256

EAST AFR. PROT

3499

C.O.
3499
21 JAN 20

[illegible] 477

Electricity Supply Order

1920
Jany

Submits memo by Mombasa Electric Lighting Co.

Previous Paper.
297/19

[illegible]

Subsequent Paper.
[illegible]

(h) Wt. 26669—35 50,000 11/19. H. St. G. 122/41.

C.O. 3499

RECD 21 JAN 20

257

6, STONE BUILDINGS,

LINCOLNS INN, W. C. 1.

January 20th 1913.

To the Under Secretary of State for the Colonies,
THE COLONIAL OFFICE,
W H I T E H A L L, S. W. 1.

Sir,

I have the honour to submit Memorandum which I promised you should have at the beginning of this week. I have kept it as short as possible and have refrained from adverting at length to many points in order to keep out, as far as possible, the personal element.

The Mombasa Electric Light & Power Company is, however, prepared to substantiate the allegations contained in the telegram which I had the honour to bring to your notice should occasion arise.

I have the honour to be,

Sir,

Your most obedient servant,

Encls.

6, STONE BUILDINGS,
LINCOLNS INN, W. C. 1.

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Sir,

Your most obedient servant,

Encls.

Mr Bottomley
? attach memos below
ML 3/2

5, STONE BUILDINGS.

LINCOLN'S INN

W. C. 2.

February 3rd 1920.

The Under-Secretary of State for the Colonies,
Colonial Office,
WHITEHALL. S. W. 1.

Sir,

MOMBASA ELECTRIC LIGHT & POWER CO. LTD.

Herewith I have pleasure in enclosing two further copies of the Memorandum with Appendices, as requested.

I have the honour to be,

Sir,

Your obedient servant,

[signature]

Encls. 2.

C EAP

3477

261

DRAFT.

MINUTE.

C/3484 EMP

Pd Urgent

21 Jan 20

James [illegible]
C/134 Adel[illegible]

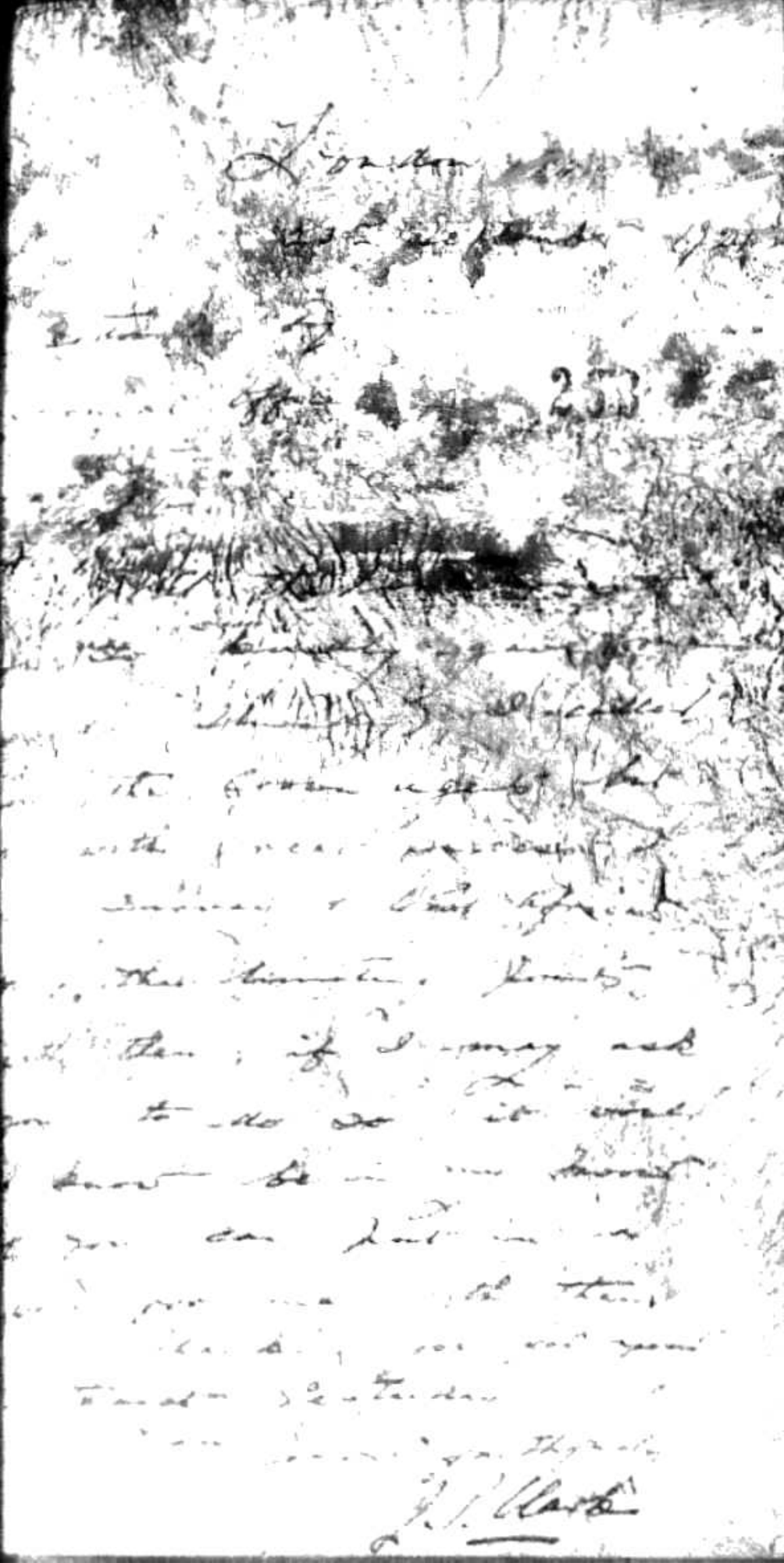
Sir,

I am [illegible] to [illegible] you the accompanying memo. by the [illegible] Electric Light & Power Co regarding its position under its concession and the application of the new Electricity Order of the E.P.P.

2. I am to request that you will furnish your comments on this matter, [illegible] the various [illegible] [illegible] as to other [illegible] of the memo [illegible] [illegible] it is [illegible] [illegible] may be able to return it, with your [illegible], at a very early date

C.W.B.
21/1/20

C-3481



C. 9138/20 Eal 265

DRAFT.

CA

Ed

Sd 1 March ~~February~~ 1920

Gentlemen

MINUTE.

Bramley 26 Feb
Parkinson 27.2.20
Mr. [illegible] (4132)
Mr. Grindle 1/2/20
Mr. H. Lambert
Mr. H. Read
Mr. G. Fiddes
Mr. Amery
Sec of State

With ref to your letter M. Eal 2946 of the 26th of Jan I am directed to inform you that there is no objection to your considering Mr. Clark with the coast for employment under [illegible] post of one of the Eastern [illegible] for which it is understood that he [illegible] desires [illegible]

[illegible]

Se Qucl

Draft

4 March 1920 — J.P. Clark Esq

Sir,

I am directed to ack the LPB 26 Feb

recd of your letter of the 18th [illegible]

of Feb, & to inform you that [illegible]

the [illegible] have been

informed that they may now with [illegible]

consider you for employment

under the Govt of one of the

Eastern Colonies if you [illegible]

apply to them for suitable

employment

Sir [illegible]

Mr Bottomley

You asked me to revive the [illegible] of a forestry expert being sent to report on the [illegible] Forests.

I understand that [illegible] 10896 in which the matter was originally discussed has been lost.

However I remember that you asked me to make inquiries & I did so of the Professors of Forestry at Oxford, C[illegible] & Edinb.

Prof [illegible] of Oxford said he would like to go himself if his Univ: would agree & he would [illegible] [illegible] [illegible] would let him go abt Dec I think he mentioned [illegible] again the scale of remuneration he [illegible] [illegible] [illegible] [illegible] [illegible] about it.

The Reader in Forestry at Cambridge [illegible] [illegible] [illegible] I should not bother with him [illegible] [illegible] & dilatory [illegible] [illegible] [illegible] [illegible] [illegible]

Prof Stebbing [illegible] [illegible] [illegible] answered to a [illegible] [illegible] that he [illegible] [illegible] [illegible] able to [illegible] [illegible] [illegible] shortly [illegible] [illegible] [illegible] below. But [illegible] [illegible] [illegible] [illegible]

Personally I don't think you will be troubled much by Prof. Trouton. He has had considerable experience in the Indian Forest Service & I think there is a chance all round to their advantage for Training that he had conducted a timber survey in India.

Sir D. Prain - I believe very highly of him & he is certainly answering his satisfactorily. Professor Bidwell writes

I will wait a few more days but let me write & ask him to come up & have a talk with me saying that the delay has been due to my having to wait for replies to enquiries made in other quarters.

WBT

2/VII/20.

July 1920.

Mayo Nurse. 268

Potteries Trust. letter of 25/VI/20

Steam coated at C.P.O. 986/20

Uganda Air Survey will Prof. Trouton or Hedley be glad to have a talk to you about their work in Africa & other kindred matters

Nothing to be done at present. He is leaving this country for Spain on 15th

WBT 15/7.

Entered

249

[illegible] July, 1920.

Dear Professor Troup,

With reference to our conversation here some weeks ago about the possibility of your visiting East Africa to report on the forests, I am now writing to ask whether you could call here in the near future to discuss the matter personally with the head of the East African Department, who would very much like to see you. If you will let me know and come and see him, I will take you along and introduce you to him. I very much regret the delay which has occurred over this business. We felt bound to wait for replies to enquiries which we had made in other quarters and these have been very slow in coming in, so that we are only just able to get on at all.

Will you let me know the date and time convenient to you and, if you can, give me an alternative, in case the man I wish to introduce you to is engaged on Committee? The sooner you can conveniently come [illegible].

Yours sincerely,

RB R[illegible]

[illegible]

SCHOOL OF FORESTRY.
UNIVERSITY OF OXFORD.

25th. November 1920.

[illegible] Major Furse,

With reference to the proposal that I should visit the [illegible] African Colonies next year and submit proposals regarding [illegible] Administration, I applied to the University for 9 months [illegible]ve from August next, but this has been refused, mainly on the [illegible] that my services cannot be spared for so long a time. [illegible] just possible, though by no means certain, that I may be [gra]nted leave for a shorter period, and I am prepared to submit [illegible] application for leave, this time from the [illegible] of July [illegible] to the middle of January 1922; this will [illegible] 6 months for [illegible] visit to East Africa, including the journeys there and back. [The] question now is whether this period will be sufficient, and [if yo]u would let me know at you earliest convenience I shall en[deavour] to obtain leave, failing which I shall [illegible] to find [illegible] officer for the work [illegible] know [an]yone available.

I had hoped to talk [illegible] you [illegible] [I] am very sorry you [illegible] [illegible] hope you will [illegible] if you would [illegible] things [illegible] of December, say about [illegible]

[illegible]

SCHOOL OF FORESTRY,
UNIVERSITY OF OXFORD

2/12/20

Dear Major Tree,

I shall call at the Colonial Office at 12 on Tuesday the 7th, and if I do not find you I shall go and see Mr Bottomley.

I hope you are reading a good report.

Yours sincerely,

School of Forestry,
Oxford.

24th December, 1920.

272

r Major Furse,

I have again represented to the University the
stion of my deputation to East Africa. Leave for 9 months is
m afraid, out of the question. I am told, however, that it i
good as certain that I shall be allowed 6 months leave, that i
m the beginning of July to about the middle of January. Forma
ers to this effect would have been issued by this time but for
holidays, and at any rate I am told informally that the matte
be considered as settled, and we may therefore proceed on the
erstanding that it is. There will now be a good deal to talk
r as regards details, and I shall want information on various
nts, some of which is probably available at the Colonial Office
gh a certain amount of information will have to be collected
he spot before my arrival. I can come up to Town any time
r the 1st January if you will fix a day and hour and give me
w days' notice.

Yours sincerely,

R.S.Troup.

R.D.Furse.

[illegible]th December, 192[illegible].

Dear Professor Troup,

Many thanks for your letter of the [illegible] December. Could you come in and see Mr. [illegible] and me on any day before the 5th January? The best time would be between 12 and 1 o'clock, if that is convenient to you. Perhaps you would kindly let me know when to expect you.

Yours sincerely,

To Prof Troup (Oxford) 274

Meffering (Edin)

15 March 1920

Letter of 18 March from Prof Troup [illegible] booklets [illegible]

[illegible]

Mr Bottomley

I have held this up a bit in order (a) to see if we got any suggestions from Camb & Edinb.

(b) till I could write the means [illegible] general [illegible] to [illegible] which I send you herewith.

I have had no further reply from Camb or Edinb.

Personally I doubt if you could possibly do better than Prof Troup [illegible] etc.

[illegible] to deal [illegible] I have [illegible]

[illegible]

[illegible] advice especially if he did the [illegible] first.

(Shall I stir up Camb: Edinb again?)

[illegible] 14.IV.20

2 [initial]

The Cedar House,
Cobham,
Surrey.
28 February 1920

10396

Sir. I have the honour to acknowledge your letter No. Gov 4975 of the 7th inst. forwarding copy of a memorandum by the Conservator of Forests, E.A. Protectorate, with reference to an E. African forest service.

2 The aim set out therein is a wide one, & without criticising the proposals closely I beg to express my agreement with the principle, not perhaps of a single administrative control but of coordination of policy & advice. I had some time ago instructed my Chief Forestry officer, Mr Fyffe, to bear in mind the requirements for the future to prepare schemes for a system of plantations, & to take steps to prevent forest waste & destruction.

The Under Secretary of State
The Colonial Office

3. You will also be aware that a

a year ago I recommended the appoint-
ment of a Forest adviser, probably
India, Ceylon or the Malay States, to
in Uganda for, say, a year, & to evo
a definite forest policy which Mr
would carry out; Mr Fyffe was him
in full agreement. The principle
approved, but I recommended lat
the proposal should be delayed till
was about to return to Uganda a
his present leave.

4. I may state my opinion that the
in Uganda capable of being work
commercially are not of great ex
high quality, & while I think a Bur
information to the timber trade
idea, I believe that Uganda & East
will use all the timber that we ca
produce for some years to come &
little will be available for expo
oversea.

2.

5. The question however is not one of urgency, and should I think await the report of the Forest Adviser for Uganda to whose appointment I have referred above. I think it would be advisable if you would communicate with Mr Fyffe, who I understand is now taking a forestry course at Oxford, with a view to settling the appointment of this adviser.

I am Sir,

Your obedient servant,

Coryndon

DOWNING STREET,

15 March 1920.

Dear Professor Troup,

I should like to ask if you could help us with your advice in the following matter. The question of sending out a forestry expert of experience to investigate the conditions with regard to forestry in the East Africa Protectorate, Uganda and probably also in Tanganyika Territory (late German East Africa) and to advise the Governments of those Protectorates as to forest policy and (if necessary) as to the reorganisation of their local forestry services, is now under consideration here.

A senior and experienced man would of course be essential; and he would probably take several months at any rate to make the necessary enquiries.

It would be of great assistance if you could suggest any man who you think would be suitable for such a mission and who would be likely to be willing to undertake it.

We should also be very glad of your views

as

A. TROUP

as to what sort of remuneration it would be necessary to offer, as, until we know that, it is impossible for us to ask the Treasury for their approval of the scheme.

279

(50) 1 R.04

DOWNING STREET,
/S March 1920.

Dear Professor Stebbing,

I should like to ask if you could could help us with your advice in the following matter. The question of sending out a forestry expert of experience to investigate the conditions with regard to forestry in the East Africa Protectorate, Uganda and probably also in Tanganyika Territory (late German East Africa) and to advise the Governments of those Protectorates as to forest policy and (if necessary) as to the reorganisation of their local forestry services, is now under consideration here.

A senior and experienced man would of course be essential; and he would probably take several months at any rate to make the necessary enquiries.

It would be of great assistance if you could suggest any man who you think would be suitable for such a mission and who would be likely to be willing to undertake it.

We should also be very glad of your views

Yours sincerely,
W.A.B.STEBBING.

to what sort of remuneration it would be necessary
, as until we know that, it is impossible for us
Treasury for their approval of the scheme.

F.G.P. Roy

before the Indian Office, though I do not anticipate any objection from that quarter.

The total period for which I could reasonably absent myself from duties at Oxford would be 21 months, from the middle of December 1920 to the end of September 1921. As far as I can judge this period, or say 9 months, ought to be sufficient for me to carry out the necessary investigations, and to allow for the journey to and from Africa. Possibly a month or so may be necessary for the preparation of my report after my return, though I should endeavour to complete it as expeditiously as possible.

As regards remuneration, my salary, if I were to return to India, would be Rs 1,750 a month, with the probability of an increase before long. This, with the rupee at its par value (2/-) would be equivalent to £ 1,750 a year, or at its present exchange value to considerably more. Taking into consideration the fact that my salary at Oxford would be appropriated for the pay of my locum tenens, that I should be subject to Indian income tax on emoluments received for my work in Africa, I feel that I would not be justified in asking for less than the equivalent of £3000 a year. The actual amount would depend on the time for which I am engaged, for example £900 for 9 months, which I anticipate will be the approximate duration of the appointment. Travelling allowances would be additional. If required I shall be glad to attend the Colonial Office to answer any questions. I shall be away in the Forest of Dean during the next few weeks superintending the practical training of forestry students, but if I am given some days' notice I can arrange to go up to London at any time.

I am sending you, with this, a copy of a publication entitled "Work of the Forest Department in India" which I compiled three

age at the request of the Indian Government. This may be of
est in showing the difficulties which had to be overcome in the
days of the forest administration and the thorough justification,
financial point of view alone, of the measures taken to con-
and improve the forests and to bring them under systematic
(4 p.63)
ment. It is remarkable that in 50 years the net surplus yield
the forests of India has multiplied nearly 10-fold, and there
to be no reason why the colonies, profiting by India's
ence, should not do as well or even better.

Yours sincerely,

283

W S Furse-fo

R.D. Furze.

...ord of Services of Mr R.S. Troup, C.I.E. Indian Forest Service.

Received training in Forestry at Cooper's Hill College (at that ... the training centre for the Indian Forest Service) and on the ... ment. Passed first into the Indian Forest Service in 1897. ... a Fellowship of Cooper's Hill and a Scholarship in Forestry. ... years in Burma in executive forest charges. Thereafter several years at the Forest Research Institute, Dehra Dun, ... first in charge of the economic products branch, involving ...gations into the economic uses and marketing of timber and all ... forest products: then in charge of the silviculture branch, ...ing work connected with the regeneration, tending and management of forests. For some years held the post of Superintendent ...est Working Plans to the Government of India: this involved ...scrutiny of Working Pl[illegible] and advice on working plans questions ...ughout the greater part of India. Latterly held the post of ...stant Inspector General of Forests to the Government of India, ... in which not only were administrative questions of all kinds ...with, but inspections [illegible] in different parts of ... were carried out and [illegible] future administration ...organised. During the War was employed for some time as ...troller of Timber Supplies, and organised the supply of timber for ...purposes to Mesopotamia, Egypt and Salonika.

During my service in the Indian Forest Department, extending ... years, I have been called upon to a greater extent than is ... to inspect and advise on technical and administrative questions ...ecting the future working of the forests in all parts of India ... the most varying conditions; and in the course of this work I ...acquired an intimate knowledge of the history of forestry in ... and of the mistakes which have been made and which should be

28

...ecord of Services of Mr R. S. Troup, C.I.E. Indian Forest Service.

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During my service in the Indian Forest Department, extending ... 26 years, I have been [illegible] upon to a greater extent than is ... to inspect and advise on technical and administrative questions ...ffecting the future working of the forests in all parts of India ... the most varying conditions; and in the course of this work I ... acquired an intimate knowledge of the history of forestry in ... and of the mistakes which have been made and which should be

elsewhere. I have also had much experience of such administrative matters as the preparation of reorganisation schemes for ...ses of staff, the settlement of forest rights, the interpretation of forest laws, the scrutiny of contracts and leases, and other ...tions.

My published work, apart from official reports, comprises a ...al of Forest Utilization, several publications on Indian timbers, ...on the teak forests of Burma, the Eucalyptus plantations of ...a, the Himalayan long-leared pine, and various other Silvicultu... publications. At present I have in the Press a large work of ...mes entitled 'The Silviculture of Indian Trees', dealing in ...with all the more important forest trees of India. This work ... outcome of many years of research, in the course of which I ...aim to have acquired a very special knowledge of tropical fo... ...ry, which would be invaluable in formulating proposals for the ...management of forests in Africa.

SCHOOL OF FORESTRY,
UNIVERSITY OF OXFORD

2nd Oct. 1920.

Dear Major Fisher,

I must apologise for not having replied sooner to your letter of the 23rd Sept., but I have only recently returned from a tour in France. I think the best thing will be for me to meet you and explain the position, and unless I hear from you to the contrary I shall call at your office here on Thursday the 7th inst. If this does not suit you I could come round in the afternoon, in which case please let me know.

Yours sincerely,

R.S. Troup.

THE WORK

OF THE

FOREST DEPARTMENT

IN INDIA

EDITED BY

R. S. TROUP,

Assistant Inspector General of Forests

CALCUTTA

SUPERINTENDENT GOVERNMENT PRINTING, INDIA

1917.

TABLE OF CONTENTS.

LIST OF ILLUSTRATIONS.

Introduction.

It may safely be said that there is hardly any Government Department in India whose work and aims are so little realized by the general public as are those of the Forest Department. For one thing the work of the forest officer lies for the most part in remote places, so that few have any knowledge of it. For another the practical results of forest work are apparent only after long periods of time, so that the forest officer has to cultivate the habit of thinking in half centuries and to be content that the full effect of his labours shall be visible only to future generations.

This publication is issued with the object of bringing together in popular form the main facts connected with the work of the Forest Department in India and of sketching the outlook for future expansion, particular attention being paid to the possibility of the local development of industries which depend to a greater or less extent on a plentiful supply of forest products. Information on these subjects is to be found scattered throughout the annual reports on forest administration which are issued by Provincial Governments and in the various publications of the Forest Research Institute, Dehra Dun, but these are not readily available to the general public, and so it is hoped that this memorandum, which has been prepared by Mr. R. S. Troup, Assistant Inspector General of Forests, with the assistance of selected officers of the Forest Department, may prove useful to those interested in the subject.

The Work of the Forest Department in India.

1. History of the Forest Department.

In matters of forest policy India may be congratulated on having set a noteworthy example to the British race, which has not generally displayed any marked tendency to value and cherish the heritage of Nature. Necessity has compelled continental nations to keep a considerable proportion of their acreage under forest and, after centuries of experience, to practise Forestry as a fine art. But Britain is still content to rely on foreign imports for the great bulk of her timber supply, and conservation of forest wealth has not been a special feature of her administration in the past.

Even in the earliest days of the British occupation the destruction of the forests in many parts of India indicated the necessity for a strong forest policy, but whether or not our earlier administrators realized the importance of the forests to the physical and economic welfare of the country, the fact remains that little or nothing was done. During the period of prosperity which followed on the British occupation, with an increase of population and the attendant demand for timber and fuel, with the spread of agriculture and the increase of pastoral herds, the depletion of the forests began to assume a serious aspect. In the early part of the nineteenth century desultory attempts were made to safeguard the future existence of the more valuable teak forests, on which the supply of ship-building timber for the navy depended, but these attempts developed into mere plans of exploitation without any effort to ensure conservation, until these forests became more than ever depleted of valuable timber.

It was, however, by no means for want of advice and warning that little of a practical and enduring nature was accomplished during the first half of last century, for various officers were deputed from time to time to report on the forests of different localities, and all were insistent on the need for the conservation and improvement of the forest tracts inspected by them. Thus

as early as 1827 Dr. Wallich reported on the forest resources of Tenasserim, while about 1837 Dr. Helfer reported on those of Malabar; in 1847 Dr. Gibson was appointed Conservator of Forests in Bombay, while in 1856 Dr. Cleghorn was appointed to a similar post in Madras, and both these officers submitted valuable reports on the forests in their charge. During this period the name of Mr. Conolly, Collector of Malabar, stands out conspicuous. This officer, keenly alive to the dangers attending the depletion of the forests in his district and anxious to ensure the future local supply of teak timber, founded in 1842 the now famous Nilambur teak plantations, which have been regularly extended to the present day and which form a living monument to their founder and to those who have had a share in the work of their extension.

The year 1855 marked the commencement of a new era in the history of forestry in India, for it was then that Lord Dalhousie laid down a definite and far-sighted forest policy. This policy was prompted by a report submitted by Dr McClelland after an extended tour in the province of Pegu shortly after its annexation in 1852 in which attention was drawn to the necessity for saving the valuable teak forests of that province from destruction. The officer selected to establish forest administration on a sound basis was Dr. Brandis who was appointed Superintendent of Forests in Pegu in 1856, the charge being extended to Martaban and Tenasserim in the following year. Dr. Brandis' appointment marks the dawn of scientific forestry in India.

Further progress was delayed for a time by the Mutiny, but from 1860 onwards forest organization was rapidly extended to the other provinces. The earlier years of forest administration were beset with difficulties, which is not surprising considering that the Department was charged with the unpopular duty of protecting the heritage of nature from the rapacity of mankind, a duty which naturally roused the antagonism of the agricultural population of India. Brandis' early struggles in Burma are but one instance of the contest against greed, ignorance and short-sightedness, for his efforts at introducing sound principles of organization and protection met with a storm of opposition from all sides, and particularly from

mercantile firms engaged in the timber business. The conflict raged for five years, but in spite of gross misrepresentations his policy prevailed in the main. Had this not been the case matters would certainly have gone from bad to worse, and the valuable teak forests of Burma, instead of yielding a steady and increasing supply of timber, would by this time have been depleted of the bulk of their marketable trees. Such a contingency would have been a national disaster, for it is on first class teak that our Admiralty relies for its supplies of the best ship-building timber.

In other provinces also the early years of the Forest Department were marked by a constant struggle against opposition in various forms, for although Government had proclaimed its forest policy, this policy was not always appreciated by district officials, many of whom were unable to discern the potential value of the forests, or to foresee the baneful results of their destruction.

Exploration, demarcation and settlement followed by efforts to introduce protection and some form of regular management, were the first duties of the Forest Department. Work on these lines, which is not yet completed in the more backward parts of the country, has been pursued steadily from the commencement and in consequence large tracts of forest have been saved from ruin and are gradually being brought under efficient management. Whatever may have been the opposition encountered in some quarters half a century ago as to the necessity of measures such as that expressed in Lord Dalhousie's memorable declaration of 1855, there is no longer any doubt that results have amply justified the steps taken, and that in her forests India now possesses a property of constantly increasing value, the future importance of which it is hardly possible to over-estimate.

2. Area, Classes and Types of Forest

More than one-fifth of the total area of British India (including the Shan States) is under the control of the Forest Department. These areas are classified as reserved, protected or unclassed State forests. In the reserved forests rights of user in favour of individuals and the public are carefully recorded and limited at settlement, while the boundaries are

defined and demarcated: in the protected forests the record of rights is not so complete, the accrual of rights after settlement not being prohibited, and the boundaries are not always demarcated, while in the unclassed forests no systematic management is attempted and as a rule the control amounts to nothing more than the collection of revenue until the areas are taken up for cultivation or are converted into reserved or protected forests. The total forest area of British India (including the Shan States) on the 30th of June 1915, was 249,867 square miles, of which there were 97,580, 10,405 and 141,882 square miles of reserved, protected and unclassed State forests respectively.

Throughout this vast forest area, scattered over the length and breadth of India from the Himalayan snows to Cape Comorin and from the arid juniper tracts of Baluchistan to the eastern limits of the Shan States, there is, as may be imagined, an infinite variety in the types of forest vegetation, depending on variations of climate and soil and on other local factors. Broadly speaking the following main types of forest may be distinguished:—

(1) Arid-country forests, extending over Sind, a considerable portion of Rajputana, part of Baluchistan and the south of the Punjab, in dry tracts where the rainfall is less than 20 inches. The number of species is few, the most important tree being the babul or kikar (*Acacia arabica*), which, however, in the driest regions exists only by the aid of river inundations.

(2) Deciduous forests, in which most of the trees are leafless for a portion of the year. These forests, which extend over large areas in the sub-Himalayan tract, the Peninsula of India and Burma, are among the most important, comprising as they do the greater part of the teak and sál forests.

(3) Evergreen forests.—These occur in regions of very heavy rainfall, such as the west coast of the Peninsula, the eastern sub-Himalayan tract and the moister parts of Burma, and are characterised by the great variety and luxuriance of their vegetation.

(4) Hill forests.—In these the vegetation varies considerably according to elevation and rainfall. In the Eastern Himalaya, Assam and Burma the hill forests are characterized by various oaks, magnolias and laurels, while in Assam and Burma the Khasia pine (*Pinus Khasya*) grows gregariously at elevations of 3,000 to 7,000 feet. In the North-Western Himalaya the chief timber tree is the deodar (*Cedrus Deodara*) which occurs most commonly at elevations of 6,000 to 8,000 feet and in association with oaks or blue pine (*Pinus excelsa*); towards its upper limit the deodar merges into very large areas of spruce and silver fir while below it are found extensive forests of the long-needled pine (*Pinus longifolia*), which is tapped for resin.

(5) Littoral forests.—These occur on the sea coast and along tidal creeks. The most characteristic trees belong to the mangrove family (*Rhizophoreae*). Behind the mangrove belt is an important type of forest occasionally inundated by high tides, in which the most valuable species is the sundri (*Heritiera Fomes*).

The number of individual species of trees comprising the vast forest wealth of India is very considerable. The total number of woody species in India, including exotics, is about five thousand, of which rather more than half are trees, the remainder being shrubs and climbers. There are several hundred economically useful species, a few of the most important of which are dealt with in section 7.

3. Forest Policy and Legal Control.

The general policy of the Government of India in relation to forests was definitely laid down in 1894 by the classification of the areas under the control of the Department into four broad classes, namely:—

(1) Forests the preservation of which is essential on climatic or physical grounds. These are usually situated in hilly country, where the retention of forests

growth is of vital importance on account of its influence on the storage of the rainfall and on the prevention of erosion and sudden floods.

(*b*) Forests which afford a supply of valuable timbers for commercial purposes, such, for example, as the teak forests of Burma, the sal forests of Northern, Central, and North-Eastern India, and the deodar and pine forests of the North-Western Himalaya.

(*c*) Minor forests, containing somewhat inferior kinds of timber, and managed for the production of wood, fodder, grazing and other produce for local consumption; these forests are of great importance in agricultural districts.

(*d*) Pasture lands. These are not "forests" in the generally understood sense of the term, but grazing grounds managed by the Forest Department merely as a matter of convenience.

These four classes of forest are not always sharply divided from each other, and one and the same tract may to a certain extent be managed with more than one object.

The first of these classes comprises the areas which must be preserved on account of their indirect effects and without any reference to their commercial value. These indirect effects, which in many cases far outweigh the direct benefits as estimated from a commercial standpoint, may be summarised briefly as the influence of forests on climate, rainfall, water storage and the prevention of denudation. An exhaustive enquiry into this important subject was held throughout India in the years 1907 to 1914, the results of which were reviewed by the Government of India in their Circular letter to Local Governments, No. 4-F.-70—1, dated the 27th February 1915. Notwithstanding the great importance of this subject it is not possible in this memorandum to do more than indicate the main conclusions arrived at, which were—

(*i*) that the effect of forests on rainfall is probably small,

(*ii*) that denudation of the soil owing to the destruction of forests may so far as India is concerned, be looked upon as an established fact,

(*iii*) that as regards the effect of forest preservation on rainfall and the underground water supply there is nothing to justify any change in the principles on which the forest policy of the Government has hitherto been based.

The circular in question also urged Local Governments to use every effort to induce rulers of Native States and owners of private land to co-operate in the protection of important catchment areas and in the control of the injurious practice of shifting cultivation. A summary of the enquiry and its results has recently been published in the form of a note by Mr. M. Hill, C.I.E. (Forest Bulletin No. 33 of 1916).

The second class comprises the forests which, though they may have to supply some of the requirements of the surrounding population, can be managed mainly with the object of providing the greatest possible outturn of timber for commercial purposes. It is in connection with the control of these forests that the Forest Department has been termed *quasi*-commercial.

The third and fourth classes contain the areas which are managed mainly if not entirely for the production of the forest produce necessary for the satisfaction of the requirements of the local population. In some parts of India, notably in portions of the Central Provinces, Bombay and Madras, where the work of the Department is intimately connected with the daily life of the people, this phase of his work forms the most important of the forest officer's duties. Some notion of its extent may be gathered from the fact that during the year 1913-14 the amount of forest produce removed by rightholders and free grantees was—

Timber—7½ million cubic feet
Fuel—39 million cubic feet
Bamboos—nearly Rs. 88,000 in value,
Grazing and fodder grass—nearly Rs. 33,00,000 in value.

This sketch of the policy pursued in the management of the State forests is sufficient to show that the work of the Forest Department should not be judged only from the revenue producing point of view. This side of its activities is unquestionably

of immense importance, but the first duty of the Department is to provide for the wants of the agricultural population and to maintain the areas committed to its charge in such a condition that their indirect effects shall be as beneficial as possible. Forestry has been termed the handmaid of agriculture, and nowhere does this apply with greater force than in India, which is essentially an agricultural country. Apart from their ordinary domestic and agricultural requirements, for timber, fuel, thatching and fodder grass, grazing, and numerous minor products, in many parts of the country the people are largely dependent on the forest for their very existence in times of famine. It is worthy of note also that among the recommendations made by Dr. Voelcker in his report on the possibilities of improvement in Indian agriculture the one which he regarded as of the greatest importance was that of providing fuel and fodder reserves by means of afforestation. To this work he alludes as "the one practical measure which calls for the most urgent attention and from which the greatest benefits may be expected to follow."

Legal control over forests is effected under the provisions of special forest enactments. The Indian Forest Act, VII of 1878, as subsequently amended, applies to the whole of British India except Burma, Madras, Assam, British Baluchistan, Ajmer and the North West Frontier Province. Under this Act State forest or waste land may be constituted reserved or protected forest. Before any area is declared reserved forest it is subjected to a regular settlement by a forest settlement officer who enquires into the existence and nature of all private or public rights and either provides for their extinction by purchase, commutation or exchange, or settles the conditions under which and the extent to which they may be exercised. The procedure regarding protected forests is somewhat similar, rights are enquired into and recorded but not definitely settled and there is no bar to the accrual of new rights as in the case of reserved forests. The Act further provides for village forests to be settled and managed for the benefit of village communities, also for the protection of forests and trees, the control of forest produce in transit, the control of forests not the property of Government and other matters. Other special forest enact-

ments are the Burma Forest Act, IV of 1902, and the Madras Forest Act, V of 1882, while Assam, the North-West Frontier Province, British Baluchistan and Ajmer have their own forest regulations.

4. Administration and Staff.

General administration.—The forest business of the Government of India is carried on in the Department of Revenue and Agriculture. The Inspector-General of Forests is the administrative head of the Forest Department and is the technical adviser to the Government of India in forest matters.

Territorial charges.—The various provinces are divided into one or more Forest Circles, each in charge of a Conservator of Forests; provinces containing three or more circles also have a Chief Conservator who is the head of the Department for his province.* Circles are divided into a number of Forest Divisions, in charge of members of the Imperial or Provincial Forest Service; these Divisions in most cases correspond to civil districts. Each Division contains a number of Ranges in charge of junior members of the Provincial Service or of Forest Rangers or Deputy Rangers; heavy Divisions are also sometimes divided into Subdivisions. The Ranges are further subdivided into a number of beats or protective charges held by Forest Guards or in some cases by Foresters.

Non-territorial charges.—Apart from territorial charges there are various important posts of a non-territorial nature connected with Forest Research and Education, the preparation of Forest Working Plans and other special duties. Among special posts may be mentioned that of Assistant Inspector-General of Forests, who in addition to Secretariat work helps the Inspector-General of Forests in the scrutiny of working plans referred to in section 6 below.

The Forest Service.—The Forest Service comprises three branches:—

(1) The Imperial Service with a total personnel of 237 officers† consisting of the Inspector-General of

* No appointment of Chief Conservator has yet been sanctioned for Madras. For Bombay the post, though sanctioned, has not yet been filled.

† On the 1st July, 1916.

Forests, Chief Conservators, Conservators, Deputy and Assistant Conservators. The Officers of this service are recruited in the United Kingdom, the present system of recruitment being by selection subject to the possession of an honours degree in some branch of Natural Science of an English, Welsh or Irish University, or of the B.Sc. degree in Pure Science of a Scottish University. Probationers are trained at a University possessing a forest school approved by the Secretary of State (Oxford, Cambridge and Edinburgh at present), this training being supplemented by a practical course, chiefly on the continent of Europe.

(2) The Provincial Service with a total personnel of 231 officers* consisting of Extra Deputy and Extra Assistant Conservators. Officers for this service are recruited in India and trained at the Forest Research Institute, Dehra Dun, though a certain number of posts in this service are filled by the promotion of specially promising Rangers.

(3) The Subordinate Service consisting of Forest Rangers (about 760), Deputy Rangers (about 850), Foresters (about 2,000) and Forest Guards (about 10,500). The Rangers are at present trained at three different centres—the Forest College at Dehra Dun (for provinces other than Burma and Madras), the Burma Forest School at Pyinmana (for Burma) and the Madras Forest College at Coimbatore (for Madras). These three institutions were established in 1878, 1898 and 1912 respectively. A scheme is now under consideration for the further decentralization of the training of Rangers, and it is probable that before long the number of training centres will be increased. The training of subordinates below the rank of Ranger is carried out in various local forest schools and training classes.

* On the 1st July 1916.

5. Research.

For the first fifty years of the existence of the Forest Department in India no attempt was made to organize the conduct of forest research, and thus to coordinate and elaborate the scientific knowledge so necessary to successful economic working. Valuable scientific work has, it is true, been carried out from time to time as the result of individual efforts on the part of enthusiasts in special branches, but, while the results of these efforts have in many cases been published, much useful work has been lost for want of systematized methods. This state of affairs may perhaps be considered to some extent as a reproach to those concerned, but it must be remembered that the existence of the Forest Department in its earlier years depended on its justifying itself by immediate financial results, so that the very inadequate staff employed was compelled to devote the whole of its time to the preliminary work of organization, often in the face of powerful opposition.

A commencement in organized forest research was at last made in 1906 by the establishment, at the instance of Sir Saint-hill Eardley-Wilmot, then Inspector-General of Forests, of a Forest Research Institute at Dehra Dun. From that time onwards research work has been prosecuted energetically in spite of deficient accommodation. This deficiency has, however, been remedied, for the Institute buildings were completed in 1914 and further land was taken up in the following year to provide for the requirements of the Provincial Service students. The main building of the Institute contains museums and offices for the Silvicultural, Economic and Zoological branches, as well as the general library and lecture room, while the Botanical and Chemical branches and the various laboratories and workshops are housed in separate buildings. In addition to quarters for forty students and a fine playing field there are also a residence for the house tutor and two houses for research officers. The estate, which is situated in a desirable part of Dehra Dun, is a fine one and contains ample room for the expansion that will certainly be necessary in course of time.

The Forest Research Institute, which is under the administrative control of the Inspector-General of Forests, is in the

charge of a Professor. There are five main branches of research, namely Silviculture, Forest Botany, Forest Economic Products, Zoology and Chemistry, each branch being in charge of a research officer. In addition specialists are appointed temporarily when necessary and are attached to the Institute to carry out investigations in subjects of particular economic importance. Thus a cellulose expert has been employed for some time to investigate possible new sources of paper-making materials, of which the forests of India contain abundant supplies, while more recently a tannin expert has been engaged to study the question of tanning materials.

It is unlikely that all forms of forest research will continue to be centralized wholly at Dehra Dun. It has now been recognised that as regards Silviculture at any rate, on which the future treatment and economic working of the forests must depend, the best results can be attained only by the employment of local research officers who will carry out detailed investigations under the widely differing conditions of climate, soil and other environment factors in their respective provinces. These local research officers will, however, work in close communication with the Central Institute, thus ensuring continuity of general principles and preventing duplication.

The results of forest research are published from time to time in the form of memoirs, records or bulletins. Such publications, however, do not by any means represent the total results of the research officers' labours, for much information and advice is imparted verbally or by correspondence both to officers of the Department and to others. In addition the research officers deliver courses of lectures in their own subjects to the Provincial Service students, who thus imbibe during the period of their training the latest results of scientific enquiry.

4. Forest Organization and Exploitation.

Organization.—The management of some 250,000 square miles of forest of many and widely differing types and under a variety of local conditions is a large undertaking, and matters are not simplified either by the fact that in many cases these areas had been more or less ruined by misuse of all kinds before

they were made over to the charge of the Forest Department or by the numerical weakness of the staff employed for the management of this vast estate. Again the introduction and elaboration of efficient systems of management is necessarily a slow process, for the forest officer must look many decades, and it may be a century or more, ahead, while mistakes made are not rectified in a day and may prove extremely costly before they are discovered.

Natural forest tracts, when first taken in hand, are seldom in a condition lending itself to the immediate adoption of the most efficient form of management. Nature does not select the most valuable timber trees or produce regular and sustained yields of these to the maximum possible extent, but rather endeavours to multiply the species best fitted to flourish in the particular environment. Thus in rich tropical forests the economic value of the crop may be small owing to the large admixture of worthless species struggling for existence under conditions favourable to vegetative activity, while on the other hand in arid tracts the sparse and stunted nature of the forest growth may make it impossible to produce valuable forest without the aid of irrigation. Steps have accordingly to be taken to make fuller use of the productive capacity of the soil by increasing the proportion of valuable species, improving the density of the crop, and bringing the forest into the condition of producing the maximum possible amount of valuable timber or other produce per acre year after year and century after century. Nature has to be studied closely, imitated and even coerced where necessary, and the process must often be a lengthy one.

Working Plans.—The first step towards the introduction of a regular system of management in a given forest tract is the preparation of a working plan setting forth the general objects to be attained and prescribing for a series of years the operations to be carried out in order to reach these ends. Thus the foundations are laid for the gradual amelioration of the forest with the view of building up an active capital which will, when established, produce the highest possible return. The working plan further estimates what amount of timber or other produce may be removed annually or periodically from the forest with-

under this system much produce is removed free of charge by right-holders and free grantees.

The decision as to which of these two methods should be adopted in any particular case depends on a variety of circumstances. Generally it may be said that where means of extraction are easy and markets assured it pays best to rely on the agency of purchasers, more especially where standing trees can be sold annually. On the other hand it is not always wise to rely on this agency where it is necessary to develop communications or instal mechanical appliances in order to facilitate extraction on a large scale. The following extract from the quinquennial review on forest administration for the period 1909-10 to 1913-14 expresses the views of the Government of India on this important subject.

"The question of the agency by which forest produce should be extracted has given rise to considerable discussion in the past, and although certain general principles may be laid down, the form of agency most suitable to any particular province or area must necessarily depend upon local conditions.

"In forest administration the object in view is two-fold—first, to conserve and improve the forests, and this is the first concern of the trained staff, and secondly to secure to the tax-payer the greatest immediate benefit from their commercial working. To obtain the best commercial results departmental or private agency should be employed as circumstances dictate, and provided always that Government receives a fair share of the profits earned private agency should be freely employed. But when this is done the term of the contract should on the one hand be sufficiently long to enable the initial outlay to be recovered, while on the other hand provision should invariably be made for a revision of the rates of royalty at stated intervals so that Government may not be deprived of its fair share of any rise in prices which may take place. Should it be found impossible to employ private agency on these terms, departmental working should be adopted, and if this cannot be undertaken by the trained staff without prejudice to its work of conservation and improvement there seems to be no reason why a separate staff specially trained in commercial exploitation should not be employed. At times, indeed, departmental working is essential as, for instance, in the extraction of little known timbers or other products for which it is desired to create a market, when for any reason the system of extraction by purchasers breaks down, or when it becomes necessary to prevent trade manipulation or the creation of a monopoly.

"Having regard to these general principles, which in their application should govern the decision as to the form of agency to be employed, the Government of India are inclined to believe that in some parts of India departmental agency might perhaps be profitably employed more extensively than at present."

Extraction and transport.—The extraction and transport of forest produce, and particularly of timber, is often attended with much difficulty and, more especially where timber is concerned, may involve engineering problems demanding a high degree of technical skill. Timber is exploited either in the round or after partial or total conversion in the forest: the methods vary greatly according to local conditions, but fall naturally under the two main heads of land and water transport.

Under land transport the following forms may be mentioned:—

(i) By human agency. This includes the removal of head-loads of fuel and bamboos to centres within a short distance of the forest, the carriage of sleepers and other scantlings in the Himalayas from the forests down to slides or floating streams and the extraction of heavy logs in the same localities with the help of rolling roads and earth slides. The carriage of sleepers is often a difficult and dangerous operation, for a freshly cut broad gauge deodar sleeper weighs about 150 lbs. or more and the men have to work on very steep paths over difficult ground.

(ii) By animals. This includes the removal of produce by carts where suitable roads exist or by pack animals where the produce can be handled by this form of transport, the employment of elephants to drag heavy timber to floating streams as in Burma and the Andamans and to a lesser extent in other localities. Buffaloes are also used for this purpose, and their employment is extending in localities where they can work owing to the steadily increasing cost of purchase and upkeep of elephants.

(iii) By mechanical appliances. These include tramways, ropeways and skidders. Some of the most import

years 1910-11 to 1914-15 is given in the following statement :—

Forest produce removed from State forests, average per annum for the period 1910-1911 to 1914-1915.

Agency of exploitation.	Major produce (volume.)		Minor produce (value.)			
	Timber.	Fuel.	Bamboos.	Grazing and Fodder Grass.	Other minor produce.	Total.
	c. ft.	c. ft.	Rs.	Rs.	Rs.	Rs.
By Government[1]	7,326,689	16,791,908	51,529	1,79,746	4,42,454	7,04,729
By purchasers	69,752,314	116,349,906	10,49,397	25,72,958	21,44,016	60,66,371
By free grantees	2,928,910	10,188,339	18,671	4,18,517	2,67,636	7,04,824
By right-holders	4,077,721	52,706,209	64,428	26,70,575	3,51,369	30,86,372
Total	84,085,034	195,999,462	12,14,025	61,41,798	32,06,475	1,05,62,298

Much information regarding Indian timbers will be found in Gamble's Manual of Indian Timbers (1902) and in Troup's Indian Woods and their Uses (Indian Forest Records, Economic Products Series, Volume I, Part I, 1909), while information on the more important timbers and minor forest products will be found in Troup's Indian Forest Utilization (2nd Ed., 1913) and Pearson's Commercial Guide to the Forest Economic Products of India (1912). The following is a necessarily brief account of some of the more important major and minor forest products of India :—

([illegible]AJOR PRODUCE : PRINCIPAL TIMBER TREES.

A large proportion of the many species of Indian trees have little or no value at present, partly because they are imperfectly known, partly because they are so rare as to be of no consequence economically and partly because they are wanting in durability, strength or other necessary properties. Still there are several hundred species of Indian trees the timber of which is used for some purpose or other. A list of the most important of these

are enumerated below arranged in alphabetical order by their scientific names:—

Abies Pindrow, Spach, and *A. Webbiana*, Lindl. The Himalayan silver firs. The former occurs only in the western Himalaya, at 7,500—10,000 ft. (sometimes higher), and the latter both in the Eastern and in the Western Himalaya, in the latter region at a higher elevation than *A. Pindrow*. Both are tall evergreen conifers, with soft white and very durable wood, suitable for planking, packing-cases, shingles, woodpulp, matches and possibly after impregnation for sleepers. Worked to a very small extent at present. Quantity available very large but at present more or less inaccessible.

Acacia arabica, Willd. Babul. A moderate-sized to large tree of the drier parts of the plains of India, chiefly in Sind (on tracts irrigated by the Indus), the plains of the Punjab and United Provinces and the Indian Peninsula generally. The wood is light red to reddish brown, hard and durable, used for building, carts and carriages, wheels, agricultural implements, turnery and many other purposes; it yields excellent fuel. Bark used for tanning, pods for cattle fodder and tanning; also yields a gum. Present supplies generally fully utilized; heavily worked since the outbreak of war for the tanning industry.

Acacia Catechu, Willd. The cutch tree. A moderate-sized to large tree, common in most of the drier parts of India and Burma, growing gregariously on the shingly and sandy beds of streams in the sub-Himalayan tract. Wood light or dark red, very hard and durable, used for house-posts, carts, boats, wheels, furniture, tool-handles, agricultural implements, etc.; an excellent fuel. Cutch and kath are obtained by boiling down chips of the heartwood. Supply largely utilized especially in Burma.

Adina cordifolia, Hook. f. Haldu. A large tree, found in mixed deciduous forests throughout the greater part of India and Burma. Wood yellow, moderately hard, durable, rather apt to warp and crack; used for building, boats, furniture, agricultural implements, boxes, turnery, carving, toys and other purposes; this timber has been recently used for the manufacture of bobbins with considerable success. Moderate supplies available.

Albizzia Lebbek, Benth. Sirsa. Known on the English market as "Indian Walnut," though not the true walnut, which is *Juglans regia*. A large tree, wild in certain parts of the sub-Himalayan tract, the Indian Peninsula, Burma and the Andamans; largely planted along road-sides and in gardens. Wood dark brown, streaked with darker or lighter streaks, handsome; used for building, furniture, agricultural implements, wheels, carving, turning, etc. The timber is available in considerable quantity in the Andamans, where it is known by the

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Acacia Catechu, Willd. The catch tree. A moderate-sized to large tree, common in most of the drier parts of India and Burma, gregariously on the shingly and sandy beds of streams in the sub-Himalayan tract. Wood light or dark red, very hard and durable, used for house-posts, carts, boats, wheels, furniture, tool-handles, agricultural implements, etc., an excellent fuel. Catch and kath are obtained by boiling down chips of the heartwood. Supply largely utilized especially in Burma.

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Burmese name *[illegible]*; handsome carvings in this wood are executed by the convicts at Port Blair. The "burrs" which are sometimes formed on the trees are [illegible] for veneers.

Bombax malabaricum [illegible]. The cotton tree, simul. A very large tree, [illegible] the greater part of India and Burma. Wood soft, [illegible] perishable, used for packing-cases, tea-boxes, [illegible], canoes, matches, well-linings, toys and other purposes where a soft wood is required. A similar wood of rather better quality is yielded by *B. insigne*, a very large tree of Burma, the Andamans and the W. Coast of India. Present supplies generally utilized in accessible localities, especially for tea chests in Bengal and Assam.

Calophyllum tomentosum, Wight. The poon-spar tree. A large straight-stemmed, evergreen tree of the West Coast. Wood reddish brown, used for masts and spars, house-building, ship-building and construction generally. In fair demand in accessible localities.

Cedrela Toona, Roxb. Toon, red cedar, Moulmein cedar. A large tree found in various parts of India and Burma, and often cultivated. Wood red, soft, handsome, fragrant, easily worked and seasons quickly, used for furniture and cabinet work, planking, doors, boxes and general carpentry, tea-boxes, cigar-boxes, boats, carving and many other purposes. A very useful wood, resembling open-grained mahogany, and esteemed in the London market. Generally fully utilised.

Cedrus Deodara, Loudon. The deodar, Himalayan cedar. A very large evergreen coniferous tree (a true cedar) of the Western Himalaya, most common between 6,000 and 8,000 ft. Wood yellowish brown, moderately hard, oily, strongly scented, very durable. This is one of the most important timbers of India, and is largely used for railway sleepers, building, carpentry and construction of all kinds. Fully utilised.

Chloroxylon Swietenia, DC. Satinwood. A moderate-sized tree of the Indian Peninsula, furnishing the well-known satinwood of commerce, a hard yellow wood often with a beautiful wavy grain and satiny lustre, used for carving and ornamental work of all kinds. This wood is exported chiefly from Ceylon and to a lesser extent from India, where the trees are usually of small size, approaching fair dimensions only in the south. Available in fair quantity but of small size.

Dalbergia latifolia, Roxb. Blackwood, rosewood of S. India. The [illegible] of the Indian Peninsula. A large tree of Central and Southern India, extending north to the sub-Himalayan tract in Oudh, where it is of small size. This tree furnishes the well-known rosewood of commerce, a handsome hard dark purple wood with black streaks, which is exported for furniture and ornamental work. In India it is used for a variety of purposes, including furniture, door and window frames, [illegible]

furniture. Fully utilized in the Sundarbans, but large quantities available in Burma.

Hopea odorata, Roxb. Thingan. A tall evergreen tree of Burma and the Andamans. Wood yellowish brown, hard, very durable, useful for house building, bridge construction, piles, boats, wheels, carriage building, agricultural implements, etc. One of the most valuable timbers of Burma.

Hopea parviflora, Bedd. Irumbogam, ironwood of Malabar. A large tree of the W. Ghats from S. Kanara southwards to Travancore and Tinnevelly. Wood brown, hard, very durable; uses similar to the preceding. A valuable timber which is used to a considerable extent; large quantities available in localities which at present are more or less inaccessible.

Juglans regia, Linn. Walnut. A large tree of the Himalaya at 3–10,000 ft.; hills of Upper Burma. This is the true walnut of commerce, possessing a beautifully mottled brown wood with darker streaks. The "burrs" are particularly valuable for veneers, and have been considerably worked in Kashmir and elsewhere. The wood is used for furniture, veneering, carving, panelling, gunstocks, etc. The tree is fairly common in many of the Himalayan forest tracts, but many localities in which it grows are remote and extraction is often impossible at present. It is extensively cultivated in the Himalaya for its fruit.

Lagerstræmia Flos-Reginæ Reta. Jarul (Bengal), pyinma (Burma). A large tree of Bengal, Assam, Burma and the moister parts of the Indian Peninsula, often cultivated for its handsome mauve flowers. Wood light reddish grey, hard, very durable, used for house-building, bridge construction, boats, ship-building, carts, agricultural implements, wheels, furniture, etc. One of the most important timbers of Burma. Available in fair quantity.

Lagerstræmia lanceolata, Wall. Benteak. A large tree of the W. Ghats, extending southward to Travancore. Wood reddish brown, moderately hard, strong and durable; used for house-building, shipbuilding, furniture, carts, wheels etc. Available in fair quantity.

Mesua ferrea, Linn. Nahar. A large evergreen tree of Assam, Burma, the Andamans, W. and S. India. Wood dark red, extremely hard, very strong and durable, used for bridge and house construction, railway sleepers, piles, carts, boats, tool handles and other purposes. Utilized wherever accessible.

Michelia Champaca, Linn. Champ. A large tree of Sikkim, Bengal, Assam, Burma, W. and S. India. Wood light olive-brown, fine with a shiny lustre, very durable; used for planking, panelling, furniture, carriage building, boats, carving and turning and general carpentry. Fully utilized where accessible.

Pterocarpus macrocarpus, Kurz. Burma padauk. A large tree scattered in the mixed forests in several parts of Burma from Shamo to Tenasserim. The wood is yellowish-red to brick-red, sometimes streaked with brown, hard and very strong: although inferior to Andaman padauk in colour it excels it in strength, and is perhaps the best wood for ordnance work of various kinds, such as gun-carriage wheels and many other purposes. In Burma it is extensively used for naves, spokes and felloes of cart and carriage wheels, carriage-building, shafts and other purposes for which strength is required. Fairly fully utilised in accessible localities.

Pterocarpus Marsupium, Roxb. The gum-kino tree, bijasal. A large tree of Central and Southern India, extending north to Oudh and the Kumaun Bhabar. Wood yellowish brown with darker streaks, very hard, durable, used for door and window frames, posts, beams, furniture, agricultural implements, wheels, carts, boats, and many other purposes. The wood when damp is apt to produce a yellow stain. The tree yields a red astringent medical gum known as "kino" from wounds in the bark. Fairly fully utilised where accessible.

Pterocarpus santalinus, Linn. f. Red sanders. A small or moderate-sized tree occupying a limited region in the hills of the E. Deccan. A valuable wood, dark purplish red, extremely hard, used for wheels, shafts, agricultural implements, and particularly for carvings. Supply limited.

Quercus. The oaks. There are nearly 40 species of oak in India and Burma, chiefly in the Himalaya, Khasia hills, Chittagong hills and Burma. Several of these are of local importance, partly for building and other purposes but especially for fuel. None of them have as yet proved to be of any special value for export or for general use outside their immediate regions. Not fully utilised. Large quantities

Santalum album, Linn. Sandalwood. A small tree of the Indian Peninsula from the Nasik and Nagar districts southwards, particularly in Mysore, Coorg and some of the Madras districts—N. Coimbatore, N. Arcot, N. Salem, Bellary and the Nilgiris. The heartwood is yellowish brown, hard, very close-grained and strongly scented: it is used for carving and fancy work of all kinds and is burned as incense, while sandalwood oil is distilled from it. Volume for volume this is by far the most valuable wood in India; it is sold by weight, and every portion of the tree which yields heartwood of any size is utilised, the heartwood from the roots being the most valuable. Fully utilised.

Shorea obtusa, Wall. Thitya (Burmese). A large tree common, chiefly in "indaing" forest, throughout Burma. Wood brown, very hard and durable, used for house and bridge construction, piles, carts,

Photo.-Mech. Dept., Thomason College, Roorkee.

Valuable sal forest killed by abnormal drought ; one of various natural calamities which the Forest Officer has to face and to guard against.

wheels, agricultural implements, etc. Fully utilized in accessible localities.

Shorea robusta, Gaertn. f. Sal. A large gregarious tree of Northern and Central India, in the sub-Himalayan tract from Kangra to the Darrang and Nowgong districts of Assam and in the Garo Hills, Chota Nagpur, Orissa, the Central Provinces and the Tanjore district of Madras. Wood brown, hard, very durable, used for building, bridge construction, piles, railway sleepers, agricultural implements, railway waggons, ordnance work, and many purposes. Sal is one of the most important timbers of India, owing its reputation to its great strength and durability, although it is somewhat coarse and cross-grained wood and seasons slowly. The timber is in great demand, particularly for railway sleepers and building, and as large tracts of sal forest have been saved from destruction and are under regular management a sustained yield of this valuable timber may be relied on in future. Fully utilized.

Tectona grandis, Linn. f. Teak. A large tree of Central and Southern India, Bombay and Burma. Wood yellowish-brown, extremely durable, seasons well without warping or splitting and works well. Teak is the most important timber of India, being superior to all other woods for ship-building, for which purpose it is largely exported to Europe. It is put to numerous other uses, including building, furniture and cabinet work, panelling, carving, railway carriages and waggons, spokes and felloes of wheels, agricultural implements, etc. Before the war the great bulk of the teak timber comes from Burma. Here the trees do not ordinarily form pure forests of any extent, but are scattered among a large number of other species. In Burma the timber is extracted by floating and the trees are girdled three years before felling in order to kill them and render the timber more buoyant. The importance of teak in the world's markets may be realized from the fact that during the five years ending 1913-14 the average annual value exported from the Indian Empire amounted to Rs. 74,03,000, the great bulk of this coming from Burma. Although in India proper the trees do not ordinarily reach the dimensions attained in Burma there are fine tracts in Western and Southern India where timber of very large dimensions is produced, while there is always a strong demand within the country even for teak of small size. The question of securing adequate supplies of this valuable timber has engaged the serious attention of the Forest Department from its infancy, and in addition to efforts to improve natural regeneration extensive teak plantations have been formed, chiefly in Burma and in India fully utilized.

Terminalia Chebula, Retz. The myrobalan (the fruit of which is known throughout the greater part of India and Burma). Wood

brownish grey with a small irregular dark purple heartwood, very hard, used for building, furniture, turnery, carts, naves and felloes of wheels, and agricultural implements. The tree is valuable chiefly owing to its fruits, which are the myrabolams of commerce and are largely used for tanning.

Terminalia myriocarpa, Heurck and Muell. Arg. Panisaj, hollock. A very large tree of the Eastern sub-Himalayan tract and outer hills, Assam, Upper Burma. Wood dark brown, handsome, hard, used for building, tea-boxes, common furniture, boats and cart shafts. After impregnation this timber may prove suitable for sleepers. Large quantities available.

Terminalia tomentosa, W. and A. Sain, saj, asan. A large tree, common throughout India and Burma. Wood dark brown with darker streaks, hard, apt to split in seasoning, durability variable, used for building, rough furniture, oil-mills, agricultural implements, carts, boats, mining timber and other purposes. The timber is available in large quantities and is likely to make a good sleeper wood after impregnation.

Xylia dolabriformis, Benth. Ironwood of Burma, pyinkado. A very large tree, abundant in Burma. Wood reddish brown, extremely hard, heavy, very strong and durable, used extensively for house-building, bridge-construction, railway sleepers, railway trucks and carriages, boats, carts, wheels, carriage frames, agricultural implements, tool-handles and many other purposes. This is, after teak, the most important timber in Burma, where it is extensively used for railway sleepers. It is very plentiful and obtainable in large size.

Xylia xylocarpa, Roxb. Jamha, irul. A large tree of the Indian Peninsula from the Central Provinces and Bombay southwards. Wood reddish brown, very hard, heavy, durable, apt to split in seasoning, used for house-building, bridge-construction, agricultural implements and other purposes. Available in fair quantity.

(2) Minor Produce

The forests of India are so rich in minor products of all kinds that it is possible to refer only to those which are or are likely to be of commercial value. A classification together with a brief description of the more important products will be found in Troup's Indian Forest Utilization (1913), while much useful detail regarding them is contained in Watt's Commercial Products of India (1908). Among the more prominent classes are comprised bamboos, grass (including grazing), leaves for fodder,

value of grazing and fodder and thatching grass yielded by the forests amounted to Rs. 61,41,796

(c) FIBRES.

It is usual to classify fibres according to the part of the plant from which they are obtained. Flosses are silky cottons yielded by the fruit capsules of certain trees. The true "kapok" of commerce is a floss produced by *Eriodendron anfractuosum*, which is sometimes planted in India but is not an indigenous forest tree. The most important substitute for kapok is the floss obtained from the fruits of *Bombax malabaricum* while among other species yielding silk cottons are *Cochlospermum Gossypium* and *Calotropis* spp. Species of wild plantain (*Musa*) yield strong fibres from their sheathing leaf-stalks, and the leaves of the wild sago palm, *Caryota urens*, give a fibre of some value known as *kitul* and used for making fishing nets and lines as well as for brush bristles, ropes, baskets and sacking. Bast fibres are yielded by a large number of trees and by certain climbers and are employed for rough cordage though some are suitable for finer work. Among the best known are those produced by species of *Sterculia*, *Grewia* and *Bauhinia*, and several species of the orders *Malvaceæ* and *Urticaceæ*. Of forest fibres which seem to have commercial prospects may be mentioned those of the shrubs *Helicteres Isora* and *Urena lobata*. Both are very common in certain localities, and the former yields a strong greyish white fibre used in rope making while the latter produces a strong fibre nearly equal to jute. Of fibrous grasses the two most important are the munj (*Saccharum Munja*) and the thabar, haib or sabai (*Ischæmum angustifolium*); the latter is better known as a paper making material, but both are largely used for making rope and mats.

(d) OIL SEEDS.

Although many forest species yield useful oil-seeds, the cost of collection from trees scattered over large areas renders it impossible for them to compete with oil-seeds cultivated as agricultural crops. The collection of forest oil seeds, therefore, is commercially remunerative only if they possess special pro-

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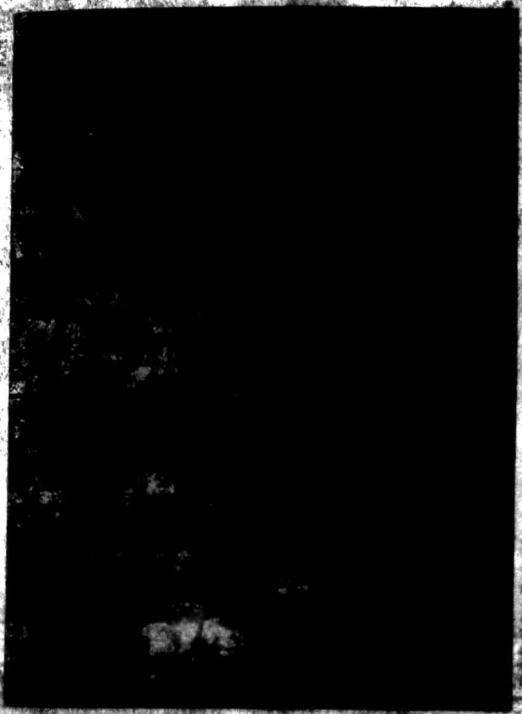

Sal forest of good quality, Balaghat.

perties; the inhabitants of the jungle, however, utilize the forest oil-seeds to a large extent as food and for cooking or lighting purposes.

Probably the best known oil-seed obtained from any Indian tree is that of the Mohwa, *Bassia latifolia*. The oil is a yellow buttery fat, obtained from the seed by expression to the amount of from 45 per cent. to 50 per cent. on the weight of the seed. It is used in India primarily for adulterating ghee, also as an ointment and for burning, cooking and soap making. It is exported to Europe in large quantities; thus in 1913-14 the total exports amounted to 665,979 cwts, valued at £364,000 of which quite 85 per cent. found its way to Germany; since the war much of the trade has been diverted to England. Bombay exports by far the greater proportion of the outturn, while the Central Provinces and the Bombay Presidency produce the majority of the crop.

The seeds of *Taraktogenos Kurzii* yield the true 'chaulmugra' oil of commerce used in cases of skin disease and leprosy. The tree is fairly common in Assam, the seeds being exported from the Khasi Hills and sold in Sunamganj. It is also common in the Sylhet and Sibsagar divisions of that province, while considerable quantities of the seed are available from the Rangoon and Shwegyin divisions of Burma. A very similar oil, which is also a variety of chaulmugra oil, is obtained from the seed of *Hydnocarpus Wightiana* which is found in the forests of the West Coast especially in South Malabar and in the Cochin and Travancore States.

The cotyledons of *Shorea robusta* yield a substance known as sal butter, used for cooking and adulterating ghee. Amongst other seed-oils may be mentioned those obtained from the seeds of *Bassia butyracea*, used in the preparation of glycerine; of *Pongamia glabra*, used for cooking and for burning; of *Juglans regia* (the walnut) used in confectionary and for cooking and lighting; of *Melia indica*, a bitter oil used in native medicine; and of *Vateria indica*, a tree of Western India and Malabar. Of recent years the tallow obtained from the seeds of this last-named species has come into prominence on the English market in connection with the preparation of margarine.

(a) TANNING MATERIALS.

The old methods of tanning with barks are being rapidly replaced by the use of extracts, the consumption of tanning materials is steadily increasing, and local supplies may soon prove inadequate; it is therefore probable that the tanners of Europe and America will have to depend in future, at any rate to some extent, on imported materials. The forests of India are rich in undeveloped tanning materials and there is unquestionably a great opportunity for technical research as well as for industrial and commercial development in this country. The study of tanning materials is being steadily prosecuted at the Forest Research Institute, and with the object of enquiring into the commercial possibilities of preparing tan extracts the Government of India have recently secured the services of a tannin expert from England. Among the more important tannin producing materials at present known the following may be mentioned :—

Myrabolans.—The fruits of *Terminalia Chebula,* or chebulic myrabolans, are tanning agents of primary importance. By themselves they do not tan leather of good texture but they give excellent results when mixed with other deeply coloured barks and are in great demand all over the world. The statistics of exports from India are as follows :—

Export figures, myrabolans.

	Quantity.					Value.				
	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£	£	£	£	£
British Empire	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	129,579	186,544	[illegible]	187,589
Foreign countries	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	162,870
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	350,459

Except as regards the possibility of manufacturing extracts locally and of exporting the dried pulp after removal of the kernels, it does not seem possible to do much more in connection with this product.

tan, is pre-eminently suitable for tanning sole leather. It contains 15—20 per cent. of tannin. In conjunction with myrabolans it gives a fairly light-coloured leather of good texture. Very large quantities are available, though the supply is by no means inexhaustible, which indicates the necessity of creating plantations in the vicinity of the more important tanneries. Recently the babul has been very heavily exploited for its bark to supply the greatly increased demand of the Cawnpore tanneries during the war.

Cassia auriculata or tarwar bark is probably the best bark available in India for tanning purposes and is the standard tan bark of Southern India. It gives good weight to leather and though it contains catechol-tannin like the mangrove bark, it is less highly coloured and yields a fairly light-coloured leather. About 50,000 maunds of it are stated to be available annually from the forests of Marwar alone. It is found in large quantities in the wild state and is cultivated: its cultivation might with advantage be largely extended.

Kahua (*Terminalia Arjuna*) and dhaura (*Anogeissus latifolia*) barks.—These barks have recently come to notice, and give promise of being useful tanning materials.

Sal (*Shorea robusta*) and sain (*Terminalia tomentosa*) barks.—These are inferior to the two previously mentioned barks, though of considerable value and extensively used in Northern India. Their value in the preparation of tan extracts has still to be proved.

Oak barks.—These cannot be considered as marketable articles on account of the inaccessibility and distance of the oak forests from the centres of consumption. They contain a similar amount of tannin to the European oak barks.

Leaf tans or sumach.—Some work regarding the possibilities of leaf tans has been carried out at the Research Institute. It has been found that the autumn leaves of *Rhus Cotinus* and *Rhus parviflora* are richest in tannin. Recently it has been proved at the factory owned by the Eastern States of Central India Export Trust that the young leaves and twigs of *Anogeissus latifolia* (the dhaura or bakli) contain valuable tanning properties. Should the results of experiments lead to

like crystals which are separated from the mother liquor by throwing the magma into a sandpit. The tan liquor is absorbed and the catechin remains as a soft pliable mass which is slowly dried. This crude method of making kattha is open to great improvement, especially in separating kattha from the liquor in hand-worked filter presses and by drying the resulting mass in a chamber heated to about 100° C.

(f) Essential oils, oleo-resins and gums.

(i) Essential oils.

Sandalwood oil is distilled by the wet process from chips of the heartwood of the sandalwood tree (*Santalum album*) the root-wood being preferred. This valuable oil is largely used in perfumery and in medicine. Before the war the wood was largely exported to Europe for distillation, although this process has always been carried out at various centres in India by primitive methods. The question of improving the methods of distillation is receiving attention in India, and it is hoped that the time is not far distant when the whole output of sandalwood required for distillation purposes will be distilled in India by modern methods and not exported for distillation abroad. The Mysore Government is now working a distillery at Bangalore with successful results.

The eucalyptus oil industry has already assumed considerable proportions in the Nilgiris, but no expansion is possible unless special plantations are formed for leaf supply.

Rosha oil.—One of the most important essential oils in this country is East Indian geranium oil or palmarosa oil obtained from the grass *Cymbopogon Martini*, Stapf. The distillation of this oil was probably commenced in the 18th century, and it was first brought to the notice of Europe in the early part of last century. Recent investigations at the Forest Research Institute have shown that improvements in distillation can be effected by employing a modern type of steam still. The main conclusions arrived at are that it is more economical to distil the grass with steam and that 20 per cent. more oil can be obtained in this way. By redistilling the crude oil a water-

Photo Circuit, Dept., Thomason College, Roorkee.

Forest steam tramway running through sal forest, Goalpara, Assam.

white oil of a standard composition can be put on the market, which should materially benefit the trade in this article.

Lemon grass oil.—The distillation of lemon grass oil from *Cymbopogon citratus* is a more modern industry than that of rosha oil, for the former was imported into England for the first time in 1882. Distillation by crude methods has been carried out for many years. The industry started in Travancore and extended later to Malabar, where stills of improved construction have been used. When Travancore held the monopoly the oil was exported from Cochin, but now that the industry has extended northwards into Malabar, Calicut is becoming a centre of distribution. The oil has lately been prepared in Assam. Before the war from 2,000 to 3,000 cases each containing one dozen quart bottles of oil were exported annually from Cochin to Bombay and to various other ports, chiefly New York, Hamburg and London. A large proportion of the oil is absorbed in the manufacture of citral and ionone, an artificial violet perfume. An export trade in the oil has recently developed in Java. The demand for lemon grass oil is steadily on the increase in Europe, and all things considered this oil would seem to have a promising future.

Saussurea Lappa.—"Kuth" roots are an important forest product. The plant grows in Kashmir at an altitude of from 6,000 to 10,000 feet. It is exported largely to China where it is burnt as incense and was sent in large quantities to Germany before the war for the distillation of costus oil, which was then valued at Rs. 150 a lb. It is used to adulterate violet perfumes. Lengthy experiments in order to ascertain the best method of distillation and the factors which determine its oil value are approaching completion at the Forest Research Institute. The work done up to date indicates that the best method of extracting the oil is with the help of alcohol. The roots should first be treated in a modern extraction plant in which the loss of solvent does not exceed 1—2 per cent and the extract thus obtained should be steam distilled. A complete note on the subject will be issued as soon as the experimental results have been confirmed on a commercial scale.

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show that wintergreen oil can be distilled at a profit in India from the leaves of *Gaultheria fragrantissima* cultivated in Assam during the winter. The fresh leaves gave as much as 0·35 per cent. of oil, or 1·2 per cent. calculated on the dry material. The Nilgiri plant gave only 0·12 per cent. of oil from fresh leaves and 0·23 per cent. calculated on dry material. The plant grows gregariously in the Nilgiris, in Assam and in Ceylon, but for a regular supply of the leaves it would be necessary to cultivate it on an extensive scale. From the wintergreen oil so distilled it has been shown that natural salicylic acid and natural sodium salicylate can be easily prepared.

(*ii*) OLEORESINS.

Pine resin is by far the most important oleoresin obtained from the forests of India, and as its collection has now reached the stage of an important industry it is dealt with separately below. Of other oleoresins the following deserve mention :—

The gum-oleoresin of *Balsamodendron Mukul* (gugal).—This is a useful product, yielding 05 per cent. of oil and 73·02 per cent. of a yellow resin similar to that obtained from Siam, the so-called acroid resin used for metal polishing. It also yields 13·66 per cent. of gum of an inferior quality.

Boswellia serrata.—The gum-oleoresin of *Boswellia serrata* may prove to be of considerable importance. Unlike the pine oleoresins, it is made up of three ingredients (1) an oil, (2) a rosin, and (3) a gum. Though it was known that the oil of myrrha and this gum-oleoresin resemble each other and that both contain pinene, it is only recently that an attempt has been made to isolate these ingredients commercially. The enquiry was initiated by the Forest Research Institute, and after much work and with the help of the Imperial Institute, a process for the isolation of the products has been evolved. A full report on the subject is under preparation, and though there are difficulties to be overcome in connection with the collection of the raw oleoresin there are good prospects for the establishment of this industry on a commercial scale.

Dipterocarp oleoresins.—The oleoresins of the Burma dipterocarps have received little attention from chemists up to

The dhaura tree, *Anogeissus latifolia*, yields a whitish-yellow gum used extensively for sizing paper and calico printing. It makes up into a poor mucilage.

Bauhinia retusa, a tree of North-West and Central India, yields a clear yellow to reddish coloured gum with a bright fracture. It is collected in considerable quantities in the outer Himalaya, being used for medicinal purposes. Professor Dunstan in a report gives its viscosity as eight times that of gum arabic.

Odina Wodier (jhingan or mohin) yields a copious gum used in fixing whitewash, sizing paper and in medicine. It is a common tree of the deciduous forests of India.

Cochlospermum Gossypium yields the "katira" gum of commerce; it exudes from the tree in long whitish corrugated streams, and is used by shoe-makers, in medicine, and as a poor substitute for gum tragacanth.

Buchanania latifolia, a tree found throughout India and Burma, yields large quantities of gum, making up into a fair mucilage which deserves further attention.

Gardenia lucida yields a hard opaque yellow to greenish-brown gum resin, used in cutaneous diseases, while that of *Gardenia gummifera* is used for similar purposes and is also edible.

(7). India rubber.

The only indigenous rubber tree of importance is *Ficus elastica*, a large evergreen tree found wild in the moist forests of the outer Eastern Himalaya, Assam and Upper Burma, chiefly in the Hukong Valley. In order to supplement the natural supplies, plantations on a fairly extensive scale have been made by the Forest Department in Assam. With the advent of plantations of *Para* (*Hevea*) rubber, however, it was found that the Assam plantations could not compete financially with them, mainly for the reason that it takes some 12 to 14 years for *Ficus elastica* to come into bearing as against 4 to 6 years for *Hevea*, while age for age the yield of *Ficus* plantations cannot compare with that of *Hevea* plantations.

The Forest Department took its share in the initial experimental work connected with the formation of *Hevea* rubber plantations in Burma. In the year 1878 the experimental planting of *Hevea* at Mergui in Tenasserim was commenced by the department: more recently planting was undertaken on a larger scale and was extended until in 1910 the total planted area amounted to 1,500 acres approximately. By this time it had been fully demonstrated that the planting of Para rubber could be carried out successfully in Tenasserim, and that the industry could be taken up safely by private agency. The plantations were accordingly sold to a Company in 1910.

(*h*) Drugs and Spices

Although the forests yield various drugs and spices which are collected for trade purposes, the intensive cultivation of these in gardens and plantations is not part of the regular work of the Forest Department. Of natural products collected from the forest may be mentioned aconite, belladonna, nux-vomica, podophylluin, barberry (" rasaut "), violet (" banafsha "), wild pepper, cardamoms, amaltas pods (*Cassia Fistula*), tamarinds and others. The experimental cultivation of *Podophyllum Emodi* has been carried out in the North West Himalaya for some years past but the growth of the plant has been found to be so slow that its cultivation for profit is as yet problematical. In the meantime supplies of this important drug are obtained from natural plants.

(*i*) Edible and other products.

Forest trees, shrubs and herbs yield an important natural supply of food which the various jungle tribes do not fail to take advantage of, particularly in times of famine. Special mention may be made, under this head, of the flowers of the mohwa tree (*Bassia latifolia*), the corollas of which are eaten fresh or are dried, ground and mixed with flour for bread, or are distilled into an intoxicating liquor. Recently they have proved to be an important source of supply of acetone.

(*k*) Animal products.

Lac, the resinous incrustation secreted on the twigs of certain trees by the lac insect (*Tachardia lacca*), and largely

used in the preparation of varnishes, in the manufacture of gramophone records, sealing wax, lithographic ink and for other purposes, is one of the most important of the animal products of the forest. There is an extensive literature on the subject of lac and its propagation. Lac cultivation is by no means confined to the forest; in many localities it is a source of profit to the cultivator in open waste or cultivated lands. The extensive propagation of lac by the Forest Department is attended with many difficulties, of which not the least is that of guarding it from theft while still on the trees. Strenuous exertions have been made to cultivate lac departmentally in the Central Provinces, but so far the results have been disappointing, and it is probable that its cultivation in future will have to be entrusted to a very large extent to private agency, the Forest Department leasing tracts of suitable forest for the purpose. The importance of this industry may be realised from the fact that in 1914-15 the value of various forms of lac exported from India amounted to as much as Rs. 1,60,57,434.

Silk is likewise a product which requires more intensive cultivation than it is possible for the Forest Department to undertake directly. The whole question of silk-production in India has recently been the subject of special investigation by Mr Maxwell Lefroy.

Horns, hides, bones, ivory and other animal products are collected as a rule under permits.

8. Forest Industries.

The important rôle which the forests of a country play in its general commercial welfare and in providing employment for its population is not always fully recognised. Ten years ago it was estimated that in Germany work in the forests provided employment for 1,000,000 persons, while [illegible],000,000 persons, earning £30,000,000 a year, were employed in working up the raw material yielded by the forests.* If similar estimates were available for India they would no doubt show that apart from the jungle population which is directly dependent on the forests

* Schlich's Manual of Forestry, vol. [illegible], [illegible] Edition, [illegible], pp. [illegible]

and the large numbers of wood-cutters, sawyers, carters, carriers, raftsmen and others working in and near them, employment on an extensive scale is provided to persons engaged in working up the raw products. Among these latter may be mentioned carpenters, wheel-wrights, coopers, boat-builders, tanners, rope-makers, lac-manufacturers, basket-makers and many other classes of skilled labourers. And yet with the further opening up of the forests, the extension of systematic working, the wider use of known products and the possible discovery of new products, a steady and extensive development of industries dependent on the forests of India may be confidently anticipated in the future.

A detailed consideration of the many important forest industries would fill a large volume; all that can be done here is to review shortly a few of them by way of example.

(1) The Indian pine-resin industry.

The commercial exploitation of the resin of the Indian pines serves a wide range of subsidiary industries. It provides rosin for shellac making, soap manufactories, paper concerns, oil cloth, linoleum, sealing wax, printing inks, electric insulation gramophone records, and wheel grease. And it also provides turpentine, which is the chief thinner and solvent employed in the paint and varnish trades, a mordant in print goods manufacture, the basis of synthetic camphor, and an ingredient of boot polishes, embrocations and liniments. This field is wide enough in peace time, but is considerably expanded in war time by the rosin used in "setting" shrapnel bullets in shells.

Of the world's trade in resin and turpentine, or "naval stores," the United States of America command about 80 per cent. of the output, France coming second with some 15 per cent. and the rest of the world taking the remaining 5 per cent.

It is now well over a quarter of a century since foresters in the North West of India began to realise the potentialities of the wide pine belt along the foot hills and lower slopes of the Himalaya. Many of them being French-trained, it was not surprising that the splendidly organized tapping

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of the maritime pine of the Landes should serve them as a model, and so from the very start the conservative cup and lip method in use in France was adopted, thus ensuring the best possible yield of resin with the minimum risk of injury to the trees. And so from small beginnings in the United Provinces, and later in the Punjab, the industry has grown till to-day (for the year ending on 30th June 1919) the annual resin collection in the United Provinces and the Punjab amounts to 69,980 maunds net (2,592 tons), the operations covering 62,000 acres of forest with 2,141,000 blazes or channels in work, giving employment to at least 2,400 operatives.

In the last five years, in the United Provinces more especially, extensive and successful organization has brought the harvesting of the resin to a high state of efficiency. Mr. E. A. Smythies' interesting pamphlet on the "Resin Industry in Kumaun" (Forest Bulletin No. 26, 1914) is available for those who wish to study the question further.

The work of setting up a crop of pots (or cups) and lips preparatory to tapping pine trees for resin is simple, when properly organized, and the resin collection in the forests offers exceptional opportunities to the surrounding villages to utilize the old and the young for earning excellent wages.

The bark of the tree to be tapped is first of all lightly smoothed, then, as close to the base of the tree as possible, the bark is entirely removed so as to expose the sap-wood on a strip some 6" high and 4" wide. A galvanised iron lip 6" wide by 2" deep is driven in at the lower end of this strip or gash and an earthern pot, made by local village potters, is hung below the lip, being kept in position by a nail or a hard wood peg. This preliminary work is done in the winter months.

The tapped forests are grouped into depôts, subblocks and blocks for purposes of control, the unit of work being a section of 1,000 blazes (equivalent to an average of 700 trees, spread over 25 to 30 acres of forest) in charge of a tapping coolie, and the unit of control being a depôt taking the produce of about 25,000 blazes or channels.

The tapping coolie at the beginning of the tapping season, sometime in March, cuts away the sap-wood on the already

experience of adverse trade criticism and adverse markets, that an apparatus good enough for America was not good enough for the maritime pine resin of the Landes and so, since 1900 or thereabouts, technical French engineers at Bordeaux, energetically assisted by the chemical section of the Bordeaux University, have devoted much attention to the subject of the resin distillation. The result has been a score or more of patents, in all of which fire heat is eliminated and complete control of temperature is maintained by systems of steam heating and steam injection. France has thus been enabled to do the best with its pine resin and produces rosin with a good reputation in the trade and a thoroughly sound, merchantable turpentine.

The lesson learnt in France gradually penetrated to India. The primitive stills first used in the United Provinces and the Punjab were re-modelled and modified till to-day the United Provinces possesses a battery of stills and secondary apparatus which ingeniously overcomes the defects produced by excessive unregulated heat, while the Punjab, boldly scrapping its obsolete plant, has erected a modern French one, modified to suit Indian conditions, which is giving entire satisfaction by the excellence of its products and the economy of its working. The Punjab rosin has been recently pronounced in some respects superior to French rosin by the well known paint and varnish firm of Messrs. Wilkinson, Heywood and Clark, Limited, London, and a large scale commercial test is now under contemplation definitely to determine the commercial value of Indian rosin in relation to American, French and Spanish rosins. Such a test, if favourable (as there is every indication of its being), will materially assist the Forest Department in capturing the whole of the Indian trade and that of Java, China, and possibly even of New Zealand and Australia. The Indian turpentine too has been standardized and certificate No. 1786-Gs dated the 7th/10th of the Railway Board Test House, Alipore, testifies that the sample submitted (Jallo Factory, Quality I) gave "a very satisfactory paint film" and "should prove very suitable for paint manufacture." The turpentine is guaranteed up to this sample and the Joint Sales Manager, Bhowali Post Office, Naini Tal District, United Provinces, is always glad to furnish samples and quotations, either direct or through local agents.

A short account of the actual distillation of pine-resin as carried out at the modern Government turpentine factory (managed by the Punjab Forest Department), Jallo, North Western Railway, Lahore District, may be of interest. The resin received from the forest is taken out of the air-tight receptacles, loaded into tip-waggons and conveyed along an elevated tramway to large melting and mixing vats. There the resin is melted and mixed, steam heat only being used, the melting being assisted by the addition of turpentine from a previous distillation. The specific gravity of the resin is thereby reduced, so that, when the melting and mixing is finished, a period of rest enables the water and dirt, etc., to sink by gravity to the bottom of the vat, the clean light resin floating on the top. Evaporation is prevented by the lids of the vats being fitted into water-joints. The next stage consists in drawing off the clean resin to a storage tank, whence a measured quantity is taken over, as required, into a steam elevator and thence into the still.

In the still, which is steam jacketted and kept hot by steam under pressure, giving one command of a wide range of temperature, the turpentine in the resin is driven off by means of steam. The water and turpentine vapours first pass through a still to prevent any resin or rosin accidentally driven over from going further, and then through a huge condenser in which they finally and whence they flow into a mechanical separator, the turpentine being pumped to bulk storage, while the water runs

To ensure standard qualities the turpentine is redistilled in a subsidiary still, passed through lime water to remove traces of resinous acids and dehydrated by filtration through anhydrous sodium sulphate. As however this last mentioned process is thought to be a possible source of contamination it has recently been replaced successfully by a period of rest in storage tanks. Experiments are also in progress to dispense with redistillation by accurately fractionating the distillate in the primary distillation. The turpentine is put up for sale in five gallon drums, bearing distinctive stencil marks, bung discs and labels, to prevent tampering by retail traders.

The hot rosin in the still is drawn off by means of a sluice-valve into a waggon and transferred to the rosin shed, where it is filtered through a layer of cotton wool and then run into casks, bags or tins while still moderately hot and fluid. The rosin is graded according to American standard into pale, medium and dark shades. Gross weight, actual tare, etc., are carefully stencilled on the packages before despatch. The rosin has proved uniform in quality, very clear and free from dirt, a most important matter in paper and shellac manufacture.

The process of manufacture at the Bhowali Factory, United Provinces, is similar, but there they have the disadvantage of working with older plant. This defect, it is understood, will be removed as soon as more normal conditions prevail in Europe.

The cost of distillation and packing varies from Rs. 1-8 to Rs. 2 per maund net, including all costs. A maund of resin yields on an average 3rds of a maund of rosin and 4·75 gallons of turpentine, of which up to 1·5 gallons is Quality 1.

For the year ending 30th June 1916, the combined output in the United Provinces and the Punjab was 67,078 maunds of resin distilled (27 maunds = 1 ton), yielding 47,149 maunds of rosin and 111,835 gallons of turpentine, all classes. The gross revenue was Rs. 5,04,249, the gross trading account profit Rs. 1,73,892 and the net trading account profit Rs. 1,46,794, while the invested capital stood at Rs. 1,61,905. Interest and depreciation per maund of resin distilled varies from annas 5 to annas 10. The financial aspect of the industry may therefore be considered quite satisfactory. This question has been dealt with instructively and exhaustively by Mr. E. A. Smythies in the "Indian Forester" for April 1916 pages 197-201, the most striking fact there brought out being that whereas a chir pine tree yields at maturity at most Rs. 30 worth of resin, the gross value of its resin comes to Rs. 138, inclusive of compound interest at 3½ per cent per annum.

The possibilities of development of the Indian pine resin industry are considerable. The average annual imports of resin and turpentine into India for the five years 1907-08 to 1911-12 were about 3,000 tons and 237,000 gallons respectively. Today India is herself producing over 1,500 tons of resin and 111,000 gallons of turpentine towards her annual

Photo Media Unit, Thomason College, Roorkee.

The natural regeneration of a chir pine forest, showing how a young crop is created by opening out the overwood to admit light and protecting from fire. The old trees are being tapped for resin prior to being felled.

stuff and to shipping difficulties. In spite of this fact the outturn of paper from Indian mills increased in 1914-15 by at least 5,000 tons of paper, a fact strongly indicating the possibilities of expanding the output in this country even when the difficulties of obtaining chemicals are abnormal.

The most important raw material used in India at the present day for the production of half-stuff, is sabai, bhabar or baib grass, *Ischæmum angustifolium*, which is obtained from the forests of Bengal, Chota Nagpur, Orissa, Nepal and the United Provinces. The other materials used in India for the manufacture of paper are rags of poor quality, hemp, jute, gunny bags, waste paper and old ropes. Since the war began, limited quantities of munj grass, *Saccharum Munja*, have been used though the yield of pulp from this grass is not high, while in many parts of the country its value is considerable owing to the demand for other purposes.

The two most important substances from which pulp is prepared all over the world are wood and grasses, of which wood claims 90 per cent. of the outturn. In India owing to the large number of species and the generally mixed character of the forests [illegible] two timbers are available which fulfil the necessary conditions namely concentrated large supplies at [illegible] the manufacture of pulp. The chief of these [illegible] [illegible] silver [illegible]

Under the natural order *Gramineæ* we [illegible] grasses both of which are available in large quantities [illegible] certain localities of British India and some [illegible] experiments given very favourable results. Up to date the best results have been obtained with *Bambusa polymorpha* (kyathaungwa), a species which occurs [illegible] abundance [illegible] Burma. *Cephalostachyum pergracile* [illegible] *Dendrocalamus strictus* (the common male bamboo) have given almost equally good results, while *Bambusa arundinacea* (the thorn bamboo) and *Melocanna bambusoides* (the single stemmed bamboo) have given results little inferior to the best as yet obtained. All these species are available in very large quantities and can be extracted at relatively cheap rates. A complete note has been published by the Forest Research Institute

facturers and shippers, who have now practically captured the Indian trade at the expense of Sweden and Norway.

In the above mentioned memoir on the prospects of the match industry in India is given a detailed list of timbers suitable for making match-splints and boxes compiled from the results of tests carried out mainly by an up-to-date firm in Germany. The most universally used wood in India for match-making is *Bombax malabaricum*, the simul or cotton tree. The timber of this tree makes up into a strong good box of fair appearance. It yields fair sticks, the drawbacks to the timber being that it discolours, that it does not allow of the stick being cut uniformly square in section, and that the waste in conversion is considerable. A far superior stick can be obtained from *Abies Pindrow* and *Picea Morinda*, the silver fir and spruce respectively. The chief drawback to these species lies in the difficulty of extraction from the high elevations at which they grow in the Himalayas, a difficulty which, however can probably be overcome by mechanical extraction. Many other species of timber occur which are fairly suitable for match making, amongst which may be mentioned *Anthocephalus Cadamba*, *Bombax insigne*, *Boswellia serrata*, *Evodia fraxinifolia*, *Grewia rottleriformis*, *Populus euphratica* and *Trewia nudiflora*.

The difficulties under which the industry has laboured in India may be summarised as follows:—(1) imported matches are sold at extraordinarily cheap rates (2) great difficulty has been experienced in obtaining a first-class indigenous timber within a working figure of cost, (3) railway freight has hit the local trade, especially in connection with imports of chemicals and distribution of the manufactured product and (4) the cost of landing the timber in the round at a factory site has in many cases turned out to be excessive. In spite of the manifold difficulties experienced the industry still persists, and the solution to the problem in Northern India may be found to lie in the erection of portable or semi-portable splint machines in the hills, in the vicinity of the spruce and silver fir forests, and by exporting the prepared splints to central match factories in the plains, a system of working which it is understood has been inaugurated in Japan and other countries.

The methods by which timber can be treated may be divided into four classes, namely, (*i*) brush treatment, (*ii*) immersion in open tanks, (*iii*) treatment in pressure cylinders and (*iv*) hydrostatic injection. The first is not an impregnation method but relies on protecting the timber by applying a superficial layer of paint or antiseptic oil. Immersion in open tanks is suitable for treating posts, telegraph poles, mining props, and limited quantities of sleepers or building material. Of timber artificially protected in Europe and America, the greater proportion is treated in pressure cylinders, while hydrostatic injection is not now in common use.

Many treating processes have been evolved, differing both in the antiseptic used and in the method of introducing it into the timber. The antiseptics which are at present employed may be divided into two main groups, namely, oils and salts; by far the most important oil is coal-tar creosote. Many other antiseptic oils have, from time to time, been put on the market, either patents or otherwise, but nearly all of them are derived from coal-tar creosote. The other oils to which attention has been paid in recent years are petroleum products.

A large number of salts have been employed in the treatment of timber, of which chloride of zinc has best withstood the test of time. Of other well known salts may be mentioned copper sulphate, corrosive sublimate or bichloride of mercury, saccharine and arsenic solutions and compounds of fluorine. The various processes embodying the employment of these salts have generally been named after the inventors of the processes, such as burnettizing, employing chloride of zinc, the Boucherie or Margary process, in which copper sulphate is used, and powellizing, in which molasses and arsenic form the chief ingredients. Besides the above processes may be mentioned the Haskin or vulcanising process, in which the substances in the timber are sterilized and rendered unfit for the nourishment of insects and fungi.

The primary factor governing the treatment of timber in any country is the procurability of a good grade of cheap coal-tar creosote. This oil is not at present available in India, all supplies having to be imported. Again, the variable climate in different parts of India not only affects the timber to be treated,

produced in India. The solution to the difficulty lies in producing coal-tar creosote locally; were this undertaken, there can be no doubt that not only would an entirely new industry spring up but also the sleeper requirements of the railways would be far more easily satisfied.

In reviewing the position of affairs in regard to the treatment of timber, in connection both with sleeper work and with constructional timber, there can be no doubt that India is far behind most civilized countries. On the other hand the possibilities are great, for suitable timber is available in large quantities, which, after treatment can be successfully employed for sleepers and constructional work, while the growing scarcity and ever increasing rates paid for the better classes of constructional timber all point to the utilization of our auxiliary species, which after careful seasoning and treatment might well take the place of timbers now more commonly in use. Another aspect of the position which deserves attention is that relating to the growing demand for timber due to increase of population and higher civilization. Owing largely to the inaccessibility of many of our important forest tracts this can be barely met by our present supplies and has to be augmented by imports, so that every effort should be made to husband resources. There can be no doubt that the treatment of timber to make it more durable is a matter which deserves more serious consideration than it receives at present.

(5) The dry distillation of wood.

The manufacture of charcoal is as old an industry as civilisation, though even now the methods usually employed involve the loss of all the volatile products given out during its preparation. A stage further than simple charcoal making is found in the wood-tar industry of Sweden and the United States of America, where the wood is burnt in masonry kilns. The tar as it trickles from the burning wood is collected in a channel at the bottom of the kiln and is passed through a pipe to a collecting vessel. In this process, however, the valuable out of many valuable products are recovered.

The modern dry distillation plant is a more perfect. It consists of a system of retorts which are heated by coal or wood

Wood alcohol is largely used in the varnish industries as a solvent for resins, for the manufacture of formaldehyde and for the purposes of denaturing ordinary grain alcohol

Acetate of lime is used for the manufacture of wood acetic acid, acetates, acetic ether, acetone, iodoform and chloroform, etc.

The financial success of this industry rests on the disposal of the main products acetates, charcoal, alcohol and tar, for which a high development of chemical industries is essential: in ordinary times, the manufacture of acetone from the acetates for the purpose of making cordite or smokeless powder cannot absorb all the output.

In countries where ordinary grain alcohol is produced on a large scale, denatured alcohol is cheaper than wood alcohol, so that the demand for the latter, even in the varnish trade and for fuel, is limited. Charcoal, when produced on a large scale from a destructive distillation plant, has to be disposed of wholesale for the manufacture of pig iron, and for this again there is not much demand at remunerative rates the pig-iron being now made with coal instead of charcoal. An article on the hard-wood distillation industry by Katzenstein in the Scientific American of 1st January 1916, while paying a tribute to the great service of the industrial chemist in improving the processes and plant necessary for the rectification of acetic acid and wood alcohol, thereby making a substantial reduction in the cost of their production, betrays the somewhat unsound condition of the industry in America before the war, due entirely to the difficulty in finding a ready market for the different products. In this connection the Scientific American states:—

"The hard-wood distillation industry has been brought to special attention of late, on account of the rapid increase in value of one of its products, acetate of lime, which is being converted, in large amounts, into acetone for the manufacture of smokeless powder. This special interest has been a great boon to the industry, for with low prices for

wood alcohol since the passage of the denatured alcohol act, overproduction and low prices for acetate of lime and a constantly decreasing premium for charcoal pig-iron, the outlook for the industry has not been brilliant for the past few years."

It seems somewhat premature to think of wood distillation in India when countries like the United States of America, which is so much better placed in respect to markets, experience difficulties in disposing of the products.

Destructive distillation on a commercial scale necessitates the supply of timber in considerable quantities. The wood must be of little value for other purposes, while as has already been stated, hard woods are preferable to soft-woods for the preparation of acetic acid, wood alcohol, etc. In India, these conditions are not ordinarily fulfilled in the more accessible localities, where there is usually a fair demand for wood. In the Kumaun hills, however, there is a large supply of chir timber, *Pinus longifolia*, which owing to twisted fibre is useless for sleepers or constructional timber and which it may be possible to utilize for the production of Stockholm tar.

If the question of starting destructive distillation of wood in India should at any time take practical shape the mangrove forests of Arakan and the Tavoy and Mergui coastal areas of Burma are examples of tracts capable of furnishing very large supplies of wood, more especially if it is found possible to produce a satisfactory tannin extract from mangrove bark.

Of other species of timber which might be found to meet the necessary requirements are the oaks of the Himalayas, certain hard-woods of the evergreen forests of Assam, such as *Cameltia polyandra*, or again various species found in the forests of Burma or of the West Coast.

9. Financial Results.

The steady growth of forest revenue, expenditure, and surplus during the past 50 years is shown in the following

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9. Financial Results.

The steady growth of forest revenue, expenditure and surplus during the past 50 years is shown in the following

statement, which gives annual averages for quinquennial periods* :—

Financial Results of Forest Administration in British India from 1864-65 to 1913-14 (in lakhs of rupees).

Quinquennial period.	Gross revenue (average per annum).	Expenditure (average per annum).	Surplus (average per annum).	Percentage of surplus on gross revenue.
	Lakhs.	Lakhs.	Lakhs.	Lakhs.
1864-65 to 1868-69	37·4	23·8	13·6	36·4
1869-70 to 1873-74	56·3	39·3	17·0	30·2
1874-75 to 1878-79	66·8	45·8	20·8	31·2
1879-80 to 1883-84	88·2	56·1	32·1	36·4
1884-85 to 1888-89	116·7	74·3	42·4	36·3
1889-90 to 1893-94	159·5	86·0	73·5	46·1
1894-95 to 1898-99	177·2	98·0	79·2	44·7
1899-1900 to 1903-04	196·6	112·7	83·9	42·7
1904-05 to 1908-09	257·0	141·0	116·0	45·1
1909-10 to 1913-14	299·0	163·7	132·8	44·7

This statement exhibits the striking fact that the surplus has increased nearly ten-fold during the past 50 years, and that it averaged £882,000 sterling per annum during the last quinquennial period, without including the large sum represented by the value of forest produce given away free or removed by right-holders, which at a rough estimate amounts to over £400,000. The increase in the surplus is all the more satisfactory when it is considered that all capital expenditure has been met from revenue and that a considerable proportion of this expenditure is incurred on silvicultural and other operations which as a rule do not show any return for a long period of time.

Forest revenue and expenditure prior to the 1st April 1911 were in the major provinces shared equally between imperial and provincial, but in the minor provinces were wholly imperial. From the date mentioned, however, revenue and expenditure in the major provinces were wholly provincialized. Under the terms of the latest provincial settlements forest revenue and expenditure are imperial in Coorg, the Andamans and Ajmer, in the North-West Frontier Province and Baluchistan forest revenue but one-half and one-third forest expenditure respectively are provincial.

* From the Quinquennial Review of Forest Administration in British India for the period 1909-10 to 1913-14.

Given the necessary staff, the organisation and development of the forests should in future proceed even more satisfactorily than it has done in the past, for the pioneer work is approaching completion and the results of scientific research cannot fail to make themselves felt in an increasing degree. The present yield of the forests as judged by the productive capacity of the soil is a mere fraction of what it might be, and gives little idea of their potential value when fully brought under scientific management. India may therefore rest assured that in her vast forests she has an asset of great potential value which holds out a bright promise for the future.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET

10896/1920

Downing Street,

March, 1920

DRAFT.

or R. Troup,
ol of Forestry, Oxford

or E. P. Stebbing
ol of Forestry,
Edinburgh

MINUTE.

ajor Furse

I should like to ask if you could help us with your advice in the following matter. The question of sending out a forestry expert of experience to investigate the conditions with regard to forestry in the East Africa Protectorate, Uganda and probably also in Tanganyika Territory (late German East Africa), and to advise the Governments of those Protectorates as to forest policy and if necessary as to the reorganisation of their forestry services, is now under consideration here.

A senior and experienced man would of course be essential, and he would probably take several months at any rate to make the necessary enquiries.

It

DRAFT.

14 January 1921

Sir,

MINUTE

the completion of your mission. You would also be granted free transport locally & a ... allowance whilst in Africa at the rate of £7.50 ... a day. You would be expected to furnish a report on your mission on your return to England & to advise this Dept. ... on points arising out of it.

(from the beginning of July next to January 19..)

In view of the limited time for which (the ... services) it is understood ... you can be available ... that your mission should be limited to Kenya & Uganda only, ... at any rate in the first instance ...

... are prepared to accept the offer of ... the conditions stated, & if so at what ... You will be ... to leave ... Africa ...

...

C/10496/20 E&I

RAFT.

..d at J.S.

India Office

14 January 1921

MINUTE.

Sir,

I am ... to request you to inform Mr Lee Warner that his Lordship desires to employ Professor R. ... C.I.E. for a short period on a mission to ... to investigate ... conditions ... It is ... that Professor ... from ... in April ...

not ~~purposed~~ contemplated that he should in any case proceed to Ceylon before July but Lord ... will be glad ~~to learn~~ before proceeding with his selection that the ... has no objection to the utilisation of Prof. Dronp's services in the manner proposed.