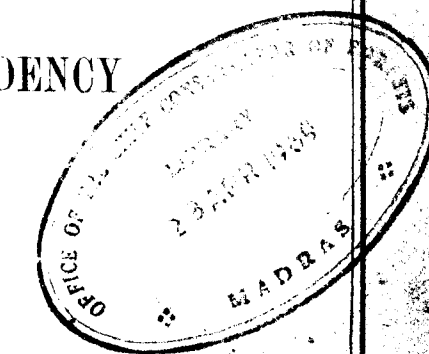


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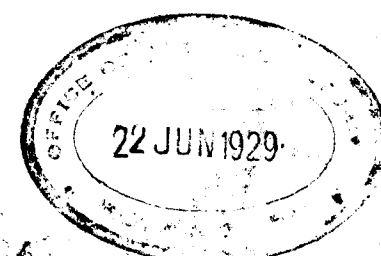
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REPORT ON
SYLVICULTURAL RESEARCH IN THE
MADRAS PRESIDENCY
1927-28



BY
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REPORT ON SYLVICULTURAL RESEARCH IN THE
MADRAS PRESIDENCY FOR 1927-28.

SYLVICULTURAL RESEARCH AND EXPERIMENTS

1. Until almost the close of the year Mr. Connolly was in charge of Research. Mr. Littlewood succeeded him as Forest Research Officer on 28th of March 1928. The Research Progress Report, which is attached, was prepared by Mr. Littlewood.

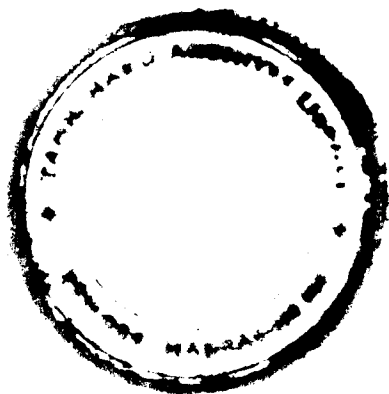
2. Regarding some subjects research has advanced to a point at which it is possible to draw some conclusions.

3. In the Annual Report of 1926-27—page 79—the subject of underplanting teak plantations is discussed. Experiments in underplanting, specially with *Hopea*, have been carried on for some years by the Forest Research Officer, whilst fairly extensive underplanting has been conducted by the District Staff of Nilambur, with both *Hopea* and mahogany. [Use has been made of mahogany on alluvial ground since according to experience it does better than *Hopea* with which we, at any rate, have been more successful on lateritic soil and sloping ground.] Mahogany, otherwise effective and worth encouragement, if for nothing else, on account of its shade-bearing character and capacity for natural regeneration, has suffered much damage from deer. But extensive introduction of either *Hopea* or mahogany has proved expensive. Although the soil improving characteristics of both *Hopea* and mahogany cannot be denied, the practical application is now concluded to be somewhat restricted, as follows.

4. *Stocking of small patches, perhaps 25 cents in area, in situations adjacent to teak plantations.*—From such 'islands' the spread of natural regeneration into the adjacent teak area may ultimately be hoped for. Compartment 83 of Nilambur, where a single *Hopea* seed-bearer has, in this manner, stocked with flourishing natural regeneration several acres of teak plantation, affords a convincing argument in favour of the above theory.

5. *Experiments with teak plantation combined with rice cultivation ('ponam') versus teak-planting without 'ponam.'*—In Research plots 44 and 46 at Nilambur—fenced areas—paddy crops were raised in conjunction with establishment of teak.

In 44, teak was introduced by the notching of germinating seeds.



In 46, nursery seedlings were planted in prepared patches, soil having been dug to 1 foot depth.

In 45 and 47 we have, respectively, notched germinating seeds put out at stakes, ground not specially prepared; and nursery seedlings planted out in prepared ground following the exact prescriptions of Mr. Bourne's Working Plan. No paddy was grown in these two plots.

The results have been a sweeping victory for the latter two areas.

6. In Travancore forests we know that excellent results are obtained by stump-planting of teak in conjunction with rice cultivation. The results given above confirm the view, already held, that there are important factors of difference in 'locality' between Nilambur and Travancore teak regeneration areas.

Paragraphs 87 to 90 of the Progress Report deal with the above experiments.

7. In paragraph 94 of the Progress Report allusion is made to the results of notching teak seed as compared with use of nursery seedlings transplanted. The former are, up to the time of writing, *as satisfactory as the latter and cost less*. So far as I am aware, in regenerating with the use of notching teak seeds there has not been the same ground preparation (that is to say, one foot deep working of the soil), that is carried out in planting teak nursery seedlings, and experiment in this direction is therefore indicated.

8. *Cutting back of mixed evergreen species of advance growth on a clear-felled area.*—In the case of Sal regeneration in Ganjam district this cutting back is a standard practice. Progress Report—paragraph 93—deals with an experiment to determine the behaviour of advance growth of evergreens in Chenat Nair forests when cut-back on a clear-felled area. The results show that cut-back plants do not grow satisfactorily and remain for several years stunted. The information is of value negatively. The idea of cutting back evergreen advance growth is one that might continue to be toyed with by executive officers. A similar test, under conditions of shade favourable to evergreens, would carry the matter a little further.

9. *Sudden exposure of Hopea.*—Progress Report—paragraph 95—conveys a warning, if it is needed, against sudden complete exposure of *Hopea* plants 4½ years' old. This is an age at which it might perhaps be supposed that the plants were fully established and capable of standing and benefiting from exposure.

10. *Application of a ground fire in a simple coppiced coupe after felling (South Mangalore division).*—Progress Report—paragraph 96—deals with an experiment in running fire through mixed deciduous

West Coast fuel forests after clear-felling. Results of the burning are clearly to stimulate regrowth, seedling, coppice and root-suckers: particularly of *Xylia*.

11. Good progress has been made with determination of the number of seeds that go to the ounce in the case of Madras 125 tree species. This work continues. Information is needed in view of prevalent uncertainty on the subject.

12. The following are some subjects of importance, now under examination, in which advances have been made but regarding which reliable conclusions must still be awaited.

13. The Forest Research Officer describes—paragraph 22—observations regarding attempts to transplant *Acrocarpus*. The use of ordinary transplants has not been attended with success. Some success has been obtained using stump plants. At Top Slip it can be seen that direct sowing of *Acrocarpus* in the open is effective; but that this species, in spite of its very rapid rate of growth, fails to afford protection to the ground. Evidently a suitable species for mixture requires to be sought.

14. With regard to *Hopea*, its introduction under shade, both by direct sowing in patches and by the use of transplants, has been under experiment in Nilambur division. Results by the former method in Nilambur are reported on favourably and agree with experience gained in North and South Mangalore divisions. (Research Report—paragraph 50.)

15. As regards *Hopea* transplants, the Forest Research Officer has found that transplantation of young nursery seedlings gave results inferior to those with one and two year old nursery plants. He has a preference therefore for the use of the older plants; and anticipates that experience with other evergreens such as *Mesua*, Poon, etc., will be similar. It has been stated, however, in South Mangalore division (1926-27 Administration Report—page 164) that the younger transplants of *Hopea* gave better results than older plants, so the matter cannot be regarded as settled yet.

16. *Research Report—paragraph 82—Walayar Coppice Coupes.*—Hitherto we have been content merely with making revenue from simple coppice coupes; and few serious attempts have been made to improve the condition and composition of the crops. At Walayar the results experienced by introduction of teak, by stump-planting, in coppice coupe areas deficient in a more valuable species make a favourable impression. In the work of the first two years, under the new Walayar Working Plan, the teak stumps were introduced too extensively and with a corresponding rate of expenditure. The 1928 area, in which restraint has been exercised, will be watched with interest. Guiding principles are yet to be found in the tending of the resulting mixed crops. There is, of course, a fight for

light between the less valuable but vigorous coppice growth, and the light-demanding slower grown teak plants. Research plots have been set up to enable the subject of cleanings to be examined. In this work at Walayar it is the definite policy to produce mixed crops, with a strong teak constituent.

17. *Research Report—paragraph 91—Treatment of very inferior second rotation teak crops at Nilambur.*—The teak crop was coppiced over in 1926. In one Research plot, weeding, burning, ploughing, and underplanting with *Trewia nudiflora* was carried out. In a second plot merely weeding and burning were done. Height measurement of the teak coppice regrowth, which had been reduced in 1927 to one shoot per stool, was recorded in April 1927 and again in April 1928. The height growth between April 1927 and April 1928 has, in the first plot, an advantage of $4\frac{1}{2}$ feet as against that in the latter plot. The experiment is still young. Success of underplanting with *Trewia* is indefinite as yet.

18. Experiments with teak regeneration from seed collected from certain distinct sources are in progress in Nilambur.

19. Sample plots have been opened at Aramby, Nilgiris, to study volume increment of various Australian hardwood species.

20. Nursery experiments with evergreen species are in progress at Kannikatti, Sappal and Karien Shola.

21. Regeneration methods under trial, where 'selection' fellings have been made in the Silent Valley forests, are under observation.

22. Mr. Littlewood's report is as follows:—

PART I.—PROGRESS OF FOREST RESEARCH IN MADRAS FOR 1927-28.

I.—EXPERIMENTAL SYLVICULTURE.

(i) GENERAL.

1. The following are the important conclusions drawn from the experimental plots maintained during the year.

(a) Teak.

2. Provided a good burn can be secured, the cheaper method of notching germinating seedlings—the method has been described in the sub-paragraph (2) of paragraph 2 of the previous year's report—gives as good if not better results than the more expensive one of transplanting nursery plants into prepared pits both in second as well as in first rotation crops. See Nilambur plot 45, second rotation (paragraphs 87 and 88) and Nilambur plot 27, first rotation (paragraph 94).

N.B.—The successful results obtained by notching germinating teak seedlings in Nilambur plot 32—second rotation crop—were dealt with in detail in paragraph 2 of the annual report for 1926-27; in that case, however, no comparison was possible between results from this method and planting in the ordinary way.

3. As regards success obtained by notching in a first rotation crop, reference was made to it in paragraph 6 of the previous year's report; that success has been maintained.

(b) *Dalbergia latifolia*.

4. In plot 45—Palghat district, Bolampatty range—this species has done remarkably well. The seed was sown on bunds 18" wide, 9" high and 24' apart in July 1926, after the area had been cleared and burnt in May 1926, and field crops were allowed to be raised between the bunds.

5. In a part of the area field crops were raised only once in 1926 and in the remainder a second crop was raised in 1927, but this made little, if any, difference to the rosewood.

6. A redibbling of rosewood seed was done in 1927 but results from this second operation were very poor in both the once and twice cultivated portions and practically all the plants (1,711 counted on 2nd May 1928) were two-year olds with individuals up to 8' high which is probably a record for two-year old rosewood. The height to which the plants attained at the end of the first year has not been recorded in the plot file, but in paragraph 7 of last year's annual report Mr. Connolly has made the remark that "the growth in the first year is much faster than in Nilambur."

7. Enumeration in May 1927 showed 1,915 plants then in existence. Except here and there and in one or two poor lines, it can be said that the stocking is now as good as it needs to be.

8. Compare this with the poor results obtained in plots 30, 31 and 52 of Nilambur in respect of which the following are the details:—

In plots 30 and 31 rosewood was sown and notched respectively at an espacement of 12' x 3' in May and June 1926, after the existing crop of teak (plantation of 1854) had been clear-felled and burnt. As in Bolampatty, the space between the lines was allowed to be cultivated with field crops in 1926. Early in June 1927 there were 66·8 per cent survivors in plot 30 and 53·5 per cent in plot 31. Casualties were replaced in July 1927 in plot 31 and redibbling was done in May 1927 in plot 30.

9. In May 1928 the following was the state of affairs:—

Plot 30.—Survivals—1,231—nearly 78 per cent. The tallest being $3\frac{1}{2}$ feet but the great majority are very much smaller down to 6 inches.

Plot 31.—Survivals—636—41½ per cent—one plant was $3\frac{1}{2}$ ' height a few are between 1' and $1\frac{1}{2}$ ' and all the others are smaller.

10. In plot 52 Nilambur, under standing teak 73 years old (third quality) rosewood was sown on 21st May 1927 in half an acre, while half an acre in the same plot was planted up in prepared pits on 11th July 1927 the same espacement of 6' x 6' being adopted in both cases. There was practically nothing to cut and burn in this plot.

11. Enumeration in May 1928 gave the following results:—

Sown—216 or 26 per cent. Tallest about 9 inches; average 4 inches.

Planted—226 or 28 per cent. Tallest 14 inches; average 9 inches.

It is on record that the young plants in this plot suffered badly from drip.

N.B.—(1) Elevation of plot 45 Bolampatty—1,600 feet. Rainfall about 60 inches.

(2) Elevation of Nilambur plots about 150 feet. Rainfall about 120 inches. Soil in Nilambur plots varied. In plot 30 it consisted of deep sandy alluvium in the west with disintegrated laterite in the east.

In plots 31 and 52 mostly disintegrated laterite. The soil in plot 45 of Bolampatty is a sandy loam.

12. Again in Nilambur plot 19 (disintegrated laterite) rosewood planted in 1924 under broken shade gave good results as recorded in paragraphs 1 (a) and 18 of the annual report for 1925-26.

13. In this case although unmarketables were left standing, the forest was virgin deciduous of good quality and an excellent burn was secured from tops and lops of felled trees, as good a burn probably as was got in Bolampatty plot 45. In plot 19 of Nilambur cultivation of field crops was not undertaken.

14. In contrast to the good results in plot 19 of Nilambur (under broken shade) we have the Mount Stuart experience as recorded in paragraph 7 of last year's annual report which is to the effect that sowing and planting under broken shade gave poor results, the sowing being a complete failure whereas direct sowing in the open had done well.

15. It is difficult from the above apparently contradictory results to draw any definite conclusions but since the conditions in Bolampatty and Mount Stuart are more or less the same, we may safely assume that in these and similar localities the sowing of rosewood preferably on bunds, in the open after a good burn gives the best results.

16. It must be observed that none of the Nilambur experiments were conducted on exactly the same lines as that at Bolampatty; the nearest approach to it was in plot 30, and the nearest approach to the Bolampatty results was also in plot 30; in the latter, we did not have a good burn nor did we dibble on bunds as in Bolampatty and it is probable that if these two conditions had been fulfilled, the results in plot 30 would have equalled those in plot 45 of Bolampatty. Work on these lines will therefore be undertaken next year.

(c) *Pterocarpus marsupium*.

17. In plot 45—Palghat district, Bolampatty range—seed of this species was sown on bunds 18" wide, 9" high and 24' apart in July 1926 and field crops were allowed to be raised between the bunds. It happened that in the northernmost portion of the area so treated, cultivation was done only once in 1926, whereas in the remainder, a second cultivation was done in 1927. The result as seen in May 1928 was that the once cultivated portion was fairly heavily overgrown with undergrowth, including coppice and thorn (*Acacia intsia*), while in the rest of it (twice cultivated) there was practically no undergrowth not even of coppice. These two differing conditions have very considerably affected the *Pterocarpus* which has done infinitely better in the once cultivated area in which the height growth of the plants is perhaps as good as it can be, many individuals reaching 9 feet, whereas in the twice cultivated portion there are a very few up to 6 feet.

18. Again in the once cultivated portion there is an entire absence of damage by insects while in the other a very large percentage have been badly attacked by a leaf-roller and most of the foliage of plants so attacked is twisted and yellow giving a very unhealthy appearance. In addition to this unhealthy appearance, the plants in the twice cultivated area are stunted and nearly every one of them (from 1926 sowings) has been browsed back or burnt back (at time of second cultivation) or have died back as a result of exposure.

19. The number of plants per unit of distance on the bunds is however greater in the twice than in the once cultivated portion, but the large number of small plants in the former are obviously the result of the second dibbling done in 1927. There are hardly any such small plants in the once cultivated part. Both areas were redibbled in June 1927.

20. Two conclusions can be drawn from the above results—

(1) That a complete removal of overhead shade is necessary for the successful germination and primary growth of *Pterocarpus*.

(2) After the first year the plants require other growth to come up along with them if they are to develop and be protected against insects and browsers.

(3) That a good burn and the cultivation of the soil, if not absolutely necessary, go a long way towards helping germination and early growth.

(d) *Acrocarpus frazinifolius*.

21. In a locality—the Chenat Nair reserve—in which this species is naturally plentiful, attempts to grow it by planting out small forest transplants have definitely failed in plots 43 and 44 of Palghat district and this despite repeated replacement of casualties in 1926 and 1927. On the other hand 20 stumps (1 inch stem, 6 inches root) put out along the edge of plot 43 in August 1927 have given 50 per cent success according to enumerations made in June 1928 without any casualties having been replaced. Forest plants 7 or 8 feet high and up to one inch thick were used for stumping and they were probably two years old or more.

22. Judging from the analogy of certain other evergreens, it is possible that had bigger (older) plants been used, better results would have been secured with ordinary transplanting, but in order to determine the proper age at which the best transplants are secured, extensive nursery experiments will have to be undertaken and this, it is hoped, to do next year.

(e) *Colophyllum tomentosum*, *Mesua ferrea*.

23. Neither of these species is difficult to grow from forest transplants but there are definite indications in plots 36 and 37 (Palghat) respectively that within certain limits—not yet ascertainable—the older the transplants the better the success. That this is the case with *Hopea parviflora* has already been proved [see paragraph (f) below] and that it holds good for mahogany also has been shown by the District Forest Officer, Palghat, as noted in paragraph 10 (b) of the previous year's report.

24. In these plots it has been positively established that after the first year, the plants especially *Mesua* respond in a marked degree to the opening of the canopy by cutting out the lower storey. In this connexion it is interesting to note that in respect of *Hopea parviflora*, paragraph 8 of last year's report records the observation that in Nilambur a low dense shade is not beneficial. The opening out of the canopy after the plants are well established is thus clearly indicated in the case of three of the slow growing evergreens with which we have experimented in Madras.

25. In the same plots endeavours to raise these two species from seed sown direct in the forest in prepared pits and at stakes proved bad failures.

(f) *Hopea parviflora*.

26. In the experiment to ascertain the best age at which to transplant this species (plots 41 and 59, Nilambur), it has been found that two-year old seedlings give the best percentage of success. In paragraph 8 of the annual report for 1926-27 it was observed that one year old *Hopea* seedlings gave better results than six weeks old seedlings.

(g) *Hardwickia pinnata*.

27. The success of this species has been maintained in plot 40, Nilambur. Enumeration in May 1928 showed 484 survivors at 600 stakes. The species is of doubtful utility as an underwood in a teak plantation owing to its very slow growth in early years; it is possible that like *Mesua* it will respond to the admission of light and with a view to test this, the lower storey in half the plot is being removed.

(ii) NATURAL REGENERATION.

28. *Acrocarpus fraxinifolius*—Plot 42 of Palghat.—With a view to study the natural regeneration of this species an area of 4 acres was demarcated in September 1925. All seedlings of *Acrocarpus* and other good species were freed of weeds. The area had previously been logged in 1925.

One acre was completely hoed.

Do. hoed in lines 6' apart.

Do. completely weeded.

Do. was weeded 6' apart.

One acre outside the four acres was marked as a control plot. The following are the enumerations recorded up to May 1928;—

—	November 1926.	July 1927.	September 1927.	May 1928.
Area completely hoed	131	97	..	88
Area hoed in lines 6' apart	303	249	..	178
Area completely weeded	156	158	..	96
Area weeded in lines 6' apart	207	152	..	135
Control area	..	..	142	92

29. As there has been a steady decline in the number of seedlings it may be assumed that the exposure resulting from the weeding and hoeing has acted adversely. In this connexion it is perhaps well to recall the experience of the District Forest Officer, Palghat, reproduced in paragraph 23 of last year's report which is to the effect that in weeding natural regeneration in a logged area in Chenai Nair reserve, heavy weeding is definitely harmful.

The Conservator of Forests, Third Circle, has been addressed with a view to abandoning the plot.

30. Other evergreen species—Plot 41 of Palghat.—The following are the results of the enumerations in September 1926, July 1927 and June 1928 in the plot laid out in 1924 to promote natural regeneration of evergreen species before felling. Undergrowth was cut, half the area was hoed up the other half being left unhoed:—

September 1926.

Species.	2½ acres hoed.					2½ acres not hoed.					1 acre control.				
	0-2'	2-4'	4-6'	Over 6'	Total.	0-2'	2-4'	4-6'	Over 6'	Total.	0-2'	2-4'	4-6'	Over 6'	Total.
<i>Calophyllum</i> ..	87	19	18	29	153	168	29	9	13	219	61	26	5	22	104
<i>Mesua</i> ..	28	17	13	18	76	59	37	10	14	120	47	27	8	12	94
<i>Dichopsis</i> ..	12	5	8	15	40	21	1	..	2	24	12	17	6	10	45
<i>Hopea</i> ..	..	2	..	..	2	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	271	..	..	..	..	363	..	..	..	..	243

Species.	2½ acres hoed.					2½ acres not hoed.					1 acre control.				
	0-2'	2-4'	4-6'	Over 6'	Total.	0-2'	2-4'	4-6'	Over 6'	Total.	0-2'	2-4'	4-6'	Over 6'	Total.

July 1927.

<i>Calophyllum</i> ..	52	27	15	13	107	125	40	15	18	198	41	21	15	15	92
<i>Mesua</i> ..	30	27	15	10	82	55	28	15	14	112	39	20	10	11	80
<i>Dichopsis</i> ..	6	8	7	9	30	19	3	..	2	24	16	13	8	8	45
<i>Hopea</i> ..	..	2	..	..	2	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	221	..	..	..	..	331	..	..	..	..	217

June 1928.

<i>Calophyllum</i> ..	65	26	17	18	126	86	37	17	21	161	28	19	12	11	70
<i>Mesua</i> ..	32	22	14	11	81	60	29	15	14	118	20	23	8	9	60
<i>Dichopsis</i> ..	12	4	6	11	33	15	..	3	2	20	16	11	3	10	40
<i>Hopea</i> ..	..	1	..	1	2	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	212	..	..	..	..	299	..	..	..	..	170

31. The results are indefinite or if they prove anything, it is that the hoeing up of soil results in less regeneration than if things were left to nature. In the control plot in which nothing was cut and no hoeing done, the number of plants per unit of area is greater than in either of the two others.

The Conservator will be addressed to abandon the plot.

(iii) SEEDS.

32. A list has been made out showing (for various species) the number of seed that go to an ounce and additions will be made to the list from time to time. Information is now available for 125 species.

33. A ledger file to record the seed years of the following species has been opened and information posted from 1927:—

Tectona grandis, *Hopea parviflora*, *Dalbergia latifolia*, *Shorea robusta*, *Mesua ferrea*, *Terminalia tomentosa* and *paniculata*, *Pterocarpus marsupium*, *Santalum album*, *Hardwickia binata* and *pinnata*, *Acrocarpus fraxinifolius* and *Pterocarpus santalinus*.

34. It has been found that a small percentage of *Acrocarpus* seed germinates after being stored for one year. The discovery was made accidentally and actual figures cannot therefore be recorded; the percentage is however too small to be of any practical use.

35. The seed of *Hydnocarpus* goes bad if attempted to be stored, but in plot 28, Nilambur, it was found that some of the seeds sown in the forest in 1927 were germinating after the break of the early rains in April 1928.

36. Sandalwood seed was stored in three different ways to see whether the method of storing in any way affects germination. Five hundred seed of each will be sown in nursery beds in 1928 and results watched.

(iv) NURSERY WORK

37. Teak seed (a) from Mount Stuart, (b) from natural forest in Nilambur, (c) selected plantation, (d) unselected plantation were collected during the year and stored with a view to carrying out an elaborate nursery experiment to see which of these will do best and a nursery was got ready for the purpose in compartment 16 of Nilambur.

38. The permanent nursery at Nilambur was maintained. There were found to be several beds in it, in which plants of *Hopea* and other species of 2 and even 3 year old existed. It is proposed to plant out and stump some of these in 1928 to ascertain at what ages the best results are obtained.

(v) ARTIFICIAL REGENERATION.

39. To ascertain the best method of establishing a crop of *Calophyllum tomentosum* seedlings in the Sappal Valley, before exploitation, an experiment was started in that valley in 1924 (plot 36). The area selected was in evergreen forest. Four hundred pits were sown in September 1924 at three seeds to a pit. The survivals in April 1928 were 82 or 20 per cent, i.e., the same number as counted on 1st March 1927.

40. In an adjacent area, 1,240 pits were planted up in 1924 (at one seedling per pit) with seedlings from the forest; enumeration in April 1928 showed 50 per cent success after replacing casualties in 1926. Some light was let in by cutting out the lower storey in April 1927 and where that was done the plants have begun to grow.

41. The third portion of the same plot dibbled with seeds has proved a total failure.

A similar experiment (plot 37) carried out with *Mesua ferrea* in the same unexploited evergreen forest has shown that planting is much to be preferred to sowing or dibbling and that the transplants used must be well lignified and therefore much older than a few weeks or even a few months.

42. In this plot a little light was let in April 1927 with the result that the plants have begun to grow since then.

The survivals by planting were 77 per cent in April 1928. Pit sowing 6 per cent in April 1928 and dibbling a failure.

43. In July 1927 one acre of this last named failed area was staked 6' x 6' and planted with seedlings, one at each stake. The seedlings for this purpose were obtained from a nursery in which seed has been sown on 5th May 1927: only 925 plants were available and they were all very young and small. Of these 752 died and were replaced in August 1927 by transplanting very young (a few weeks old) seedlings collected from the forest. The young seedlings had only one pair of leaves when transplanted and suffered severely from drip. The survivals in April 1928 were 35 per cent.

It is believed from evidence in the other planted portion of this plot that for successful planting of *Mesua*, much bigger (older) plants should be used.

44. Plot 43, Palghat.—To study the artificial regeneration of *Acrocarpus fraxinifolius*, one quarter of an acre at Sappal was cleared of creepers and shrubs in lines 6' apart. On 29th September 1925 seedlings 3" high collected from the forest were planted 6' x 6' in 216 patches at two seedlings to a

patch. The plants were not put into pits but were notched in with a stake. In May 1928, 85 plants were counted or 40.5 per cent. This result was secured after repeated filling in of casualties on 31st October 1925, July 1926, July 1927, August 1927 and October 1927.

45. In August 1927, 20 stumps of *Acrocarpus fraxinifolius* were planted in a line immediately outside the plot. The stumps were made from forest plants 7 or 8 feet high which were at least two years old and consisted of 1" stem and 6" of root. In May 1928, 9 were found to be living and more or less thriving; they were very much bigger than the ordinary transplants of 1927. This gives 45 per cent success without filling in casualties and it would appear that stumping is the proper method to adopt, or at all events that the use of larger plants than 3" high, is indicated for planting purposes.

46. Plot 44, Palghat.—A similar experiment with the same species (*Acrocarpus fraxinifolius*) was conducted in another area of one acre at Sappal. At the end of July 1926, stakes 6' apart along cleared lines were put in and seedlings, two to each stake, were notched in at 1,160 stakes. On 26th May 1928, only 235 seedlings were counted or 20 per cent. This percentage was obtained after replacing casualties in November 1926, July 1927 and August 1927 and seedlings in September 1926, December 1926, June 1927 and August 1927.

47. Nilambur plots 60 and 61.—To see if *Acrocarpus fraxinifolius* is a suitable species with which to regenerate natural forest on laterite soil, two plots were laid out in June and July 1927. In one, seed was sown 6' x 6'. In the other, nursery seedlings were planted at two to a stake with the same espacement. The type of forest chosen was miscellaneous deciduous with bamboos but in the plots themselves it consisted of almost pure *Xylia xylocarpa*. In the plot in which seedlings were planted, the canopy was open while in the sown area it was fairly complete. The experiment proved a failure, the percentage of survivals on 22nd May 1928 being 4 per cent in the sown area and 18 per cent in the planted area.

48. Nilambur plot 62.—Similar experiments in the same type of forest carried out in July 1927 with *Dipterocarpus indicus* gave 73 per cent success. In this case the canopy was open. The crop was raised by transplanting nursery seedlings which were about three months old. Espacement 6' x 6'.

49. Nilambur plots 13 and 14.—To test the possibility of growing *Hopea parviflora* from seed on laterite soil under the shade of the existing deciduous forest these two plots were laid out in 1924—

Plot 14.—In half the area pits 1' x 1' x 1' were dug 6' apart and six seeds of *Hopea* dibbled in each; in the other half, stakes were aligned 6' apart and 6 seeds of *Hopea* were dibbled at each stake after wounding the soil. Enumerations in May 1928 gave 85 per cent success in each case.

Plot 13.—This plot was first tried with *Artocarpus integrifolia*. As it failed, seedlings of *Hopea parviflora* were transplanted in pits in half the area and at stakes in holes in the other half. In May 1928, the percentage of survivals at stakes was 79 and in the case of pits 81. These two plots show that under similar conditions sowing at stake of *Hopea* gives at least as good results as planting in prepared pits.

50. Nilambur plot 25.—To ascertain whether *Hardwickia pinnata* is a suitable species to use for the conversion of deciduous into evergreen forest an area of half an acre was demarcated on 19th July 1926, 600 pits were

planted with this species; espacement being 6' x 6'. Casualties were replaced in August 1926 and June 1927. The growth of this species is exceedingly slow at least in the earlier stages. Survivals in May 1928 were 361 or 60 per cent.

51. *Nilambur plots 30 and 31.*—These two plots which were laid out in 1926 in compartment 120, Panangode, to see if rosewood can be grown in the open in conjunction with field crops was continued to be maintained. The work originally done in these plots is described in paragraph 35 of last year's report. The survivals in May 1928 were—

Plot 30 sown 78 per cent.

Plot 31 notched 41 per cent.

52. *Nilambur plots 33 and 35.*—Two plots were laid out in 1926 to see if *Lagerstræmia lanceolata* can be grown in the open in conjunction with field crops. The ground was cleared and burnt and also ploughed in May 1926. In plot 33 seedlings were notched and in plot 35 half a handful of seed was sown at each stake. The espacement in both cases was 12' x 3'. The survivals in May 1928 were 78 per cent in the notched plot and 28 per cent in the plot sown with seeds. This latter area was so poor that it has been ordered that Vengai is to be dibbled wherever *Lagerstræmia* has failed.

53. These two experiments are particularly interesting because plot 33 in which plants were notched was not fenced and was badly browsed over, whereas plot 35 was protected against cattle by a good fence. The obvious moral is never to try and grow *Lagerstræmia* by sowing seed direct in the forest.

54. *Nilambur plots 34 and 36.*—To see if *Albizia* can be grown in Nilambur, two plots were laid out in 1926, after clearing and burning the ground in compartment 120, Panangode. In one, 6 seeds were sown at each stake and seedlings 2 to 2½ inches high were notched in the other. The espacement in both cases was 12' x 3'. The survivals in May 1928 were 38 per cent in the sown plot and 53 per cent in the planted plot. It has been decided that this species is not suited to Nilambur and an endeavour is to be made in 1928 to plant blank spots in plot 34, with *Cedrela toona*.

55. *Nilambur plot 51.*—To see if *Bambusa arundinacea* is a suitable species with which to stock alluvial deposit, a plot of one acre was laid out in compartment 6, Aravallikava. The area originally bore a plantation of teak which was clear-felled and a second crop of teak was raised in 1917. This was totally destroyed by floods in 1924 and the same floods deposited 2' to 3' of silt on the area.

56. Bamboo clumps in Panangode were examined to find new culms which were a foot high or less. These were dug up and the rhizome cut a few inches from the new culm, 38 plants were obtained in this way. Two more were obtained as follows:—

The clumps were examined for culms having new buds at their bases. The culms were cut 3' above ground level, the culms were dug up and the rhizome cut a few inches from the culm without damaging the buds. The above 40 plants were planted 30' x 30' on 22nd June 1927. On 5th July 1927, strong sprouts were observed from the two cuttings made in the latter way. In August 1927, these two plants were doing well while all others had been dug up and partly eaten by pigs. On 27th February 1928, one of the two big plants had a shoot about 10 feet long. The casualties will be replaced in 1928 by the successful method.

57. *Nilambur plot 55.*—In order to see whether *Hopea parviflora* can be grown more successfully if planted out in bamboo tubes, the following experiment was conducted:—

In January 1927 *Hopea* seedlings (1926 nursery plants) were transplanted into bamboo tubes. These were watered and kept in the nursery. Two hundred of these tubes were on 14th July 1927, planted out 3' x 3' after cutting off the node at the bottom of the tube. Fifty-five per cent survived in May 1928.

58. *Chittoor division.*—In order to see how best to grow Red sanders with a view to introducing it in places where it was non-existent, three plots were laid out in Mamandur valley—a mixed deciduous forest of average quality—

Plot 1.—The overhead cover was left untouched and all the undergrowth cut and removed. Pits 1' x 1' x 1' were dug and on 20th June 1927 first sowing was done. There was no germination as there was no rain. Again on 14th October 1927 sowing was done for the second time. On 25th November 1927, 70 seedlings were enumerated in the plot. They were marked with pegs. On 25th February 1928 only 55 remained.

Plot 2.—Five hundred and twenty-eight seedlings that had been in baskets for over five months were planted in June 1927. In February 1928 there were 439 survivors.

Plot 3.—Four hundred and fifty seedlings were transplanted with balls of earth. First weeding was done on 4th January 1928. On 20th February 1928 it was found that 137 had died and that 313 were living and healthy.

59. *South Mangalore.*—The experiment to find out if *Hopea* stump planting will succeed, proved a failure, the percentage of success being only 15. The experiment was conducted in June 1925 after the south-west monsoon had begun. Type of forest—semi evergreen. Four-year old seedlings were planted with 2" stem and 6" root.

(vi) RECLAMATION AND AFFORESTATION.

60. Nil.

(vii) THINNINGS AND CLEANINGS.

61. The only thinnings carried out were in connexion with the measurement of teak sample plots in Nilambur and *Eucalyptus* sample plots in the Nilgiris.

(viii) MIXTURES.

62. Nil.

(ix) UNDER-PLANTING.

Hopea parviflora.

63. *Nilambur plot 6.*—This species was introduced in 1924 in the teak 1916 plantation. Casualties were replaced in 1925 and 1926. The survivals in May 1928 were—

Single plants in pits 43 per cent against 51.3 in May 1927.

Double plants in pits 31 per cent against 58 in May 1927.

Similar introduction of *Hopea* in the 1919 teak plantation (Nilambur plot 21) in 1924 gave the following results in May 1928:—

Single plants 59 per cent against 61.6 in May 1927.

Double plants 51 per cent against 72.6 in May 1927.

Casualties had been replaced in 1925 and 1926.

Results in the above two plots indicate that *Hopea* can be grown under teak at Nilambur at a price, but it is necessary to remark that since the above experiments were started our knowledge has developed in respect of *Hopea* and much better success is now secured by using one-year old and two-year old seedlings—vide Nilambur plots 41 and 49 (paragraphs 85 and 86).

Hydnocarpus Wightiana.

64. Nilambur plot 28.—Seeds were sown under teak in the 1854 plantation in May 1926 at 400 stakes, at an espacement of 6' × 6', six seeds were sown to a stake. Before sowing the ground was wounded to a depth of 3" and the seeds were sown on the day of collection. Enumerations in May 1928 showed 73 per cent against 56.8 per cent success in May 1927. The increase is due to a redibbling having been done in April 1927 at stakes at which there were no plants.

65. Nilambur plot 37.—*Hydnocarpus* plants raised in the nursery at Nilambur (seeds were sown in the nursery in April 1926) were transplanted, when about 3" high, in June 1926 at an espacement of 9' × 9' under teak in the same plantation. Casualties were replaced in July 1927 using the previous year's nursery plants. In May 1928 there were 80 per cent survivals against 68 per cent in June 1927.

The plants resulting from sowings in plot 28 are now as vigorous and well grown as the planted ones in plot 37.

66. In plot 43, Nilambur 400 two months old seedlings of *Hydnocarpus Wightiana* from the Nilambur nursery were transplanted in pits 12' apart under *Lagerstrœmia Flos-Regina* in compartment 120 in June 1926. The overwood was 70' high.

67. In August 1927 casualties were replaced with one year old nursery transplants. In May 1928 there were 39 per cent survivals against 56.8 per cent in May 1927, and the plants were then (May 1928) miserably small as compared with those in plots 28 and 37. The reason for the difference is to be found in the fact that plot 43 is liable to be flooded more than once every year and it is obviously water-logged whereas plots 28 and 37 are in well drained alluvium.

Swietenia macrophylla.

68. Nilambur plots 29, 38 and 39.—Under teak in the 1854 plantation, mahogany was also tried with a view to study the possibility of growing this species as an understorey when the soil is disintegrated laterite; the question of the best espacement being also of importance, three plots were laid out in 1926.

69. In one plot (29) seeds were sown in May 1926 at 400 stakes, 6' × 6' at six seeds to a stake. The ground round the stakes was wounded to a depth of 3" before sowing. In the second (plot 38) seedlings raised by sowing seeds in the nursery in April 1926 were transplanted at the end of June 1926 at an espacement of 9' × 9' and in the third (plot 39) similar seedlings 400 in number were transplanted at the same time 12' apart. The survivals in May 1928 were—

Mahogany sown 6' × 6' = 82.5 per cent against 23.5 per cent in May 1927.

Mahogany planted 9' × 9' = 70.2 per cent against 71.5 per cent in May 1927.

Mahogany planted 12' × 12' = 68.7 per cent against 76.5 per cent in May 1927.

N.B.—In the sown area a redibbling was done in May 1927 with 12 seeds at each of the stakes at which there were no plants and in the two planted areas casualties were replaced in June 1927 using six weeks old nursery transplants. It is very probable that planting would have given better results, had older seedlings been used, for it has been shown by the District Forest Officer, Palghat, that this is the case, see paragraph 10 (b) of the previous year's report and evidence is accumulating; that at least so far as evergreens are concerned, older seedlings than six weeks give much better results.

Hardwickia pinnata.

70. In the experiment to introduce this species (Nilambur plot 40) as an underwood to teak in the 1854 plantation, 600 seedlings were transplanted in pits 6' apart. The seedlings were obtained from the Nilambur nursery and were seven months old. They were about 4" high when transplanted on 29th June 1926. Enumeration gave 80.7 per cent in May 1928 against 73.3 per cent in May 1927. Casualties were replaced in June 1927 with one year old nursery seedlings.

71. There is heavy overhead shade in this plot and the plants are growing very slowly. Some of this shade over half of this plot is being removed in 1928 to see whether the letting in of light will benefit growth as it has done in the case of *Mesua*.

Vateria indica.

72. An attempt was made to grow this species as an underwood to teak in the 1854 teak plantation (Nilambur plot 53). The plot was only a narrow strip. On the west was the river and on the east the clear-felled portion. In the plot itself no previous clearing was done. At four seeds to a stake, 200 stakes were sown on 17th June 1927. The survivals in May 1928 were 67 seedlings or 33.5 per cent.

73. Another plot (Nilambur plot 54) which had an undergrowth chiefly of grass 3' high in the same 1854 teak plantation was planted with *Vateria indica* seedlings raised in bamboo tubes. There were practically no survivals in May 1928.

The failure in both the cases was probably due to too much sunlight. The experiment will be again tried by direct sowing.

Pericopsis mooniana.

74. The experiment to grow this species as an underwood in the 1854 teak plantation gave only 34 per cent success in May 1928 in spite of filing in casualties in August and September 1927 (Nilambur plot 56).

Filicium decipiens.

75. An attempt was made to grow *Filicium decipiens* as an underwood to teak in 1854 plantation by planting seedlings. It was a failure. There were only 14 survivals in May 1928 against 300 planted in July 1927 (Nilambur 57).

Mesua ferrea.

76. Nilambur plot 58.—Seed was obtained from a temple in South Mangalore division. When the seed began to fall (December 1926) the ground under the trees was swept clean. The seeds that fell in the first, second and third weeks were collected and kept separately and sown in the

Nilambur nursery as soon as received. That collected in the third week gave the best results. The resultant seedlings were planted on 13th July 1927, 6' x 6' at 300 stakes in the 1854 teak plantation.

In May 1928 there were 197 survivals or 66 per cent. Casualties were not replaced in 1927.

Bambusa arundinacea.

77. Nilambur plot 26.—An experiment was started in June 1926 to grow *Bambusa arundinacea* in the 1886 teak plantation by sowing a handful of seeds at each stake—espacement 30' x 30', in about 20.0 acres. The survivals in May 1928 were 537, the average height being about 1'.

Artocarpus integrifolia.

78. The experiment to introduce *Artocarpus integrifolia* in the 1921-22 teak plantation resulted in failure as monkeys wiped out the seedlings; the plot was fenced against cattle and deer (plot 23, Nilambur).

79. The experiment to introduce *Artocarpus hirsuta* under teak started in August 1925 had also to be closed as the growth was miserable.

Dalbergia latifolia.

80. Plot 52, Nilambur was started to see whether rosewood can be grown in a very open third quality teak plantation with a view to changing the species to rosewood in the second rotation because, in that division, second rotation teak on third quality soils has usually failed. The plot is one acre in extent and was laid out in the 1855 teak plantation, third quality. The western half of it was sown with rosewood 6' x 6', a handful of seeds at each stake, on 21st May 1927. The eastern half was planted with rosewood nursery seedlings two and a half months old at an espacement of 6' x 6' on 11th July 1927. On 18th November 1927 the stocking in the sown area was poor and in the planted area it was not even fair although it was complete at the end of the monsoon.

On 24th May 1928, 216 seedlings were counted in the sown area (tallest being 9") and 226 in the planted area (tallest being 14").

The plants suffered badly from drip and as there was nothing to burn when planting or dibbling was undertaken, they did not have even a fair start. It is probable that the results would have been better if the overwood had first been felled and lops and tops burnt.

(x) SILVICULTURAL SYSTEM—Nil.

(xi) MISCELLANEOUS.

81. Paighat plots 47 and 48.—The object of the Walayar Working Plan is to produce a pole forest consisting largely of teak but with a good proportion of other species. The mixture to be intimate. Bamboos are not wanted. Two plots were laid out in compartment 3 of Walayar reserved forest in November 1927 to compare the results of the working plan prescriptions (plot 48) with the results obtained by a more heavy thinning among the coppice shoots (plot 47).

82. The type of forest in which the plots are situated is mixed deciduous, clear felled in 1925. Bamboos were common. They were all cut in both the plots by the district, in common with the rest of the compartment and

burned in 1926; the burning was done after piling the debris on the cut clumps. In 1927 the area (both plots) was weeded in July and all bamboo shoots and creepers were cut by the district. Coppice growth consisted of Teak, *Grewia tiliaefolia*, *Anogeissus latifolia*, *Stephegyne parvifolia*, *Terminalia paniculata*, *Pterocarpus marsupium*, *Lagerstræmia lanceolata*, etc. When the plots were started the average height of the coppice in plot 47 was about 15' and that in plot 48, 12'. In 1926 teak stumps had been planted out by the district in lines 9' x 9'. In November 1927 the stocking was good and the average height of the plants was about 2 feet.

83. In November 1927 in both the plots coppice shoots interfering with the teak seedlings were cut. The teak was weeded by cutting the weeds 2' round the plants. Bamboo shoots and creepers were cut down. In plot 47, in addition to the above work the remaining coppice shoots were thinned out leaving not more than two shoots to each stool. There were 172 teak seedlings (stumps) in each of the plots. On 27th May 1928, 158 seedlings were counted in plot 47 and 163 in plot 48. Bamboo shoots had come up again in both the plots but the growth was not so dense and vigorous as it was in November 1927.

The relative development of the seedlings and coppice shoots will be watched further.

84. Nilambur plot 41.—With a view to ascertain the best age for transplanting *Hopea*, 400 seedlings one year old and 400 six weeks old were transplanted side by side on 12th July 1926 at an espacement of 3' x 3' in pits. A few casualties were replaced on 23rd September 1926. In May 1928 the survivals were one year old plants 238 or 67 per cent; six weeks old plants 108 or 27 per cent.

85. A similar experiment made with two years old, one year old and six weeks old seedlings in July 1927 (Nilambur plot 59) gave the following results in May 1928:—

Six weeks old—23.5 per cent.

One year old—64.5 „

Two years old—78.5 „

It is believed that not only with *Hopea* but with many other evergreen species as well much greater success would have resulted from our experiments if we had used older seedlings.

86. Nilambur plots 44 to 47.—To compare the results of orthodox planting of teak as done in Nilambur (plot 47) with planting combined with rice ponam (plot 46) and the notching of teak (plot 45) with notching of teak combined with rice ponam (plot 44), four plots were laid out in January 1927, in the 1847 teak plantation.

87. All the teak had been felled and extracted in 1926 by the district. In January-March 1927 the underwood (there was very little of it) was felled and piled and burned by the Research branch. Plots 44 and 46 in which rice was to be raised along with the teak was fenced; the other two plots were left unfenced.

88. The following works were then carried out:—

(a) Plot 44.—In May 1927 paddy was sown and soil was wounded. Germinating teak seeds from dumps were notched in at 3,104 stakes on 30th May 1927.

The notching in this plot and in plot 45 was done with germinating seedlings mostly having only two cotyledons and in some cases with the cotyledons still yellow, taken from dumps made in April 1927. The seed was soaked for two days before being dumped.

The paddy was harvested in October 1927. Three thousand one hundred and eighty-one casualties in all were replaced on 16th June 1927, 8th August 1927, 23rd August 1927, 20th September 1927 and 29th September 1927.

Weeding was done on 16th August 1927, 15th September 1927, 12th October 1927, 15th November 1927 and the area was then ploughed.

The first three weeding consisted chiefly of pulling up the paddy growing within 6" of the seedlings. The last weeding in November 1927 was expensive as a great deal of *Mimosa* had come in.

(b) Plot 45.—Germinating seeds were notched at 4,064 stakes on 1st June 1927.

Four thousand one hundred and fifty-four casualties in all were replaced on 16th June 1927, 7th July 1927, 24th August 1927, 17th September 1927, 24th September 1927 and 1st October 1927. The area was weeded on 7th July 1927, 22nd August 1927, 21st September 1927 and 26th November 1927.

N.B.—It is on record that the high percentage of casualties in both plots 44 and 45 was due to the very small seedlings (from dumps) being nipped across by insects and not to drought.

(c) Plot 46.—Paddy sown on 23rd May 1927 and soil wounded. Eight inches seedlings were planted in June 1927 in 3,017 pits each 1' x 1' x 1'.

Paddy was harvested in October 1927. Altogether 2,946 casualties were replaced on 17th June 1927, 4th July 1927, 9th August 1927 and 28th September 1927. The area was weeded on 14th August 1927, 14th September 1927, 29th September 1927, 15th October 1927 and 12th November 1927 and it was then ploughed.

On 14th August 1927 and 14th September 1927 the weeding consisted of pulling up the paddy for 6" round each seedling. On 29th September 1927 the paddy was pressed down in lines to relieve the seedlings and on 15th October 1927 the paddy stubble was pulled up for 18" round the seedlings.

(d) Plot 47.—Eight inches teak seedlings were planted in 2,642 pits each 1' x 1' x 1' in June 1927. Altogether 2,915 casualties were replaced on 16th June 1927, 17th June 1927, 4th July 1927, 22nd July 1927, 9th August 1927 and 27th January 1927.

The area was weeded on 18th July 1927 to 26th July 1927 and 30th September 1927 to 11th October 1927 and 4th December 1927.

N.B.—It is recorded that the high percentage of casualties in plots 46 and 47 was due to drought as there was a 10-day break in the monsoon after planting, and the large transplants used suffered severely. Casualties were replaced with much smaller plants.

The survivals of teak in May 1928 were—

Plot 44—1,486 or 48 per cent.

„ 45—3,649 or 89 „

„ 46—1,742 or 46 „

„ 47—2,354 or 89 „

and in that month the height growth in plots 45 and 47 was immeasurably better than in plots 44 and 46.

89. In 1919 teak plantation three plots were laid out in 1927 to see if the growth of second rotation teak can be improved when it is very poor compared with the yield tables. (Nilambur 48 to 50.)

(a) Plot 48.—A second rotation crop. The first rotation crop was second quality on the flat, third on the slope and failure round the solid laterite. The second rotation teak growth was miserable. In patches the teak on the flat was better than on the slope, but still much below second quality. The rest of the flat was swampy and the teak failed.

Undergrowth of all sorts was cut and burnt in March 1927 and the teak cut back to ground level in April 1927.

On 26th February 1928 the following observations were recorded:—

“Coppice on third quality soil has been badly defoliated, but not on second quality. There is yet no sign of the shoots branching at the top; shoots are vigorous.”

(b) Plot 49.—A second rotation crop. The first rotation was second quality on the flat and third on the slope. The teak growth was miserable. Although there was plenty of teak on the slope the area would probably have to be classed as a failure, as it was most probable that the teak would have been smothered by *Lantana* and *Helicteres* in the course of the next two or three years. There was practically no teak on the flat swamp.

All undergrowth was cut and burnt in March 1927. Teak cut back to ground level in April. Teak and *Terminalia tomentosa* were notched in the swampy portion.

In February 1928 the number and growth of the seedlings were very poor. The coppice shoots were found to be vigorous.

(c) Plot 50.—A second rotation crop. The first rotation was first quality. The teak height growth had deteriorated to third quality. The majority of poles were forked and badly grown.

All undergrowth was cut and plot burned. The teak was not cut back. Seeds of *Trewia nudiflora* were sown on 7th June 1927 as an underwood. This species was chosen as the underwood because it grows naturally on alluvium, it is in full leaf for practically the whole of the hot weather and it appears to form a canopy quickly.

Number of *Trewia* transplanted—1,856—6' x 6'. Survivals on 23rd May 1928—75 (tallest 14").

Number of *Trewia* sown—2,560—6' x 6'—927 (tallest 1 foot).
cuttings—1,042—12' x 12'—85.

90. Two patches one square chain each were laid out in plot 50 for periodical measurement of the heights of shoots, and a third patch of the same area was also marked outside the plot to serve as a control. The following are the measurements recorded:—

	Average height on	
	30th April 1927.	30th April 1928.
Patch 1, weeded, burnt, ploughed and underplanted.	24' 7"	29' 1"
Patch 2, weeded, burnt, but not ploughed or underplanted.	25' 0"	26' 2"
Patch 3, control (nothing done)	...	28' 5"

91. Palghat plot 25.—In May 1920 an experiment was started to learn something about the coppicing power of young seedlings of evergreen species if they are cut back in the event of their being damaged during felling and removal of the overwood in the general scheme of exploitation in the Chenat

Nair evergreen forest. The seedlings in the open were counted and were then cut flush with the ground. They were staked before being cut back so that the number of seedlings which threw out coppice shoots may be readily found out later. The age of the seedlings when they were cut back was between two and five years.

92. Some of the well grown coppice shoots were marked to facilitate further observation. The experiment was closed on 27th February 1924 with the following remark:—

"The results of enumerations recorded separately show that the coppiced seedlings have put on very little growth in three growing seasons, and that therefore it would probably be wiser not to cut back any but damaged seedlings after exploitation." The plot was however retained to compare the height increment of evergreen seedlings and coppice shoots in the open. The results of measurements are given below:—

Species.	Coppiced seedlings average height on		Natural seedlings average height on	
	13th September 1925.	18th October 1927.	13th September 1925.	18th October 1927.
<i>Cullenia excelsa</i> ..	2' 16"	6' 6" (2 seedlings)	6' 7"	9' 0" (5 seedlings)
<i>Mesua ferrea</i> ..	3' 10"	6' 6" (5 ")	7' 4"	9' 7" (4 ")
<i>Dichopsis elliptica</i> ..	..	Died.	6' 0"	8' 1" (1 seedling)

93. Plot 27, Nilambur.—To compare the result of planting from nurseries with notching small seedlings of teak from dumps, a plot of one acre was marked in the 1926 plantation (conversion working circle). Both this plot and the surrounding plantation were formed along with a field crop of rice. The spacing in both cases was 6' x 6'. The plantation surrounding this plot was formed by the district by planting seedlings 9" to 1½' high from the nursery, while the experimental plot was planted up with germinating seedlings from dumps. The seedlings were just forming their first pair of leaves.

Casualties in the plot were replaced on 4th July 1926, 24th July 1926, 14th September 1926, 30th June 1927 and 4th September 1927.

The following were the observations recorded on 20th April 1928.

"Looking at it to-day, it was certain that the planted area was no better than the notched plot. The number of casualties or at least of small plants (taken to represent casualty replacements) was smaller, area for area, than in the plantation proper."

One thousand and forty survivals were counted in the plot on 28th May 1928.

94. South Mangalore.—To ascertain the effect of complete removal of overhead cover on *Hopea* seedlings which were four and a half years old and which looked established and to compare the height growth with that of seedlings of the same age growing under the shade of an overwood, two plots were laid out in January 1925 in compartment 7 Parappa reserved forest. This is a mixed deciduous forest verging on semi-evergreen. The area has been sown with *Hopea* in the rains of 1920 in patches 12' x 12'. In this area two acres were marked. All the overwood which was about 40' high and which

in the rains formed a close canopy was cut down and removed from the area, totally and suddenly exposing the *Hopea* below, which were about four and a half years old. Twenty-four seedlings varying in height from 6½" to 36½" were staked.

In the adjacent area which had similarly been sown with *Hopea* in 1920, 24 seedlings varying in height from 9½" to 37" were also staked.

Both the areas were kept weeded regularly.

In the clear-felled plot four seedlings were found on 1st May 1925 to have died and by 1st October 1925 four more had died, by 19th July 1926 one more. Thus in the course of 18 months 9 out of 24 died and the surviving 15 had been very heavily browsed.

Unfelled area.—On 20th January 1927 all the seedlings were found to be alive though several of them had been lightly browsed.

This experiment has established the fact that complete and sudden removal of the overwood is injurious to young *Hopea* four to five years old.

95. South Mangalore.—With a view to find out how the regeneration of valuable species will succeed under varying densities of canopy and whether the germination of seeds of valuable species will be stimulated by burning, the following experiment was started in 1918 in Nerankimale reserve of this division. This reserve is worked for fuel:—

Description of area.—Mixed deciduous forest in undulating country.

Soil.—Laterite.

Elevation.—About 300' above sea level. Rainfall about 175". Maximum temperature about 100. The area contained no appreciable blanks. *Xylia* was a common species.

An area of 4 acres was divided into four plots, each about an acre in extent. These were numbered A-1, A-2, B-3 and B-4. A-1 and A-2 were clear-felled, B-3 and B-4 were treated with fairly heavy improvement fellings (about 50 per cent of the trees over 1' in girth having been felled). In A-2 and B-3 seeds of teak, *Xylia*, *Terminalias*, *Lagerstræmia* and *Pterocarpus Marsupium* were sown. Then all the four plots were burnt. (When the seeds were sown and when the plots were burnt are not recorded.)

In July 1919 many seedlings were seen in A-2 and B-3 more in A-2 than in B-3, A-1 and B-4 showed no seedlings at all. The area was burnt again in the hot weather of 1920, the burning was not thorough, the seedlings were not killed. In June 1920 growth of coppice shoots and root suckers were found to be very good in A-1 and A-2. In August 1920 *Pterocarpus* and *Lagerstræmia* formed the majority of the seedlings. The plots were kept weeded and all shrubs and weeds and interfering coppice shoots were cut every year up to date. The original sowing and burning was done by the Vernacular Training School free of cost. Subsequent burning was carried out by the beat staff. Tending from 1920 up to date cost about Rs. 5 per annum or Rs. 40 in all.

Results of enumeration.—In September 1919, A-1 showed 120 seedlings, A-2, 495 seedlings, B-3, 175 seedlings and B-4, 25 seedlings. In August 1920, A-1 showed 440 seedlings, A-2, 1,150 seedlings, B-3, 640 seedlings and B-4, 215 seedlings.

Results of a detailed enumeration made on 1st July 1924 after thoroughly weeding the plots are given below.

Number of seedlings in different plots.—Plot numbers and the number of seedlings in each—

Species.	A-1.	A-2.	B-3.	B-4.
Benteak <i>Lagerstramia (lanceolata)</i> ..	296 (5)	335 (1)	359	157 (1)
<i>Terminalia paniculata</i>	284 (13)	135 (7)	103 (1)	170 (6)
Rosewood	Nil.	14	2	Nil.
Teak	Nil.	85	33	Nil.
<i>Pterocarpus marsupium</i>	Nil.	158	49	Nil.
<i>Terminalia tomentosa</i>	1	33	22	Nil.
<i>Xylia xylocarpa</i>	1,098 (74)	668 (17)	353 (10)	216 (7)
<i>Bridelia retusa</i>	Nil.	Nil.	1	2
Mango	Nil.	Nil.	1	Nil.
Soapnut	1	Nil.	Nil.	1
<i>Terminalia arjuna</i>	1	Nil.	Nil.	Nil.
Total ..	1,681 (92)	1,428 (25)	923 (11)	516 (14)
Grand Total ..	4,578 (142)	..	..	..

Of the several species war enumerations made, this is the most accurate as it was done in the presence of the District Forest Officer, hence only the results of this are given.

Figures within brackets are coppice shoots.

NOTE.—A few seedlings of species not sown were also found in the plots. These resulted from self-sown seeds from the adjacent forests.

Several of the plants counted as seedlings are root suckers, especially in the case of *Xylia*.

Results of enumerations from time to time are shown below :—

Plot numbers.	September 1919.	August 1920.	November 1921.	June 1922.	July 1924.
A-1	120	444	435	426	1,681 (92)
A-2	495	1,156	1,088	1,057	1,428 (25)
B-3	175	640	549	528	923 (11)
B-4	25	213	204	183	516 (14)
Total ..	815	2,453	2,276	2,194	4,578 (142)

Figures within brackets show coppice shoots. The increase in the number of plants after September 1919 is due to the appearance of root suckers mostly.

The following are the conclusions drawn :—

In the mixed deciduous forests in the West Coast (where *Xylia* occurs commonly) which are worked for fuel, clear felling combined with burning, gives satisfactory results in regeneration, the regeneration consists of root suckers, coppice shoots and seedlings, clear felling and burning bring out large numbers of root suckers specially of *Xylia*, clear felling is preferable to coppice with standards, no sowings are necessary except in large blanks, and root suckers keep on appearing for a number of years after felling and burning.

II. WORKING PLANS AND STATISTICS.

(i) WORKING PLANS.

96. Nil.

(ii) YIELD TABLES.

97. Nil.

Figures have been collected from Nilambur and South Coimbatore divisions for the following species :—

Teak (*Tectona grandis*).

Venga. (*Pterocarpus marsupium*).

Rosewood (*Dalbergia latifolia*).

Shorea talura.

Karimarudu *Terminalia tomentosa*.

Venteak (*Lagerstramia lanceolata*).

Poomarudu (*Terminalia paniculata*), etc.

When information for a sufficient number of stems is available it will be tabulated and volume tables prepared.

98. Four new sample plots were laid out and measured in Nilambur division to study the volume increment of second rotation teak. Six new plots were also demarcated and measured in the Nilgiris to study the volume increment of—

Eucalyptus pilularis.

„ *eugenioides*.

„ *propinqua*.

Eucalyptus acmenoides.

„ *paniculata*, and

„ *punctata*.

99. The sample plots in the Nilambur division including those laid out by the Research Institute, Dehra Dun, in 1916-17 were remeasured in the beginning of the 1928 with the help of a measuring party from Dehra Dun. The files containing the remeasurements are being sent to the District Forest Officer, Dehra Dun, for completion and working up the results.

(iii) VOLUME AND FORM FACTORS.

100. Nil.

(iv) BARK MEASUREMENTS.

101. Nil.

(v) MISCELLANEOUS.

102. Nil.

III. MISCELLANEOUS.

103. Nil.

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