear felling in the colonization areas as stated above have not only upset the prescriptions of the Working Plan, but have also added many problems in the field of extraction. Large areas have to be cleared within a limited period, which is not possible without mechanised extraction. The colonization areas are situated alongside the creeks and in scattered patches involving construction of long tramlines for removal of commercial timber.

PLATE No. 1.
An elephant dragging a log in the extraction area.

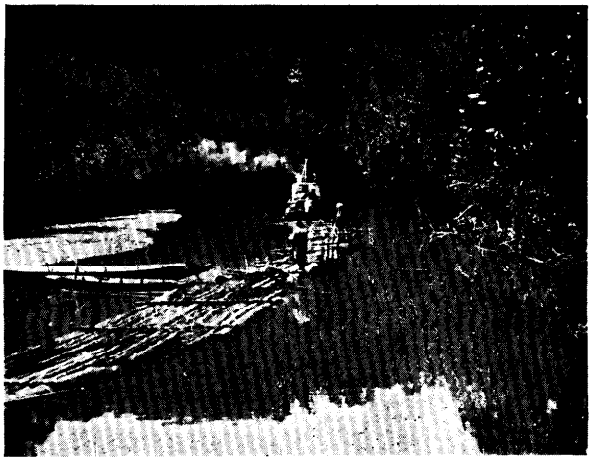

PLATE No. 3.
A Motor boat towing rafts from the rafting point to the Log Depot.

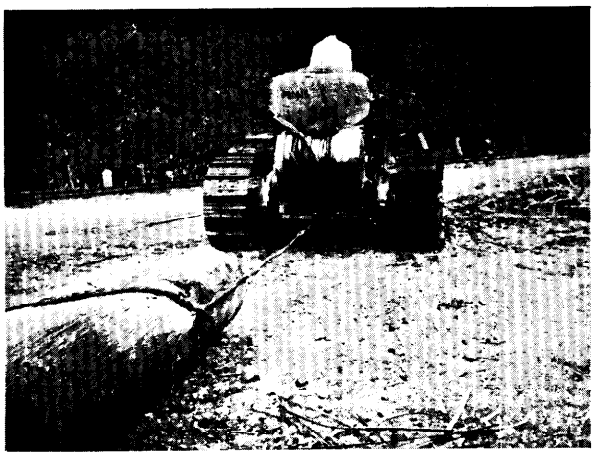

PLATE No. 2.
A D6 Caterpillar tractor dragging logs.

PLATE No. 4.
A pair of timber trucks ready for loading.

PLATE No. 5.
An elephant loading timber trucks at the loading deck.

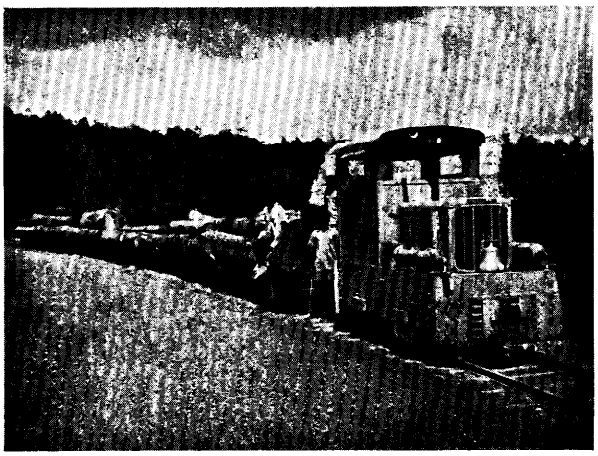

PLATE No. 7.
A Brookville diesel driven locomotive with loaded timber truck.

PLATE No. 6.
An elephant hauling a log-loaded train.

PLATE No. 8.
Elephant unloading timber trucks at the unloading deck.

IX. METHODS OF TIMBER EXTRACTION FROM 1858 TO 1942

Departmental working of the forests date back as much as the beginning of the settlement in 1858, though the Forest Department came into existence only in 1883. In the earliest days the extraction was confined only to some valuable species such as padauk, *pyinma, koko* and silvergrey.

The timber was extracted by direct haulage over the ground with the help of buffaloes or/and elephants. Petty contractors were also employed, who extracted small size timber from short distances with the help of buffaloes, yoked together and dragging in pairs. By these means, extraction fellings were confined mainly to the coastal areas and to areas within half a mile of the sea or tidal creeks from where the timber can be rafted easily. It will be, perhaps, of interest to know that though great advances have been made since then in the field of extraction of timber, buffaloes still find a limited use in the extraction of timber in these islands and in most of the cases, they are still the only means of timber extraction available with the petty contractors.

There was infact no concentrated fellings and felling operations used to be often shifted from place to place to extract timber for meeting the special orders. A party of 6 men or so under a Burmese *Jawabdar*, moved away in the forest with one elephant and came back to the coast after about a week with just one large piece of padauk or silvergrey which had been felled and rough-squared in the jungle and dragged over sometimes 2 to 4 miles by the elephant which could normally cover about half a mile per day. This was extremely a slow process and out-put was therefore very poor, amounting to about 3,000 tons per year with 16 elephants. Conditions did not improve much for long and remained thus until improved methods could be developed.

Slowly the demand for Andaman timbers like padauk and silvergrey grew. Though due to stiff specifications and non-availability of timber and inadequate shipping space, not much progress could be made in the foreign market, Indian markets developed and a steady demand for Andaman timbers especially padauk arose. Therefore in order to meet an increasing demand of padauk, large scale extraction of the padauk bearing deciduous forests became necessary. This brought about problems of land and water transport. In the beginning only buffaloes and elephants were used for extraction of timber from the forests, but increased mortality rate among the elephants due to over-exhaustion necessitated finding of other means of extraction. As a result a 1½-miles long tramline of 2 feet gauge was laid down in 1890 at Dhanikhari at a cost of Rs. 15,683 including the cost of the materials (rails, fishplates, etc.). The rails used were 18 lbs. (per yard) rails. At that time unlike present days, not much expenditure was incurred on the labour because of the free convict labour. Eight men for a pair of truck were used to push the loaded trucks down the slopes and buffaloes were engaged for uphill haulage. This proved quite efficient and more tramline were laid. Later on the dragging power was replaced with the elephants which increased the efficiency tremendously and proved very useful. A pole tramway was also constructed in Ranikhet in 1891 but had to be abandoned due to its unworkability during the rains and frequent derailments.

A further improvement in land transport was made introducing steam tramway. A 6-miles long tramline of 24 inches gauge with 18 lbs. rails was constructed in 1903–04 at Wimberleygunj at a cost of Rs. 99,550 connecting Shoal Bay areas with Port Blair harbour. The locomotive hauled 8–10 logs per trip against 25 to 30 logs per trip with the diesel locomotive of the present day.

Six miles of 8 feet wide metalled road was also constructed in Bomlungta Valley at a cost of Rs. 19,454.

In 1915, the idea of construction of road was given up and it was proposed to extract timber with the help of monorails and buffaloes similar to those then in use in Siam. This was also, however, abandoned in favour of tramlines which were already gaining favour with the forest staff.

In 1921, Mr. M. C. Martin, an American, the then consulting Forest Engineer to the Government of India, recommended after a visit to these islands construction and use of meter-gauge railways and introduction of caterpillar tractors and observed that this would reduce the cost of extraction by 50%. Due to Mr. Bradley the then Chief Forest Officer's opposition, scheme of Mr. M. C. Martin could not materialize. However a skidder mounted on a wooden barge was tried in Alexander Island, but did not meet success and was abandoned.

Later on Mr. Pearce, an American, the then Logging Engineer, Madras Forest Department visited these islands somewhere in 1928 and observed as follows :—"The Andamans have now reached the cross roads in Forest exploitation. They must either take the road of re-organization, improvement and expansion or back to restricted progress, lessened production and decreased profit. There is no middle way". He recommended the introduction of :—

(*a*) Roader and elephants for all coastal and creek areas.

(*b*) Yarder later known as skidder for all areas of difficult topography.

(*c*) Combination system for interior areas and steam engines most suitable for the Andamans.

His recommendations were accepted and mechanical extraction with a skidder at a cost of Rs. 1,57,441 was started under the supervision of Mr. Pearce himself, in the Interview Island in December 1936. Nine 12'-15' wide and 20-30 chains long lines radiating in all directions from the skidder were cleared for running the skyline cableway. Between these, all the logs were dragged with the elephants to the cleared lines and from there they (logs) were yarded at the railhead with the help of skidder. This resulted in an increased outturn. But unfortunately the skidder worked only for a year or so and had to be closed down as its operation required concentrated clear-felling and the timber thus removed could not find ready market due to world wide depression in the timber trade.

X. PRESENT DAY EXTRACTION

It will be of great interest to know that the Andamans, though in many ways is the most backward state, is the foremost State in the Indian Union in the field of mechanized extraction. It will be seen from the foregoing that prior to World War II, extraction of timber was confined mainly to the easily accessible and nearby areas and it was carried out mostly with the help of elephants. Wherever the lead from the felling site to the rafting point was small direct dragging was done. In comparatively long lead extraction areas, elephant tramways were laid for removing the timber to the nearest rafting point. After the World War II, demand for timber suddenly rose up. As the easily accessible and nearby areas were already exploited, it was felt necessary to work more difficult and interior areas. Thus in order to meet the ever growing demand for timber and to work comparatively difficult areas mechanical extraction with the help of various types of tractors equipped with or without hyster winches and logging arches was introduced. The elephant tramways were gradually replaced by diesel driven locomotive tramways. Recently a remarkable development has been made in the field of mechanical extraction by installing a Wyssen Skyline Crane. The introduction of this equipment has made it possible to work even those areas which were hitherto considered inaccessible and unworkable. At present there are over a dozen of Caterpillar tractors working in these slands. Almost all of them are fitted with hyster winches and two of them (one D6 and one

D8) are also equipped with logging arches and bull-dozers. Thus in present days extraction, tractors, locomotives, skyline crane, timber towing and timber carrying boats play an important, active and integrated part. In fact under the present conditions mechanized extraction has become a necessity.

Logging operations are carried out all round the year. But the tempo of logging operations is at its highest during the dry season, i.e., January to May when the mechanical equipment can be put to its maximum use.

In order to give a clear picture of the present day extraction, the various operations involved in logging are briefly discussed below.

(*a*) *Felling*—Unlike mainland, most of the trees in Andaman are highly and heavily buttressed which makes the felling near the ground level difficult. In some cases the buttress extends up to 20 feet from the ground level. A *machan* (stilted platform) has therefore to be built up round the tree before the tree is felled. The fellers stand up on the *machan* and axe the tree down at the end of the buttress. In felling usually no saws are used. Sometimes, however, when the ground is level and trees are not buttressed, felling saws are also used along with the felling axes.

Fellings are done only with the manual labour. A feller in Andamans fells 3 to 5 trees per day depending upon the species and the size of the trees. He can fell larger number of softwoods (light hardwoods) as compared to the hardwoods (heavy hardwoods).

Mechanical fellings have also been tried but did not meet much success due to ill-suited machinery and large size of the trees. Telepower-saws and WD6 tip saws fitted with pressure bars were used. Mechanical fellings also could not find much use because of felling through manual labour being comparatively cheaper.

(*b*) *Logging*—Logging is the most important operation and deserves special attention because bad logging can result in heavy loss of valuable timber. While logging, the following points are given due consideration and more stress is laid on the first and the last.

(1) Maximum utilization of timber.
(2) Shape and condition of the bole.
(3) Configuration of the felling areas.
(4) Nature and condition of the dragpath.
(5) Dragging power.
(6) Market demand.

Logging is also done by manual labour with the help of $5\frac{1}{2}$ to 8 feet long cross-cut saws. A pair of sawyers, logs about 3 to 5 tons of hardwoods and 5 to 7 tons of softwoods a day. Mechanical logging with power chain-saws was tried but did not prove much useful for the following reasons and had to be discontinued.

(1) Large size of the trees.
(2) Broken country which makes the carriage of the power saw difficult.
(3) The rains continue more than nine months in a year. The power-saws can not be profitably used in the rains.
(4) These saws are too heavy for the the normal Indian labour.
(5) The labour is comparatively cheaper. These inferences have been drawn from the personal experience of the author while supervising logging operations in Middle Andamans. Two and four feet power-saws were used. Limited use of the power-saws for cutting tramline sleepers is, however, still in vogue.

(c) *Dragging*—It is the most mechanized operation in these islands. After the trees are felled and logged they are removed to the railhead or nearest rafting point. This is termed as dragging and is carried out either purely by elephants or by tractors or by combination of the both depending upon the nature of the country, the size of the logs, the distance from the felling site to the railhead or the rafting depot. Wherever the lead is small, that is below half a mile, timber is removed from the forest only with the help of elephants. When the lead is more than this, usually tractors are employed. If the country is hilly and badly broken, the tractors work at the top and the elephants at the bottom or vice versa ; again depending upon the configurations. Because in some areas due to steep slopes, tractors cannot work, therefore in such areas elephants are engaged which chute down the logs. It is better to discuss elephant and tractor dragging separately as the dragpath requirements and other particulars for the both are variable.

(i) *Elephant dragging*—Elephant working in Andaman is slightly different from that in the mainland especially as seen in some places in Madras and Kerala. Unlike mainland, the elephants are let loose, after the working hours. Actually it will not be a wrong statement if it is said that the elephants employed in the Andamans Forest Department are semi-wild. The elephants are brought to work spot early in the morning. The elephants are worked usually before noon, because it is not possible to get much work from them in the hot sun and the elephants get exhausted early. Moreover it is deleterious to the health of the elephants. An interesting fact in elephant extraction is that during the rainy season when the mechanical extraction by tractors falls down badly, the elephant extraction reaches its maximum due to congenial climatic conditions for elephant working. The monthly outturn for each elephant is fixed in accordance with the condition and age of the elephant. In the case of some very good elephants it is fixed at 100 to 120 tons per month.

Unlike Madras State (as seen at least in some places) where the elephants drag logs by holding the rope tied to the end of the log in the mouth, the logs are tied at their ends to the chain which is hooked on to the breast strap of the elephant. Cutting of the chain groove and making of the snout are essential for better drag-chain hold and efficient dragging. Moreover if the logs are not snouted, the elephant gets *galaband* (shoulder gall). One to three logs are dragged by the elephant at a time depending upon the size of the log, the lead, the nature and condition of the dragpaths and condition of the elephant.

The dragpaths are made alongside the contour. They are 8 to 10 feet wide. They have to be carefully aligned and are corduroyed or skippered with 10′ to 12′ long and 2″ to 3″ thick round *ballies*. They are necessary to reduce friction and for efficient dragging. All the boulders, stumps, etc., are cleared, the presence of which considerably slows down extraction of timber and results in *galaband* of the elephants.

(ii) *Tractor dragging*—Tractor dragging is much more efficient as compared to elephant dragging. But its working is only economical and advisable in the areas where large scale concentrated extraction has to be carried out. Moreover due to its high initial cost, it is not possible for the petty contractors to make use of it. It can be profitably employed by the Govt. Department or a Company engaged in large scale concentrated long-term extraction.

The use of tractor with the hyster winches has revolutioned extraction in Andamans. The areas which could not be tapped in the past with the elephants are now easily tackled with the tractors. In view of large size trees and no proper communications the use of tractors in Andamans has become more or less compulsory.

The tractors do not require special dragpaths. A 15′–20′ cleared strip of forest with no stumps or big boulders on it can very well serve a dragpath. However, in a boggy area the dragpaths have to be corduroyed. The advantage of the tractors with the hyster winch is

that tractors need not be taken to the stump site. The tractor is brought to a convenient place and the load of logs is hauled up and collected from the felling site with the help of the hyster winch. Depending upon the type and condition of the tractor, configuration of the country, the tractor with a logging arch can drag 5 to 10 tons (50 c.ft.) at a time. The drawbar pull of D6 Caterpillar tractor on the level ground is about $2\frac{1}{2}$ tons (50 c.ft.) and that of D8 Caterpillar tractor is about 5 tons. When coupled with logging arch, it can be increased to 5 and 10 tons respectively. With the tractors there is no need of logging the tree at the stump site as the tractors can haul full bole lengths to the loading deck. Logging at the loading deck results in increased outturn and less wastage of timber due to avoidance of making a large number of snouts, as for dragging each log a separate snout has to be made. This also normally results in lowering unit cost of hauling. The logs are tied with the sling and hooks which is hooked on to the drawbar or the hyster winch. During the climb the logs are hauled with the help of the hyster winch and in the flat and down hill areas they are dragged on the drawbar.

Another point which deserves special consideration and which goes a long way in economical working, is the choice of correct type of tractors. There are two main types from the mobility point of view :

(1) Wheel type.
(2) Track type.

For the dry flat areas, the former type is better while for the comparatively muddy, loose soil and hilly areas the latter is better because of the better grip.

Tractors are also classified according to the power of their engines and they are termed differently by the various tractor Firms. The Caterpillar tractors are classified as follows :—

1. D2
2. D4
3. D6
4. D7
5. D8

D9 Caterpillar tractors also appear to have come into the market, D2 and D4 tractors are too small and are not of much use. D8 tractors are too big and are not much suitable for extraction as it is difficult to feed them speedily and sufficiently. A D8 tractor with a logging arch under normal conditions can easily drag about 50 tons a day. An extraction below this will result wastage of the machine power and ultimately in uneconomical running. From the experience in Andamans, both from the the cost and utility point of view, D6 tractors are very useful. D8 tractors are very costly and cost almost twice the value of D6 tractor. D8 tractors are actually more suitable for earth work.

A word about the various types of the makes may also be said. There are various types of tractors. But the more important types are the International tractors or Caterpillar tractors. It is difficult to say which is better of the two. But from the use of the Caterpillar tractors in the Department it can be safely said that the Caterpillar tractors are quite reliable and suitable for timber extraction for our conditions.

The dragging outturn of the tractors can still further be raised considerably with the use of logging arch. We have got two tractors fitted with logging arch one D8 Caterpillar tractor and the other D6 Caterpillar tractor. When the logging arch is used, it requires wider dragpath. A D8 Caterpillar tractor with logging arch requires a minimum 20 feet wide dragpath. Under normal conditions a D8 Caterpillar tractor fitted with logging arch can easily extract about 50 tons a day (8 hours shift).

The only drawback of tractor use in Andamans is that they cannot be put into operation efficiently and economically throughout the year. During the rainy season, they have to be closed down, as the extraction does not keep pace with the one obtained in the dry season and the wear and tear of the tractors increases considerably.

It may be mentioned that for economical and efficient running of the tractors, a well equipped tractor workshop with ample spare parts manned by a well-versed tractor engineer and good mechanics is essential. Day to day upkeep of the machinery is also very important and should in no case be lost sight of. At the same time well planned organization, good supervision and thorough training of the staff and labour in the use of tractors are absolutely essential.

Wyssen Skyline Crane—This is comparatively a recent invention in the field of extraction of timber. It is in fact an improvement of great importance and value on the various types of aerial ropeways. It was designed by a Swiss engineer. The crane was obtained from Dehra Dun Forest Research Institute and was installed near Manarghat in South Andamans. The crane has proved of great use and made it possible to work even those areas which were hitherto considered unaccessible. The cost of carriage is much low as compared to any other means of transport.

But unfortunately full use of the machinery could not be made due to its limited carrying capacity. The carrying capacity of the present Wyssen Skyline crane is 1½ tons dead weight. Under the Second Five-Year Plan we have another crane on order of higher capacity and diesel driven instead of petrol driven. The latter factor will further bring down the carriage cost.

(*d*) *Land Transport*—There are no roads in these islands except round about Port Blair Settlement Area. Recently, however, construction of some roads has been taken up in the Colonization areas. One fair weather road of about 3½ miles length has also been constructed in the forest area for timber extraction and some timber has also been extracted over it with the help of WD6 tractor and a four wheeled trailer. Thus in the absence of any proper communications, tramlines temporary or semi-permanent in nature, are constructed in the forests to provide essential means of communications. These are elephant or loco operated tramways. It will be seen from the account of the pre-war extraction methods discussed earlier that the former was greatly used in the pre-war days. After the World War II, due to long leads, the elephant tramways did not prove much useful. They are fast disappearing and getting replaced by loco-tramways. Actually in most of the working areas the elephant tramways have become a thing of the past. They are only laid and put into operation where the lead is not more than 2 miles or at the maximum 3 miles.

The elephant tramways are in fact similar to loco-tramlines with the following few exceptions :—

(1) The elephant tramways are operated with the elephant power but the lines are constructed in such a way that as far as possible gravity is used for moving the loaded trucks.

(2) The gradient for an elephant tramway is 1 in 75 and requires some easy reverse gradients at short distances to check the speed of the loaded trucks. In the case of the loco-tramways the gradient is usually 1 in 100. There need not be any reverse gradient as the speed of the loaded trucks is controlled by the loco.

(3) For elephant tramlines 18 lbs. (per yard) rails can be used and the distance between the sleepers can be slightly wider apart, while in the case of loco-tramlines the rails should be of higher gauge depending upon the load to be

carried over it and other factors such as weight and speed of the loco. For Brookville or Fowler or Ruston loco, 24 lbs. (per yard) rails have been found quite suitable and are largely used in the loco-tramlines.

The gauge of both the elephant and loco-tramlines is the same because the timber trucks are used of the same specifications on both the tramlines. The gauge is 30 inches. This gauge is wider than the more or less conventional gauge of 2 feet and has to be adopted in preference for the safe carriage of the huge sized timber extracted from the Andaman forests. In the past round untreated jungle *ballies* were used as sleepers. Now in order to prevent derailments and to increase the efficiency and life of the tramline with minimum maintenance cost, hand squared and mill-cut sleepers of 4″ × 5″ × 4′ 6″ size are being largely used. Wherever feasible they are also creosoted. The use of squared sleepers has considerably decreased derailments and increased transport.

The alignment and construction of the tramlines requires a great technical skill. These tramlines are laid down before the area is taken up for extraction. They are usually laid alongside the streams. They lead to a rafting point. The timber is dragged down from either side of the tramline and carried over it and dumped at the rafting point. The cost of construction of the tramline varies from Rs. 35,000 to Rs. 40,000 per mile depending upon configuration of the country (This also includes the cost of rails, fishplates, etc. The cost of labour is only about Rs. 8,000 to Rs. 10,000 per mile). The earth work is mostly carried out through manual labour. Of late tractors fitted with bull-dozer have also been employed in construction of tramline for earth work and have been found very useful. Where there is more earth work the cost is higher and vice versa. These tramlines are of great use in timber transport over the land in these islands and there are about 50 miles of tramlines in these islands out of which about 40 miles will be locomotive tramlines. But unfortunately use of the tramlines is limited only to the valleys and level sea-coast areas. As such the necessity of forest roads is still actually felt and construction of a net work of 20 miles of *pucca* forest roads is envisaged under the Second Five-Year Plan.

Timber truck loading and their haulage—The timber trucks are four iron wheeled bogies fitted with a swivel bolster for carrying logs. The swivel bolster is provided with a C.I. sliding block on its either end which holds the logs in position. Two timber trucks are joined by 5/8″ iron chain. The distance between the two trucks depends upon the length of the logs because the logs are loaded in such a way that either end of the log does not protrude beyond the truck frame, so that when the loaded train of trucks moves, the logs may not collide resulting in overthrowing of the logs. On each pair of trucks, 3 to 5 logs are loaded depending on the size and weight of the logs and the condition of the tramline. In other words about 1½ to 2 tons (50 c.ft.) of logs are loaded on each pair. The logs rest over the swivel bolsters. In order to keep the loaded logs in position the logs are tied with ½″ to 5/8″ iron chain. Coupling bars have also been tried but did not give satisfactory performance and have to be given away. Trucks are usually provided with hand brakes. In order to give an idea of the timber bogies used, sample specifications are given below.

GENERAL

(1) Bogies fitted with swivel bolster for carrying logs up to 5 tons load on each bogie suitable for a rail gauge of 30″ fitted with hand brake. Component parts of the bogies are interchangeable.

(2) *Bogie Frame*—The bogie frame to be built up of 5″ × 2½″ R.S. Channels with two Cross Channels of same section and four longitudinal thrust channels of 4″ × 2″ section. The joints of the frame to be suitably cloated and gussotted. The centre pivots top and bottom to be of best quality cast iron with machine bearing surfaces and fitted with a pivot pin of 2″ diameter.

The Axle Guards to be of Flat section not below 3″ × 3/8″. The Axle Guards to be connected with 2″ × 1/4′ angle tie.

The Buffer to be pressed from 1½″ thick M.S. plates tightly packed with timber. The Buffer height to be 1′ – 3½′ from the rail level.

The Coupling links and pins to be made from 1⅛″ and 1¼″ diameter rounds respectively.

(3) *Swivel Bolster*—The bolster to be built up of 4″ × 2″ R.S. Channels fitted on two C.I. sliding blocks which are adjustable by rotatings crews. The blocks are to be provided with eyes at the top for lashing rope. There should be a minimum loading space of 5 feet between the sliding blocks.

(4) *Running Gear*—The wheels are to be of cast steel shrunked on to the Axle. The Axle is to be of Mild Steel 2–½″ diameter with 2″ dia. Collared Journals.

The Axle boxes are to be of best quality cast iron provided with seat for Coil Springs at the top.

The Coil Springs are to be made from carbon spring steel and of adequate strength for carrying the load.

(5) *Hand Brake.*—The Hand brake is to be operated from one side by lever and with C.I. Brake Block action on two wheels on one Axle.

The trucks are loaded with the elephants. Loading decks are constructed alongside the tramline. The loading decks are wooden sloping platforms. Their height is adjusted in such a way that the level of the deck is just flush with the level of the swivel bar. The elephant bunches the logs on the deck and pushes up over the rollers on to the timber trucks with the help of his trunk, tusks and forelegs. Usually tuskers are engaged for loading timber trucks.

Though mechanical loading can be done and it was done for some time in 1938 or so in the Rangat Valley in Middle Andaman with the help of a skidder, elephant loading remains still of great utility due to cheaper cost of loading and easy carriage of the elephants over any sort of area where carriage of machinery if does not become impossible, at least greatly difficult. The elephants work with a great degree of precision. It is a delight to see an elephant loading timber trucks – how he carefully places them on trucks and adjusts their weight and makes them fully secure. A good elephant can easily load 30 to 40 tons a day. It may not be out of place to mention that though mechanisation is entering into every sphere of forest operations in these islands with greater utility and benefit, the position of elephant in respect of various forest operations still remains unmatched and its use will perhaps remain indispensable for years to come.

When the haulage power is provided by the locos the number of pairs of timber trucks can be increased to 8–10 depending upon the power and condition of the loco and nature and condition of the tramline. The Brookville loco which has proved quite useful and reliable under our conditions, can haul 20 tons (50 c.ft.) at a time. Over a distance of about 8 miles about 50–80 tons (50 c.ft.) of logs are transported daily by a Brookville loco. The locos used are diesel driven. Though the running of steam locos may be cheaper, the use of diesel driven locos appears to be more suitable for the Andaman conditions on account of the following reasons:

(1) The steam locos are heavy and they will require heavier rails and bigger sleepers, which will considerably enhance the cost of tramline construction.

(2) The tramways in Andamans are of temporary nature and they are shifted from time to time as the extraction in a particular area is completed. In such cases

it is easier and safer to dismantle and transport diesel driven loco than the steam loco.

(3) The steam loco if unfortunately gets derailed and the boiler gets damaged, it is condemned once for all.

(*e*) *Water Transport*—It is lucky that the coast of these islands is much indented and irregular which provides well sheltered nice harbours. There are also plenty of salt water creeks which go far inland and provide excellent means of communications especially in the absence of any other communications. In fact, but for them, most of the areas would have still remained unentered and unworked.

The logs are either dragged or railed to the nearest rafting point. From the rafting point they are either transported to the shipping ports where they find their way into the holds of the ships bound for an Indian or a foreign port, or to the Chatham Saw-mills where they are converted. The logs are unloaded from the timber trucks with the elephants and dumped into shallow water, where they are rafted with the canes. Rafting is also very interesting operation and requires good knowledge of the species sepecially with regard to their buoyancy. Unfortunately all the Andaman timbers are not floaters. The light hardwoods - locally known as softwoods a few heavy hardwoods such as padauk and white *chuglam* are only floaters. All the remaining species including gurjan which forms about 30% of the total extraction, are sinkers. However it will be of interest to note that sometimes some floater species, e.g., padauk, white *chuglam* and *didu* are sinkers and sinker species like black *chuglam* and gurjan behaves like a floater. These occurrences are rare and are confined only to a particular area. It is a general observation that the time lag between the felling and rafting has got no effect on sinkers regarding their floatability. The long felled species are as good sinkers as the fresh felled ones. Therefore while rafting, sinkers and floaters are to be tied in such a mixed manner that the maximum number of sinkers are rafted with minimum number of floaters. The floaters-sinker problem is so important that the extraction has to be arranged in such a way that sufficient number of floaters are available for rafting the sinkers. Usually the rafts are 5 logs wide - three sinkers and two floaters. The buoyance of the various floating species is greatly variable. Of all the floating species white *dhup* is the best floater. No ropes are used for rafting, only canes which are plentifully available and are of not much other use, are used for rafting. The species of canes used for rafting is *Calamus pseudorivalis*. Due to its excessive use for rafting, it is called rafting cane - the green mature portion is used for rafting and the white tender portion for cane work.

The individual rafts are secured with 3″ (circumference) coir ropes and are poled where the water is shallow and motor boats cannot go ; they are towed with the boats where the water is deep and navigable.

The towing is mostly confined to the creeks where there is no swell or breakers. Towing through the open sea is only confined to short distances and resorted to only during the calm weather. Because in a rough sea the rafts get broken ; the sinkers get sunk and lost once for ever and the floaters get scattered away, the collection of which becomes highly difficult and expensive. It may be mentioned that towing through long distances in open sea is also said to have been carried out during the war time. The rafts were secured with steel wire ropes. Though they are said to have travelled 50 miles of open sea or so they were attended with heavy losses, when the sea became rough. Even in 1955 a few rafts were towed to Elphinstone Harbour from Henry Lawrence through a stretch of 25 miles of open sea.

An important point in towing is that towing has to be arranged in accordance with the tides. Because towing against the tide is mostly impossible and has got a detrimental effect on the engine of the boats. The towing is usually taken up with the rise or fall of the tide as

the case may be depending upon the direction in which the rafts are to be towed. The quantity to be towed at a time depends upon the power and condition of the engine of the towing boat.

Where there is open sea and towing is not possible, the timber is transported in the small vessels. We have got two types of vessels. One type is steam powered which lifts the logs from the rafts with the help of derricks and loads them into the hold. The other is the war time diesel powered L.C.T. (Light Cargo Transport). The running of steam powered vessel is comparatively cheaper. The L.C.Ts. are very useful and carry about 120 to 150 tons (hoppus measure) of load at a time. Their speed is faster than the present working steam vessels and they have got the advantage over the other type vessel that due to their flat bottom they can beach and pull the logs from the shore directly with the help of locally fitted loading device. The loading is also more efficient and easy. But their running cost is comparatively high due to high diesel consumption.

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NEWS AND NOTES

Indian Council of Agricultural Research, New Delhi

PRUNING SWEET POTATO VINES

New Delhi: Pruning of all lateral shoots of the sweet potato vine to a particular length leads to an increase in sweet potato yields.

This was seen in an experiment conducted at the Agricultural College, Coimbatore, Madras State.

By pruning the vine, its vegetative growth is checked and the increase in yield may be possibly due to the greater enlargement of the roots.

In the experiment, vines were pruned to one foot, two feet and three feet. The pruning treatment generally promoted increased yields as compared to the untreated vines.

The rolling of vines also appeared to reduce the yield to a certain extent.