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ANNUAL REPORT ON
SILVICULTURAL RESEARCH
IN
THE MADRAS PRESIDENCY
FOR THE YEAR 1931-32

MADRAS

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SUMMARY.

I. EXPERIMENTAL SILVICULTURE.

(i) *General*.—Nilambur as one of the main centres of research has been replaced by a station opened in the Wynad. A new research range has been formed with headquarters at Chittoor, for work in the “dry” districts. Several new experimental gardens for carrying out Stage I (a) investigations under carefully controlled conditions have been opened. A start has been made in using methods of statistical analysis for assessing the “Significance” of observed differences—paragraphs 1 to 4.

(ii) *Natural regeneration*.—A new set of plots for the study of measures necessary for bringing up existing natural regeneration of *Hopea parviflora* has been opened. It has been found that *Strobilanthes* (reticulatus?) a troublesome weed in many evergreen forests and a great impediment to natural regeneration, can be destroyed as effectively by cutting it above ground level as by cutting it at ground level and severing the aerial roots. The former method is of course considerably cheaper—paragraph 9.

(iii) *Seeds*.—Reporting the seeding of principal species by districts has been put on a more satisfactory basis (paragraph 11). Systematic seed tests have been carried out mainly at Chittoor with species intended for use in improving the poor dry fuel forests common in many districts of the Presidency (paragraphs 12 to 21). Investigations into the effect of seed origin have been continued, and new plots have been opened as part of an all-India investigation into this subject (with teak), initiated by the Central Silviculturist. Indications at present seem to be in favour of the use of local seed in a given locality—paragraphs 23 to 33.

(v) *Artificial regeneration—Stocking of felling gaps*.—Much work is being done in several districts (by the district staff) both in evergreen (paragraph 36) and deciduous (paragraph 35) forest. Success is not yet claimed, but the work shows more promise than many observers thought possible.

Direct sowing.—“Rab” sowings in fuel coppice coupes are being carried out in most districts where this type of forest is found and the results are giving indications of the lines on which to work in improving, or saving from further deterioration, this type of forest—paragraphs 37 to 41.

Manuring.—The addition of lime to the soil in areas artificially regenerated with teak and rosewood appears to have had no effect, beneficial or otherwise—paragraphs 42 to 44.

Drainage was successfully employed in a swampy area under artificial regeneration with teak but the cost was prohibitive—paragraph 45.

Weed control and soil aeration.—In last year's report it was stated that the results of certain experiments appeared to show that "scraping" (i.e., removing the weed growth without disturbing the soil) had an effect on the growth of a young teak plantation as beneficial as a deep fork-weeding involving a thorough aeration of the soil. A more carefully designed experiment conducted this year (paragraph 50) shows (subject to confirmation by repetitions) that this belief is a mistaken one, the difference in favour of fork-weeding being, as might be expected, distinctly significant—paragraphs 46 to 53.

Stump planting.—The results of the trials of this method of artificial regeneration with a number of species are recorded (paragraphs 54 to 65). Worth special mention are the excellent results obtained with rosewood (paragraph 57) and *Terminalia paniculata*—paragraph 60.

Several plots dealing with the optimum season and method for stump planting are described (paragraphs 66 to 72). It appears that given luck in the matter of pre-monsoon showers planting stumps in April or May can give excellent results, and considerable added height growth in the first year. But early planting is a gamble in rain, and a departure from the normal practice of planting with the first real monsoon rains is not, on our present knowledge, recommended. Between planting in "pits" and planting in "crow bar holes" differences are often not significant, but taking all results together there is probably a slightly increased height growth with pits. It is unlikely, however, that this slight advantage of pit planting can justify the greater cost of pitting.

The Forest Botanist's report on his examination of a number of specimens sent to him goes far to dispel the fear expressed by some observers that teak grown from stumps is liable to be unsound.

Cuttings have been tried with various species both by the Silviculturist and by the District Forest Officers. Results have been uniformly unsuccessful—paragraphs 81 and 82.

Cover crops.—*Tephrosia candida* and *Centrosema pubescens* have been introduced in young teak plantations at Nilambur. *Tephrosia* is of doubtful benefit, and *Centrosema* is definitely harmful as it develops into a troublesome climber—paragraph 83.

Miscellaneous.—Cashewnut (*Anacardium occidentale*) is extremely easy to raise at Nilambur on poor shallow laterite by direct sowing—paragraph 84.

(vi) *Reclamation and afforestation.*—Nil, though much of the work done in trying to improve the poorest type of scrub fuel forest might be classed under this head.

(vii) *Thinning and cleaning.*—An experiment by the District Forest Officer, Lower Godavari, indicates that the routine mechanical thinnings now being made in young plantations of *Casuarina equisetifolia* are preferable to thinnings made according to "Silvicultural requirements"—paragraph 86.

(viii) *Mixtures* and (ix) *Underplanting.*—Experimental work is mainly concerned with teak plantations. Attempts at rather elaborate mixtures have given unsatisfactory results. Underplanting is receiving less attention than formerly. Earlier work has shown that underwoods of various species can be introduced at a price, but experience now points to the belief that with a careful encouragement of all woody growth from the time of the first weedings onwards an adequate underwood and moderate degree of mixture can be obtained without recourse to artificial methods. Some work continues, mostly with bamboo, and *Cephalostachyum pergracile* (paragraphs 92 to 95) is giving encouraging results.

II. WORKING PLANS AND STATISTICS.

(i) *Working Plans.*—The Provincial Silviculturist is in touch with Working Plans Officers, and silvicultural and statistical prescriptions are referred to him from time to time.

(ii) *Yield tables.*—Eighty-one permanent sample plots were maintained and those due for re-measurement were measured.

(iii) *Volume tables.*—A considerable number of local volume tables were prepared and progress was made in the collection of data for others—paragraphs 107 to 110.

(iv) *Bark measurements* and (v) *Miscellaneous.*—The only bark measurements are those made in the course of sample plot re-measurements. Ring countings on systematic lines have been started in felling areas at Mount Stuart.

III. MISCELLANEOUS.

All the ledger files (344 specific and 60 general) have been rearranged on Howard's system. Twenty-eight new experimental plot files have been opened and 63 have been written up and closed.

Two areas have been set apart for permanent preservation of forest types and action is being taken in respect of a third.

I. EXPERIMENTAL SILVICULTURE.

(i) GENERAL.

Nilambur has been one of the main centres of research work for the past 10 years. During this period work by the District staff and the Research Branch has given a satisfactory answer to the question of raising teak plantations in the second rotation, a problem which for some years gave rise to much anxiety. A high standard has been reached there in the more important silvicultural works, and (without suggesting that there is no scope for further experimental work in this district) it has been thought desirable to restrict

research at Nilambur in order to devote more attention to similar problems in the Wynad, where there are, in addition, greater facilities for the study of evergreen rain forests. Arrangements to this end were made during the year, and shortly after its close the Research Ranger headquartered at Nilambur was moved to Manantoddy.

2. The Government of Madras have held in abeyance the posting of a second Gazetted Officer to the Research branch, but a Ranger has been added to the staff. With headquarters at Chittoor, where a research nursery and experimental garden have been opened, he is concerned mainly with work on problems affecting the more arid forests of the Presidency. Among these problems the question of the improvement of the poorer type of fuel coppice forest, covering large tracts in most of the dry districts, is receiving the largest share of attention.

3. Greater stress is now laid upon the importance of conducting preliminary investigations (Stage I-a) before embarking on work on a larger scale and arrangements have been made for the formation of research nurseries and experimental gardens at Anaipady and Karianshola in the South Coimbatore Division and at Begur and Chandanatode in the Wynad Division, in addition to the garden opened at Chittoor. Two of these are in mixed deciduous forest, two in evergreen rain forest, and one in dry scrub jungle.

4. Some of the plots opened this year show an advance on earlier work as regards the care taken to secure initial comparability, and to define clearly the object of the investigation. But there is still a tendency to complicate experiments in an endeavour to answer more than one question from one set of plots. The importance of all these points is now realized and they are receiving the attention they deserve. A start has also been made in using methods of statistical analysis to assess the "significance" of observed differences, and these methods will be employed in future wherever they are applicable.

(ii) NATURAL REGENERATION.

5. *Mesua ferrea* (Experimental plot 52, Palghat).—Opened in 1928 at Neelikal. In an area in evergreen rain forest in which abundant natural regeneration of *Mesua ferrea* had appeared, following a good seed year in 1927, two indicator plots were laid out, one under dense shade and the other in a "gap" caused by the removal of a tree in the course of selection fellings. The situation to-day is that ample seedlings have established themselves in both indicator plots, and that those under the gap in the canopy are undoubtedly growing more rapidly than those under dense shade. In both cases, however, growth is very slow (under 12" after five years) and the difference between the plants in the two plots though obvious, is not very great. The conditions in the two plots are, as far as can be judged, identical except as regards light.

6. *Hopea parviflora* (Experimental plots 115-117, South Coimbatore).—This set of comparative plots was opened in December 1931 in Karianshola to study the response made by existing natural regeneration of *Hopea parviflora* in the seedling and sapling stages to the admission of light in different degrees. There are two plots for differential treatment, with a third as control. Indicator plots are laid out in each and enumerations and measurements have been recorded. There are of course no results to report yet.

7. *Mesua ferrea* and *Cullenia excelsa* (Experimental plot 25, Palghat).—This plot opened in 1920 and closed during this year has shown that young natural regeneration of *Cullenia excelsa* and *Mesua ferrea* 2 to 5 years old, when cut back after injury in exploitation can be relied upon to coppice; and that so far as can be judged from the few measurements made there is little difference in rate of growth between the coppiced and undisturbed plants. The plants in question are growing practically in the open on an area where exploitation amounted almost to a clear-felling.

8. *Natural regeneration in heavily exploited evergreen* (Experimental plot 32, Palghat).—In February 1923 a count was made of the seedling and sapling natural regeneration of the principal species on an area of some 10 acres of virgin evergreen forest at Sappal. Shortly afterwards the area was heavily exploited, leaving only scattered unsalvageable material standing. Enumerations (of questionable accuracy on account of the large size and precipitous slope of the plot and of the tangle of secondary growth of soft woods) have been made periodically ever since. Beyond the fact that the bulk of the regeneration present in 1923 perished during and after exploitation, little can be deduced. Inspection in January 1932 shows a good deal of *Cullenia excelsa* in the sapling stage, a sprinkling of *Calophyllum tomentosum* and *Mesua ferrea* and a little *Dichopsis elliptica*. Other species are present in smaller quantity, but are not conspicuous. From the present appearance of the plot there seems a prospect that the area will some day revert to its evergreen character and there are probably enough saplings on the ground now to give, eventually, a forest similar in composition to the one destroyed. A large part of the plot has been swept away by a landslip (a lesson in itself) and the problem has lost much of its interest since it is remotely unlikely that forest of this type will ever again be exploited intensively. The plot has been closed.

9. *Destruction of Strobilanthes* (Experimental plots 51 and 81, South Coimbatore).—*Strobilanthes* (*reticulatus*?) flowered in Karianshola (evergreen forest) in 1924-25 and died after seeding. Dense masses of seedlings appeared shortly afterwards, especially in areas where the canopy showed any tendency to be more open than the normal. It is believed that the dense gregarious growth of this plant is a serious impediment to natural regeneration (though a certain amount, notably of *Hopea parviflora*, manages to persist under and among it). An experimental plot (Experimental

plot 51, South Coimbatore) was opened in 1928 to study methods of dealing with it. These have been described in previous reports, where it is recorded that the weed is easily destroyed by cutting it at ground level, so that the aerial roots are severed. An examination of the plot during the current year shows that the destruction has been effective, for no regrowth has appeared. It may be mentioned, however, that in another plot (Experimental plot 81, South Coimbatore) opened in 1930, the *Strobilanthes* was, contrary to orders, cut above the aerial roots—at some 9" above ground level. This method proved to be equally effective in destroying the plant and is of course considerably cheaper.

10. *Work by districts—Pterocarpus santalinus*.—Natural regeneration is normally abundant but is burnt back annually by fierce fires over large tracts. Experimental plots have been maintained since 1928 by the District Forest Officers, North and South Cuddapah and Anantapur, in which various measures for bringing up this natural regeneration are being tried. These include early burning after cutting the grass round the seedlings, and cutting back the seedlings before and after early burning in December, and late burning in April. None of these plots has yet yielded results, though it appears that no appreciable benefit has resulted from cutting back and burning.

Dalbergia latifolia.—The District Forest Officer, South Mangalore, has started an investigation into comparative rates of growth of rosewood root suckers and seedlings. No result is yet reported.

(iii) SEEDS.

11. Seeding of principal species in 1931.

Species.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
		G	..	M	P	..	..	..	M	P	P	P	P	P	P	M	M	P	M	M	G	..	P	G	G	G	G	M	..	M
Teak	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hardwickia binata ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dalbergia latifolia ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Terminalia tomentosa ..	..	G	P	M	M	G	..	G	M	M	P	..	G	P	M	G	M	G	M	M	G	..	..	G	M	M	G	M	G	M
Pterocarpus marsupium ..	..	G	P	M	M	G	..	G	P	P	P	..	M	P	M	G	P	M	G	M	M	..	M	M	M	M	M	M	..	M
Santalum album ..	..	..	..	..	..	P	..	..	..	..	..	..	G	G	G	G	M	G	M	G	G	G	G	G	G	..	..	P	..	..
Pterocarpus santalinus ..	..	..	..	..	..	..	..	..	..	..	..	M	G	M	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hopea parviflora ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	G	..	..	P	..	G	M	P	G	G
Terminalia paniculata ..	..	..	G	..	..	G	..	G	..	..	..	..	G	..	G	..	G	G	..	..	G	..	M	G	..	G	M	G	G	G
Lagerstroemia lanceolata ..	..	..	..	..	M	..	..	M	..	..	P	..	..	..	P	..	..	..	..	..	M	..	..	G	P	P	G	G	M	M
Mesua ferrea ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	P	..	G	..	..	G	..	G	..	..	..	..
Shorea robusta ..	..	G	M	..	..	..	..	G	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anogeissus latifolia ..	..	..	..	..	G	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Acrocarpus fraxinifolius ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	M	..	..	..	..	..	..	M	..	..
Hardwickia pinnata ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	P	..	..	..	..	..	..	..	..	P
Calophyllum tomentosum ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	P	..	..	..	..	..	..	..	..	M

G = Good.

M = Moderate.

P = Poor.

The District Forest Officer, North Salem, kept nineteen sandalwood trees under observation for seeding seasons. The trees seeded twice, (in October–November and February–March), the February–March crop being the heavier. In the same district it was found that young sandal trees (4–5 years) if deprived of their hosts, either do not seed at all or produce only one crop of infertile seed annually.

12. *Seed tests*.—The following are the results of seed tests carried out in the new research nursery at Chittoor. In the pre-treatment test, three treatments were used, in each case, with an untreated control :—

- (1) No treatment.
- (2) Seed soaked in cold water for 24 hours.
- (3) Seed immersed in hot water (as hot as the hand can bear comfortably) which was then allowed to cool before the seed was taken out.
- (4) As in (3) but with boiling water.

Germination tests were carried out in seed beds.

“Plant per cent” was recorded, but this was done shortly after the conclusion of germination which is too early to give a figure of much value. It gives an idea of the wastage during the germination period, but it is not considered worth recording here.

13. *Acacia cyanophylla*.—Seed received from Cyprus in August 1931. Date and other particulars of collection not known.

Purity per cent	..	..	..	96
Seed weight	..	..	..	1730 per oz.

Germinative Capacity.

Pre-treatment.	Test No. 1.	Test No. 2.	Test No. 3.
	PER CENT.	PER CENT.	PER CENT.
Not treated	.. 11	7	10
Cold water ..	.. 16	7	18
Hot water ..	.. 49	8	15
Boiling water	.. 94	32	19

The marked benefit of the boiling water treatment in tests 1 and 2 is noteworthy. Whether the poor result in test No. 3 means that the seed has lost much of its vitality is being determined by further tests with seed from the same sample.

14. *Acacia sundra*.—Seed collected in February 1931 in Chittoor and tested between November 1931 and March 1932.

Purity per cent	..	..	..	90
Seed weight	..	..	..	790 per oz.

Germinative Capacity

Pre-treatment.	Test No. 1.	Test No. 2.	Test No. 3.
	PER CENT.	PER CENT.	PER CENT.
Not treated	.. 30	6	3
Cold water ..	.. 23	8	2
Hot water ..	.. 43	4	7
Boiling water		1	2

Boiling water seems definitely detrimental. Poor results in tests 2 and 3 appear to indicate that after December 1931 seed collected in February 1931 has practically lost its vitality; but further tests are being carried out.

15. *Albizia amara*.—Seed collected in Chittoor district in February 1931.

Purity per cent	..	..	..	84
Seed weight	..	..	..	390 per oz.

Germinative Capacity.

Pre-treatment.	Test No. 1.	Test No. 2.	Test No. 3.
	PER CENT.	PER CENT.	PER CENT.
Not treated	.. 32	60	50
Cold water ..	.. 7	64	55
Hot water ..	.. 54	77	45
Boiling water	.. 47	57	26

Pre-treatment appears to give little if any help.

16. *Anacardium occidentale*.—Seed collected in Malabar in March 1931 and tested in January 1932. It gave germinative capacity as follows :—Untreated 26 per cent, cold water 23 per cent, hot water 20 per cent, boiling water—Nil. A second test in March 1932 gave practically no germination with all treatments. The seed was in a bad condition when received. Seed from the same source sown at Nilambur within a few weeks of collection gave, untreated, a germinative capacity of almost 100 per cent.

Seed weight	..	..	..	115 per lb.
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17. *Cassia siamea*.—Seed collected in Chittoor in March 1931

Purity per cent	..	..	..	92
Seed weight	..	..	..	1,082 per oz.

Germinative Capacity.

Pre-treatment.	Test No. 1.	Test No. 2.	Test No. 3.
	PER CENT.	PER CENT.	PER CENT.
Not treated	.. 36	61	53
Cold water ..	.. 35	58	59
Hot water ..	.. 55	53	46
Boiling water	.. 72	79	70

Results are remarkably consistent and indicate a decided benefit from the boiling water treatment.

18. *Erythroxylon monogynum*.—Seed collected in Chittoor in January 1932. There was practically no germination with any treatment. It is said that the seed year for this species has been a very poor one.

Purity per cent	...	...	99
Seed weight	...	...	1,018 per oz.

19. *Prosopis Juliflora*.—Seed received in June 1931 from the Horticultural Gardens, New Delhi. Date of collection, unknown.

Purity per cent	...	...	98
Seed weight	...	...	960 per oz.

Germinative Capacity.

Pre-treatment.	Test No. 1.	Test No. 2.	Test No. 3.
	PER CENT.	PER CENT.	PER CENT.
Not treated	74	89	60
Cold water	78	84	84
Hot water	74	76	66
Boiling water	46	73	63

Untreated seed has a high germinative capacity and treatment seems scarcely worth consideration.

20. *Prosopis spicigera*.—Seed collected in Chittoor district in March 1932.

Purity per cent	...	...	92
Seed weight	...	...	190 per oz.

Germinative Capacity.

Tested within a fortnight of collection gave a germinative capacity of 79 per cent with untreated seed, against 57 per cent, 63 per cent and 50 per cent with cold, hot and boiling water treatments. Further tests are being made.

21. *Pterocarpus santalinus*.—Seed collected in Chittoor in February 1931 and tested between December 1931 and February 1932

Purity per cent	...	...	94
Seed weight	...	...	38 per oz. (616 per lb.)

Germinative Capacity.

Very low. Varied from 0 per cent to 13 per cent in two tests showing slightly better results with cold and hot water treatment than with 'Nil' or boiling water.

22. *Work by districts—Terminalia chebula*.—Seed sown by the District Forest Officer, Chittoor, in November 1931 was only just beginning to germinate in May 1932. In South Salem the seed

together failed to germinate, and in Nellore practically no germination was obtained. Seed of this species is notoriously difficult to germinate. The matter is being taken up by the Research Ranger at Chittoor.

Santalum album.—The District Forest Officer, North Salem, found that Sandalwood seed stored for 13 to 15 months had germinative capacities of 38 per cent and 25 per cent, respectively. Sandalwood of the February and October crops (1930) sown by the District Forest Officer, North Salem, early in 1931, both lots at the same time, gave a higher germinative capacity in the case of the October crop (39 per cent against 24 per cent).

23. *Effect of seed origin*.—Experiments with seed from different local sources have been going on since 1928, and during the year under review plots were added in connexion with an investigation initiated by the Central Silviculturist and covering the whole of India. Nothing approaching a conclusion can yet be drawn, but there are indications that in most cases local seed is to be preferred. The following is a brief account of the work done on this subject.

24. *Experimental plot 63—Nilambur (Teak)*.—Opened in 1928 and began as a nursery investigation into the comparative merits (for use at Nilambur) of seed from four sources—viz., (1) Mount Stuart (2,000 feet, rainfall 65"), (2) Nilambur (100 feet, rainfall 120") natural forest seed, (3) Nilambur plantation seed (selected seed bearers) and (4) Nilambur plantation seed (unselected seed bearers). The investigation was unduly complicated by the employment of three variations of nursery treatment and of two variations of seed pre-treatment with each origin of seed. The lay-out of the nursery beds was not such as to eliminate possible initial inequalities (there was only one bed for each treatment) and measurements were not made at the nursery stage. The results have been described in detail in earlier reports. Nothing very definite emerged, and all that need be recorded here is that, judged by the general appearance of the beds, local seed was preferable to seed from Mount Stuart.

25. The investigation was extended by planting out seedlings of each origin treatment in lines. The number of treatments is so great that there are but few lines of each, and it is doubtful whether soil inequalities can be considered to have been eliminated by the arrangement of lines adopted, though conditions appear to be homogeneous throughout the plot. Systematic measurements were first made in 1931 and are being continued. The trees in the different lines now have average heights ranging from 22 to 25½ feet and average breast height girths of 7½ to 8½ inches. The differences, though barely perceptible to the eye, appear to be significant, but the number of variations introduced greatly obscures the issue. At present trees of Mount Stuart origin are behind those produced from local seed both in height and girth, but the difference cannot be ascribed with confidence to the difference in seed origin.

26. *Experimental plot 88, Nilambur (Teak).*—Opened in 1930 with seed of four origins—

		Elevation, FEET.	Rainfall, INCHES.
(1) Walayar	1,000	45	
(2) Mount Stuart	2,000	65	
(3) Nilambur plantation seed.	100	120	
(4) Nilambur natural forest seed	100	120	

The main investigation in this case was spoilt by soil inequalities which made themselves apparent after the plot was opened, but in the "short-term" lines put out in connexion with this plot conditions and arrangements are acceptable from the point of view of initial comparability. Taking height growth as the criterion the results in the short-term lines, in February 1932 are—

Origin.	Mean height		Standard error of mean.	Remarks.
	FT.	IN.	IN.	
Walayar	9	11	± .40	Statistical analysis shows that none of these differences is significant and the experiment has not shown that the origin of the seed has had any influence on the growth of the plants.
Mount Stuart ..	9	6	± .49	
Nilambur (plantation).	10	2	± .48	
Nilambur (natural forest).	10	0	± .52	

27. *Experimental plot 79, South Coimbatore (Teak).*—Opened in 1930 at Mount Stuart with three origins—Mount Stuart, Nilambur and Walayar. The different origins occupy separate subdivisions of the plot, each half an acre. As far as can be judged the three subdivisions satisfy conditions of initial comparability. In May 1931 height growth was as follows :—

Origins.	Average height, May 1931.		Remarks.
	INCHES.		
Nilambur—Scraped	13.4	A complication was introduced by giving each origin two weeding treatments.	
" Forked	18.5		
Mount Stuart—Scraped	33.6		
" Forked	26.6		
Walayar—Scraped	22.3		
" Forked	17.6		

During the current year the plot has been so damaged by wild elephants that further measurements have not been made.

28. *Experimental plot 97, South Coimbatore (Teak).*—Opened in 1931 at Mount Stuart and similar in design to the last plot (Experimental plot 79). Conditions of initial comparability appear

to be satisfied. There is the same complication in weeding treatment as in Experimental plot 79. In February 1932 average heights were—

	Scraped. INCHES.	Forked. INCHES.
Walayar	10	11
Nilambur	10	11
Mount Stuart ..	10	11

No difference between the origins has appeared in this case. The consistent slight, but probably significant, difference in favour of "forking" is worth noting.

29. *Experimental plot 107, Nilambur (Teak).*—This plot, opened in 1931, is part of the All-India teak seed origin investigation organized by the Central Silviculturist. The origins dealt with at Nilambur are—

Nilambur (Madras moist).	Southern Bombay.
Walayar (Madras medium).	North Burma.
Travancore.	South Burma.

The intention was that the plants of each seed origin should be put out in separate comparable plots, which would eventually form permanent sample plots. But for reasons not on record the different origins were put out in lines in sequence repeated several times. Though an excellent arrangement for a "short-term" investigation this lay-out renders the eventual formation of permanent sample plots of each origin impossible. "Short-term" lines were also laid out. The South Burma seed failed to germinate in time for the normal planting season. It was therefore impossible to include plants of this origin in the investigation. This failure of South Burma seed was experienced at other centres. The whole experiment is being repeated.

Statistical analysis of measurements made in February 1932 gives the following results :—

Origin.	Per cent surviving.	Mean height.	Standard error of mean.	Difference of means between Nilambur and.	Standard error of difference.	Significance of difference.
		IN. (a) Short-term Lines.		IN.		
Nilambur ..	81	14	± 0.66	5	± 0.77	Easily significant.
Walayar ..	65	9	± 0.39			
Travancore ..	94	15	± 0.47	1	± 0.82	Not significant.
South Bombay.	94	8	± 0.35	6	± 0.75	Easily significant.
North Burma.	43	11	± 0.72	3	± 0.98	Significant.
(b) Main Plot—Every 10th Plant measured.						
Nilambur ..	97	21.4	± 1.16	2.2	± 1.85	Not significant.
Walayar ..	87	19.2	± 1.43	1.0	± 1.63	Do.
Travancore ..	94	20.4	± 1.14	7.5	± 2.79	Significant.
South Bombay.	92	13.9	± 2.54	3.6	± 2.20	Not quite significant.
North Bombay.	48	17.8	± 1.87			

30. *Experimental plots 110-113 Palghat (Teak).*—This set of plots was opened in 1931 at Walayar and is also part of the All-India teak seed origin investigation. The origins dealt with here are —

South Burma.		Nilambur.
Mysore.		Walayar.

Here also South Burma seed failed to germinate at the proper time, and this origin thus disappears from the investigation. The position as regards the rest in February 1932 was as follows:—

Origin.	Stocking.	Average height.
	PER CENT.	INCHES.
Mysore	66	6
Nilambur	74	7
Walayar	83	7

31. *Short-term investigation in connexion with above—*

Origin.	Stocking.	Average height.
	PER CENT.	INCHES.
Mysore	68	9.02
Nilambur	76	10.11
Walayar	75	8.33

Each origin occupied a separate area in the plot devoted to the short-term investigation. The arrangement is not such as to eliminate initial differences in soil quality. Statistical analysis shows that the difference between Walayar and Mysore is not "significant." The difference between Nilambur and Mysore just reached significance, and that between Nilambur and Walayar is easily significant. But little weight can be given to these results owing to doubts concerning initial comparability.

32. *Experimental plot 80, South Coimbatore (Dalbergia latifolia).*—Opened in 1930 at Mount Stuart with the following seed origins: Nilambur, Mount Stuart and Bolampatty. The plot is fenced. In February 1932 the position was —

Origin.	Stocking.	Average height.
	PER CENT.	INCHES.
Nilambur	75	18
Mount Stuart	85	22
Bolampatti	82	22

Each origin occupies a separate half acre subdivision of the plot. The subdivisions are, as far as can be judged, initially comparable. Further measurements will be made and the significance of differences will be assessed by statistical analysis.

33. *Experimental plot 100, South Coimbatore (Dalbergia latifolia).*—This plot opened in 1931, is a repetition of the plot described above (Experimental plot 80). The plants are still too small for satisfactory measurement. In stocking and general appearance there is nothing to choose between the three origins.

(iv) NURSERY WORK.

34. Apart from nursery work incidental to germination test and other investigations, no nursery investigations have been made during the year.

(v) ARTIFICIAL REGENERATION.

Stocking of Felling Gaps.

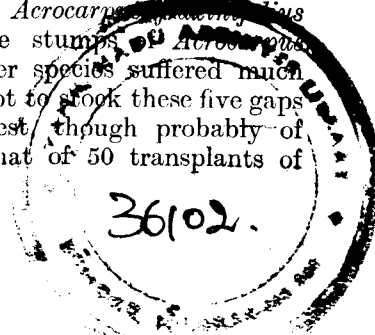
35. *Experimental plot 107, South Coimbatore (Teak).*—Twelve "Gaps" formed by selection fellings in deciduous forest are under regeneration in this plot. The main species is Teak, with Rosewood and *Pterocarpus marsupium* at the periphery of the patches. The "Gaps" are scarcely typical ones and results so far are of no particular interest. Similar work by the district here and in the Wynaad and North Mangalore Divisions on a much larger scale shows more promise than many observers thought the method would be likely to give. But it cannot be said that success is assured.

36. *"Gaps" in evergreen forest.*—The artificial regeneration of gaps caused by selection fellings in evergreen forest is being taken up with energy by the district staff in several centres, especially in the Palghat Division (Silent Valley) in the Wynaad and in Tinnevely where a special officer was employed. The results of the Tinnevely work have been described in detail in last year's report. Both there and in the Silent Valley *Acrocarpus fraxinifolius*, introduced by direct sowing, shows more promise than any other species in the larger (and consequently lighter) gaps. Plants up to 15 or 20 feet in height after three years' growth and full of vigour, are not uncommon, and the work is cheap. Unfortunately the species is attacked by a defoliator and by a shoot-borer, and the damage has assumed serious proportions. In Tinnevely, besides *Acrocarpus fraxinifolius*, *Gluta travancorica* comes up readily in gaps from direct sowings and the species has just been introduced with considerable initial success in the Silent Valley, where it is not indigenous. In the Wynaad *Artocarpus hirsuta*, planted and stump-planted, has given results encouraging enough to justify further work, though browsing by bison has done much damage to the young plants. The Working Plans Officer found in the Silent Valley that *Dysoxylum malabaricum* if protected from vermin during germination and for a short time afterwards, grows readily from seed.

There is only one research plot dealing with this question. This is Experimental plot 108—South Coimbatore (in Karian shola) in which nursery seedlings of *Dichopsis elliptica*, *Hardwickia pinnata*, *Gluta travancorica*, *Pericopsis Mooniana*, *Bischofia javanica* and *Vateria indica*, and stumps of *Acrocarpus fraxinifolius* were put out in five gaps in 1931. The stumps of *Acrocarpus fraxinifolius* did not sprout and all other species suffered much from drip and from browsing. The attempt to stock these five gaps must be considered a failure. Of interest, though probably of little practical importance, is the fact that of 50 transplants of

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Araucaria cunninghamii (the *Australian Hoopine*) put out in the gaps in September 1931 practically all have established themselves and are growing steadily though slowly.

Direct Sowing.

37. It seems inevitable that repeated simple coppice fellings in poor dry fuel forest where, as is frequently the case, natural regeneration from seed is absent or deficient and where a proportion of the old stools fail to produce coppice in each succeeding rotation, must result in a steady deterioration in the growing stock. General observation lends support to the belief and considerable attention is now being given to the problem of introducing "fresh blood" by artificial means. Direct sowing, after burning any available slash and working the ash into the soil is the method which appears to offer the best prospect of success. So far this has usually been done in the year after felling the coupe, but the impression seems to be gaining ground that some shade is necessary, and it is not unlikely that a period about the middle of the coppice rotation will prove to be the correct time at which to bring about an artificial improvement in the stocking of this type of forest.

38. The newly opened research station at Chittoor has had time so far to conduct only very preliminary work in this connexion. The results of seed tests carried out there have been dealt with already. Apart from this the Silviculturist has two experimental plots near Mettupalaiyam.

39. *Experimental plot 50, North Coimbatore.*—Opened in 1928, seed of a number of species, mostly of those characteristic of dry tracts was sown direct in patches in which ash obtained by burning brushwood had been worked into the loosened soil. Details have been recorded in earlier reports. The sowings gave initial promise; but grazing, drought and scouring during occasional torrential rains in the north-east monsoon have combined to destroy the bulk of the seedlings and there is to-day very little to show for a good deal of work and expenditure. There has been a definite falling off during the year under report, and with very few exceptions such plants as survive (mostly *Acacias* and *Albizzias*) are ill grown straggly specimens. Survivals of 1928 sowings fell from 478 to 165 between May 1931 and March 1932, and those of 1929 from 553 to 244 in the same period.

40. *Experimental plot 114, North Coimbatore.*—Another plot on lines similar to the above was opened in 1931 in the same locality. A variety of species was used. Of these *Prosopis Juliflora* alone shows promise.

41. *Work by districts.*—In most districts where this type of forest is represented experimental work on the lines indicated above is going on. Success is nowhere claimed at present, but among the species which have given encouraging results may be mentioned *Acacia cyanophylla*, *Cassia siamea*, *Albizzia Lebbek*, *Acacia auriculiformis*, *Prosopis Juliflora*.

Manuring.

42. *Experimental plot 109, Nilambur (Teak).*—A plot (opened in 1931) of 1 acre—in from a long narrow strip. There are four treatments, viz., addition of 1 oz., 2 ozs. and 3 ozs. of lime to the soil in each pit (in which teak was planted in 1931) with control without lime. The treatments are arranged in single rows with 10 replications of the sequence. The plot is homogeneous as far as can be judged and the lay-out is acceptable. In February 1932 there was no difference between the treatments perceptible to the eye. Measurement of all plants gave:—

	Survival.	Average height.
	PER CENT.	INCHES.
Limed 1 oz.	97	24
" 2 oz.	94	24
" 3 oz.	96	25
No lime added	95	26

The "significance" of these small differences has not yet been calculated. They are almost certainly not significant. Lime has apparently had no effect at all, certainly no beneficial effect. The soil is alluvium, practically devoid of lime.

43. *Experimental plot 99, South Coimbatore (Teak).*—Opened in 1931 and similar to experimental plot 109, Nilambur (above) except that the three treatments occupy separate parts of the plot and there is no control. Measurements in February 1932 show no differences in the mean heights of the plants in the different subdivisions. The soil is a light loam deficient in lime.

44. *Experimental plot 102, South Coimbatore (Dalbergia latifolia).* In separate parts of the plot, which to all appearances are initially comparable lime was added at the rate of 1 and 2 oz. per stake respectively and was worked into the soil before sowing rosewood seed on 1st June 1931. An adjoining plot is intended to serve as control. No differences were noticeable in February 1932. Actual measurement will be made when the plants are larger and the significance of any differences found will be assessed. Stocking in February 1932 showed no appreciable difference (1 oz. 97 per cent, 2 oz. 94 per cent).

Draining.

45. *Experimental plot 118, Nilambur (Teak).*—On a small plot (2 acre) in an area inclined to be waterlogged, ditches 2½ feet wide and 12 inches deep were cut with intervals of 3½ feet between them. The earth removed from the ditches was formed into bunds between them and on the bunds teak was planted in July 1931. In February 1932 success was 97 per cent and average height 14 inches. The plants were well grown and healthy. But the method is far too expensive to be of practical application.

Weed Control and Soil Aeration.

46. Much work has been done on this subject in connexion with the problem of raising satisfactory plantations of second rotation teak at Nilambur and results have been described in detail in earlier reports. In some of the plots there are doubts concerning initial comparability, but taken as a whole, the work done has demonstrated the great benefit of removing weed growth completely from strips four feet wide along the lines of teak plants, or in circles four feet in diameter round each plant. Weeding in circles round the plants appears to give less satisfactory results than weeding in strips, though it is not certain that the differences observed are significant.

A more surprising indication given by some of these experiments is that the removal of weeds by scraping with mamooties (i.e., without loosening the soil) reacts on the growth of the teak almost, if not quite as favourably as a fork weeding involving a thorough aeration of the soil. This has led to the suggestion that root competition for moisture is the dominating factor in the situation. The matter, which is of considerable practical importance on account of the difference in cost between the two methods of weed control, is receiving further attention. An experiment carried out during the year (paragraph 50 below) under carefully controlled conditions appears to indicate that the belief that "scraping" is as effective as "forking" is a mistaken one, the difference in favour of forking being clearly significant. A brief account follows of the plot still open and bearing on this subject.

47. *Experimental plot 78, Nilambur (Teak).*—Opened in 1929 to compare results on the growth of teak of four weed control methods, viz., (1) deep forking in strips four feet wide in August and October, (2) as in (1) but scraping with mamooties instead of forking, (3) deep forking in circles 4 feet diameter round the plants, and (4) weed cutting. These treatments were given in the first growing season; thereafter the different areas have been treated alike (weed cutting only). The following measurements have been recorded:—

		Average height in			
		February 1930.	April 1930.	June 1930.	May 1931.
		FT. IN.	FT. IN.	FT. IN.	FT. IN.
Forked in lines	..	2 0	2 4	5 1	13 6
Scraped	..	2 4	2 9	5 9	15 11
Forked in circles	..	1 8	1 11	4 5	13 4
Weed cut	..	0 11	1 0	2 6	7 11

Assuming initial comparability and there is nothing to indicate that this condition was absent it is noteworthy that plants subjected to weed scraping have shown development as good as, or perhaps even better than that of plants given thorough soil aeration.

* The "significance" of this difference has not been assessed.

48. *Experimental plot 79, Nilambur (Teak).*—An experiment on lines similar to the above and opened the same year. There were three weeding treatments—(1) forking in lines, (2) forking in circles and (3) mamooty scraping. The following are the recorded measurements:—

		Average height in		
		February 1930.	June 1930.	May 1931.
		FT. IN.	FT. IN.	FT. IN.
Forking in lines	..	2 11	6 0	16 3
Forking in circles	..	1 11	4 4	13 0
Mamooty scraping	..	2 0	4 6	13 7

The forking in lines seems to have given better results than "scraping." There were however floods in the area and initial comparability is doubtful.

49. *Experimental plot 71, Palghat (Teak).*—Opened in 1929, when teak was raised by direct sowing 6' x 6'. There were three weeding treatments in the first year, viz., (1) fork weeding in four feet circles round the plants, (2) forking in strips 4 feet wide along the lines, and (3) weed cutting. Measurements in April 1932 showed no difference in mean height between plants weeded by forking in circles and forking along lines (6 feet 9 inches in both cases). The mean height of the weed cut plants was 5 feet 3 inches. This difference does not quite reach significance (difference of means = 1 foot 6 inches; standard error of difference = ± 1.03 feet). The "lay out" was a set of five adjoining lines of each treatment. Soil condition, etc., in each set appear to be equal.

50. *Experimental plot 110, Nilambur (Teak).*—Opened in 1931 with four weeding treatments of teak in its first year. The four treatments are (1) forking in strips, (2) mamooty scraping in strips, (3) forking in circles and (4) weed cutting. The "lay out," in sets of four lines each treatment with 10 repetitions, is acceptable. The middle two lines of each set of four are measured. The results of measurements in February 1932 are:—

Treatment.	Percentage of stocking.	Mean height. INCHES.	Standard error of mean. INCHES.
Forked in strips	88	18.0	± 0.75
Forked in circles	88	15.8	± 0.64
Scraped in lines	89	15.0	± 0.69
Weed cut	85	10.8	± 0.49

The difference between "forked in strips" and all the other treatments are significant:—

	Difference of means. INCHES.	Standard error of difference. INCHES.
Forked in strips compared with forked in circles.	2.2	± 0.98
Forked in strips compared with scraped in lines.	3.0	± 1.06
Forked in strips compared with "weed cut."	7.2	± 0.89

The difference between "forked in circles" and "scraped in lines" is not significant (difference of means = 0.8", standard error of difference = ± 0.94).

51. *Experimental plot 96, Nilambur (Gmelina arborea).*—This plot ($\frac{1}{2}$ acre) was opened in 1930 to compare the merits of scraping, forking and simple weed cutting as methods of weed control in a plantation of *Gmelina arborea* in its first year. The plot was fenced. In January 1932 the forked and scraped areas were obviously better than the weed cut areas, in the lower part of the plot. In the upper part where soil factors are more uniform there is less to choose, but even here a complete removal of weed growth twice during the year has definitely benefited the *Gmelina*. It must be noted however that had the plot been unfenced heavy damage by deer would probably have occurred in the forked and scraped areas.

52. *Experimental plot 112, Nilambur (Dalbergia latifolia).*—Rosewood and teak were planted in alternate lines in 1931. In one half of the plot rosewood was tended only by cutting the weeds, in the other half rosewood was weeded in the same way as the teak lines, i.e., by forking in four feet strips. In February 1932 the survivals of rosewood were practically the same in both halves (86 per cent and 87 per cent). The average height was 11" in the forked area and 12" in the weed cut area. Even if this difference is "significant" no conclusion is possible as noticeable differences in soil conditions became apparent after the plot was opened, those in the weed cut areas appearing to be more favourable.

53. *Experimental plot 113, Nilambur (Terminalia tomentosa).*—*Terminalia tomentosa* was introduced in 1931 by planting (a) ordinary nursery plants three months old (one foot high) and (b) nursery plants of the same age which had been transplanted into bamboo tubes. Two weeding treatments were applied—(1) forking in 4 feet strips and (2) weed cutting. The area was full of elephant grass. The plot was not homogeneous. A swampy depression ran through it obliquely and the plants here were submerged for weeks during the monsoon, and most of these died. Forked and weed cut lines alternate in sets of five lines with a number of repetitions so as to equalize fertility variations as far as possible. Excluding the submerged area "tubed" plants gave 93 per cent success in February 1932 with an average height of 32". The area planted in the ordinary way had 85 per cent stocking with an average height of 21". In both areas the difference between forked and weedcut lines was trifling.

Stump-planting—Trial with various species.

54. *Artocarpus hirsuta*—(*Experimental plot 119, Nilambur.*)—Stumps from one year old seedlings were put out in the open in May 1931, some in pits and some in crow-bar holes. The soil is rather poor shallow laterite. Eighty per cent of the stumps sprouted and during the monsoon the shoots flourished. In February 1932 average heights were—in pits 7", in crowbar holes 5". Weed growth was

preserved to give the plants some protection from the sun, but they began to die off rapidly as soon as the hot weather began, and by March 1932 only five survived (two per cent). The situation is obviously too dry and exposed for this species.

55. *Albizzia lebbek*—(*Experimental plot 86, Palghat.*)—Stumps from one year old nursery seedlings were put out in June 1930. In February 1932 stocking was 54 per cent, but was largely of 1931 replacements. 1930 survivals are vigorous and up to 6 feet in height. 1931 plants are from 12" to 18" in height and are thriving.

56. *Gmelina arborea*—(*Experimental plot 88, Palghat.*)—Stumps from one year old nursery plants were put out in June 1930. In February 1932 the area was 77 per cent stocked with vigorous, uniform, characteristically-branched plants up to 9 feet in height. But borers had attacked almost every stem. In a small swampy depression in the plot the *Gmelina* has totally failed.

57. *Dalbergia latifolia*—(*Experimental plot 89, Palghat.*)—Stumps from one year old nursery plants were put out in June 1930. In February 1932 there were plants at 86 per cent of the stakes. Growth was healthy and uniform with average height of four feet. This plot is easily the best artificial regeneration of rosewood that the writer has ever seen.

58. *Pterocarpus Marsupium*—(*Experimental plot 90, Palghat.*)—Stumps from one year old nursery seedlings were put out in June 1930. In February 1932 success was only 39 per cent and plants looked far from healthy.

59. *Ougenia dalbergioides*—(*Experimental plot 92, Palghat.*)—Stumps from one year old nursery seedlings were put out in June 1930. In February 1932 success was 61 per cent, after replacing a number of casualties in June 1931. Shoots from 1930 stumps were, in February 1932, up to four feet in height with a bushy habit and a healthy appearance.

60. *Terminalia paniculata*—(*Experimental plot 94, Palghat.*)—Stumps from one year old nursery plants were put out early in July 1930. There was replacement of casualties in the first year and again in June 1931. In February 1932 stocking was 84 per cent with strong shoots up to six feet high (average three feet). The fact that *Terminalia paniculata* can be grown successfully from stumps is of interest in view of the extreme infertility of the seed of this species.

61. *Xylia xylocarpa*—(*Experimental plot 85, Palghat.*)—Stumps from one year old nursery seedlings were put out in June 1930. In February 1932 stocking was 79 per cent, but many of the plants were from 1931 replacements. The shoots are poor—6 to 12 inches in height.

62. *Eucalyptus tereticornis*—(*Experimental plot 116, Nilambur.*)—Stumps from one year old nursery plants were put out in May 1931. None sprouted. The area is swampy. The reason for experimenting with this species in such a locality is not recorded.

(Difference of means = 4", S.E. of difference = ± 1.59 ".) Comparing "pits" and crowbar holes the difference in favour of pits is significant with April planting (difference of means = 4 inches, S.E. of difference = ± 1.84 ".). With June planting the difference is not quite significant ($2'' : \pm 1.36$ ".). The figures for May planting have not been analysed as owing to heavy casualties misleading results are to be expected. April planting has been strikingly successful. It is noteworthy that there was considerable sprouting (for the first time) of April stumps in the months of July and August. Early in July the percentage of success of the April stumps was only 65; by the middle of September it had risen to 92. The poor stocking with May stumps should be noted.

70. This stump planted area stands out in a remarkable way above the dibbled district area adjoining it on one side, and a dibbled research plot on the other.

71. *Experimental plot 109, Palghat (Teak).*—Opened at Walayar in 1931. Stump planting was done (1) middle of April, (2) middle of May and (3) middle of June, and there is the usual complication of pits and crowbar holes. Each treatment occupies a separate part of the plot and there is no certainty regarding initial comparability. There was no replacement of casualties. Measurements are :—

	In February 1932.		In May 1932.	
	Stocking.	Average height.	Stocking.	Average height.
	PER CENT.	INCHES.	PER CENT.	INCHES.
April pits ..	39	13	40	17
April crowbar holes.	22	9	21	13
May pits ..	12	12	12	17
May crowbar holes.	35	12	37	17
June pits ..	69	16	67	21
June crowbar holes.	75	13	73	18

Walayar is almost outside the natural limits of teak, and rainfall is uncertain. In such a locality, from this experiment, pre-monsoon stump planting seems to be a thing to avoid.

72. *Experimental plot 108, Nilambur (Teak).*—Stump planting was done on three dates, 10th April 1931, 1st May 1931 and 1st June 1931. In this case there are two complications—(1) pit and crowbar planting and (2) one year and two year old stumps. The plot is in the form of a long strip and the one and two year old stumps are kept to the western and eastern ends respectively. In each half the six treatments follow in sequence by single lines, with ten repetitions. The arrangement is completely acceptable from the point of view of initial comparability, except as regards a comparison of one and two year old stumps.

No replacement of casualties was done. Measurements were recorded in February 1932. These measurements and the result of their statistical analysis are given below :—

Treatment.	Stocking.	Mean height.	Standard error of means.
<i>One year old stumps.</i>			
	PER CENT.	INCHES.	INCHES.
April pits	73	31	± 1.57
April crowbar holes.	61	30	± 1.49
May pits	67	29	± 1.32
May crowbar holes ..	72	26	± 1.22
June pits	83	22	± 1.04
June crowbar holes ..	67	18	± 1.03
<i>Two year old stumps.</i>			
April pits	59	32	± 1.30
April crowbar holes.	64	33	± 1.46
May pits	64	26	± 1.12
May crowbar holes ..	62	23	± 1.10
June pits	90	33	± 1.36
June crowbar holes ..	90	30	± 1.56

The significance of the differences between "pits" and "crowbar holes" in all cases, and between April and June planting both in pits and in crowbar holes, with one and two year old stumps has been assessed and the following are the results :—

Treatments compared.	Difference of means.	Standard error of difference.	Significance of difference.
<i>One year old stumps.</i>			
	INCHES.	INCHES.	
April pits and April crowbar holes.	1	± 2.16	Not significant.
May pits and May crowbar holes.	3	± 1.80	Not quite significant.
June pits and June crowbar holes.	4	± 1.46	Significant.
<i>Two year old stumps.</i>			
April pits and April crowbar holes.	1	± 1.95	Not significant.
May pits and May crowbar holes.	3	± 1.57	Not quite significant.
June pits and June crowbar holes.	3	± 2.07	Not significant.
<i>One year old stumps.</i>			
April pits and June pits ..	9	± 1.88	Significant.
April crowbar holes and June crowbar holes.	12	± 1.81	Do.
<i>Two year old stumps.</i>			
April pits and June pits ..	1	± 1.88	Not significant.
April crowbar holes and June crowbar holes.	3	± 2.14	Do.

Thus out of six comparisons of "pits" and "crowbar holes" one difference reaches significance, though two approach it. In five out of six cases however there is a fairly consistent difference in favour of pits, and in the sixth the difference in the reverse direction is not significant. Taking these six differences together the conclusion is probably justified that a slight addition in height growth is obtained by pit planting, but it is unlikely that this increase is large enough to justify the greater expenditure of pitting. With one year old stumps the difference in height growth between April and June planting, both in pits and crowbar holes is very striking. It is curious that similar results have not been obtained with two year old stumps, where the difference does not reach significance. The success, both in stocking and height growth of two year old stumps is noteworthy.

73. *Experimental plot 120, Nilambur (Dalbergia latifolia).*—Stumps of one year old seedlings were put out in pits and crowbar holes at the end of April and at the end of May 1931. There are two lines of each treatment, not repeated. The plot is fairly uniform, but the arrangement is not entirely satisfactory.

Results in February 1932 are—

				Stocking.	Average height.
				PER CENT.	INCHES.
April pits	..	..	..	40	16
April crowbar holes	..	..	..	84	16
May pits	..	..	..	95	15
May crowbar holes	..	..	..	99	15

No explanation suggests itself for the low percentage of success with "April pits."

Stump-planting—Rot in plants grown from stumps.

74. The opinion has been expressed by several observers that the chance of invasion by fungal hyphae at the cut surfaces renders teak grown from stumps specially liable to rot. Cases have been cited where teak saplings split open have shown discoloration at or near ground level, but there has often been some degree of uncertainty regarding the origin of these saplings from stumps.

75. Two samples grown undoubtedly from stumps which Mr. C. C. Wilson sent to Dehra Dun for examination by the Forest Botanist were reported to contain fungal hyphae which appeared to have infected the plants while they were still alive; but the Forest Botanist was unable to say whether the fungus would have produced heart rot if the trees had been left growing.

76. Two more samples sent in May 1931 from Nilambur (of certain origin from stumps) were examined by the Forest Botanist and found to be free from rot.

77. In September 1931, sixteen specimens were collected by the writer at Nilambur. Eight were of undoubted stump origin and

eight were from entire plants. All specimens were grown under strictly comparable conditions in adjoining plots, except No. 11 (an entire plant) which was growing in a small local depression in which rain water had collected. The lower half of its tap-root was obviously rotten when it was uprooted. No other specimen showed any external sign of unsoundness.

78. These sixteen specimens were sent to the Forest Botanist who reported as follows:—

" . . . A detailed examination was made of specimens 1 to 7 (all from stumps) and 11 (entire plant), and the rest were examined microscopically for rot, and were incubated with the following result. Nearly all specimens produced a crop of *Fusarium* on being incubated. *Fusarium* being one of the commonest soil organisms its appearance on incubated material does not signify the presence of any true fungal rot in the stumps. Microscopically no diseased condition of the stumps is visible, and microscopic study does not show the presence of any fungal element in the underlying tissue. No. 11 exhibited a rotten condition of the tap-root, but no definite fungus pathogene would be isolated."

79. The specimens in question were from plants about two years old and 10 feet high.

80. The Forest Botanist's report goes far to set at rest any anxiety that has been felt regarding the wisdom of using stump planting as a routine measure of regeneration.

Cuttings.

81. *Experimental plot 114—Nilambur.*—Large shoot cuttings 4½ feet long and of three sizes (4", 6" and 9" girth) of *Terminalia tomentosa*, *Xylia xylocarpa*, *Dalbergia latifolia* and Teak were put out on three different dates (April, May and June). Eighteen cuttings of each species and size were planted 1½ feet in the ground on each occasion. A few cuttings of all species except *Xylia xylocarpa* sprouted, but none established itself.

82. *Work by District Forest Officers.*—The District Forest Officer, Chittoor, tried large cuttings 6½ feet long and of girths from 6" to 12" of *Albizia lebbek*, *Albizia amara*, *Cassia siamea*, *Premna tomentosa*, *Terminalia arjuna*, *Melia indica*, and *Boswellia serrata*. They were put in 3½ feet deep in June-July 1931. Many put out shoots but only a few *Boswellia serrata* survived until April 1932.

The District Forest Officer, South Salem, put out cuttings of *Albizia amara*, and *Albizia lebbek* at several centres. None survived the hot weather.

Cover Crops.

83. *Experimental plot 67—Nilambur Teak with Tephrosia candida and Centrosema pubescens.*—Opened in 1928. The cover crops were sown in separate areas in a teak plantation in its first year, the object being to study the effect of these cover crops in

keeping down weeds, especially grass, and in improving the soil. A third part of the plot was to serve as control. The plot has been described in detail in earlier reports. Briefly, results are as follows :—The Boga (*Tephrosia candida*) established itself readily and repeatedly threatened to suppress the teak. When this happened it was pollarded. *Centrosema* in the second and third years developed into a troublesome climber, invading the crowns of the young teak. By the fourth year Boga was rapidly dying out and *Centrosema* had formed a dense mat on the ground effectively suppressing grass. Nothing definite has emerged from the experiment except that *Centrosema* is unsuitable on account of its climbing propensities. It is impossible to say whether Boga did good or not. It suppressed weed growth to some extent, but may have been itself as objectionable as weed. The teak has been badly attacked by borers and the plot will have to be given up.

The District Forest Officer, Nilambur, has tried Boga in his own plantations sowing it in the second year, and this appears to be a more suitable time to introduce it, but the general impression at present is that its use is of doubtful value.

Miscellaneous.

84. *Experimental plot 111—Nilambur (Anacardium occidentale)*.—It was thought that the Cashewnut (*Anacardium occidentale*) might be worth growing on some of the poorest laterite soils at Nilambur both for its fruit and for fuel. This plot was therefore opened in such an area. Direct sowing was the method used, with three variations, viz., on mounds, in filled-in pits, and in patches with a surface loosening of the soil. There were also two weeding treatments by forking, and by simply cutting the weeds. The species proved to be extremely easy to raise in the given conditions. Practically every seed germinated and produced healthy fast growing plants. The position in February 1932 was :—

	Percentage survived.	Mean height.	Remarks.
		INCHES.	
Mounds, forked ..	93	37	Each treatment was confined to its own part of the plot. The small differences in height growth between the different sowing methods may be due to soil variations, but the expected differences between forking and weed cutting are obviously significant.
Mounds, weed cut.	92	30	
Patches forked ..	98	34	
Patches weed cut ..	95	27	
Pits forked ..	99	37	
Pits weed cut ..	99	24	

85. *Experimental plot 93—Palghat (Eucalyptus tereticornis)*.—Nursery plants (age not recorded, but about 15" high) were put out in July 1930. Part of the plot was swampy and here the plants failed completely. Elsewhere a few survived (11 per cent) and these grew rapidly, reaching 12 feet in height in February 1932.

(vi) RECLAMATION AND AFFORESTATION.—Nil.

(vii) THINNING AND CLEANING.

86. *Experiments by District Forest Officers*.—In Lower Godavari *Casuarina equisetifolia* is thinned mechanically in the fifth year by cutting out alternate lines in both directions. In 1928 the District Forest Officer conducted an experiment to compare this method with a thinning made by marking according to what appeared to be the requirements of different parts of the area chosen. Ocular evidence to-day is to the effect that the mechanically thinned area (much more heavily thinned than the other) is easily the better.

87. The District Forest Officer, Nellore, maintains plots to compare height and girth increment of coppice thinned to three or four shoots per stool with unthinned coppice. It is stated that the thinned stools produce the best developed shoots, but measurements are not given. The species dealt with are *Pterocarpus santalinus*, *Anogeissus latifolia* and *Chloroxylon swietenia*.

(viii) MIXTURES.

88. *Experimental plot 77—Nilambur*.—Opened in 1929. Teak was spaced 6' × 12' and *Calophyllum Inophyllum*, *Adina cordifolia*, *Stephegyne parviflora*, *Xylia xylocarpa*, *Cedrela odorata*, *Dalbergia latifolia* and *Ougenia dalbergioides* were introduced by direct sowing between the lines of teak. The plot was fenced, but in spite of this advantage and of many expensive weedings, only a limited degree of success had by January 1932 attended the introduction of these subsidiary species. A few *cedrela odorata* and one or two *Stephegyne* and *Adina* plants were more or less level with the teak. Elsewhere *Rosewood*, *Pterocarpus Stephegyne*, *Ougenia*, etc., were still struggling with the mass of weed and climbers which had come in owing to the wide spacing of the teak. The plot has been closed.

89. *Experimental plot 74—Nilambur*.—This plot has been described in detail in earlier reports. Very poor III quality teak was clear-felled in 1928 and an attempt was made to form a mixed crop in raising the second rotation plantation. Unsaleable material was heaped and burnt, doing as little damage as possible to the teak and other stools, as coppice was to be encouraged. On the burnt patches seed of Teak, *Pterocarpus marsupium*, *Lagerstræmia lanceolata*, *Adina cordifolia*, *Rosewood*, *Gmelina arborea* and *Schleichera trijuga* was sown in 1929. Nearly 50 per cent of the burnt patches were sown with teak. Teak stumps were also put out. There were frequent weedings and climber cuttings, and the plot was fenced.

In January 1932, of the sown subsidiary species *Lagerstræmia lanceolata* had done best : there are little thickets almost as high as

the teak. *Pterocarpus marsupium* is present in fair numbers, and looks healthy. But it is doubtful whether the measures taken have added appreciably to the mixture which nature would have given, and the cost has been prohibitive.

(ix) UNDERPLANTING.

90. *Experimental plot 26, Nilambur (Bambusa arundinacea under teak).*—In 1926 untreated seed was sown at stake 30' × 30' under a 40 year old Teak plantation in which underwood and undergrowth were very deficient, and grass was abundant. Growth has been disappointingly slow. In February 1932, 60 per cent of the patches had bamboos in them, with an average height of 3½ feet. Some clumps were putting forth weak culms of much greater length. The shade seems more than the bamboo likes. The plot continues under observation.

91. *Experimental plot 101, Nilambur (Bambusa arundinacea under teak).*—Opened in 1930 when one year old nursery plants of *Bambusa arundinacea* were planted out 30' × 30' under a 37 year old II quality teak plantation. In February 1932 the plot was 98 per cent stocked with fairly vigorous plants up to six feet in height.

92. *Experimental plot 100, Nilambur (Cephalostachym pergracile under teak).*—Opened in 1930 to test the suitability of *Cephalostachym pergracile* as an underwood to teak. The plot, in a 37 year old II quality teak plantation was sown 30' × 30' with seed of *Cephalostachym pergracile* on 30th May 1930. Much of the seed of *Cephalostachym pergracile* was eaten by birds. Blanks were planted up with nursery seedlings. In February 1932, 90 per cent of the stakes had plants which looked healthy and averaged two feet in height.

93. *Experimental plot 104, Nilambur.*—Similar to the above, but under III quality teak 37 years old. The canopy is much more open than in experimental plot 100 (above). In this plot also transplants were freely used to fill blanks. In February 1932, stocking was 71 per cent and average height 2' 9".

94. *Experimental plot 105, Nilambur.*—Again similar, but under II quality teak 38 years old, and *Cephalostachym pergracile* was introduced entirely by planting out one year old nursery plants in 1931. In February 1932, the area was 98 per cent stocked with healthy plants uniform in growth averaging 18" in height.

95. *Experimental plot 106, Nilambur.*—A replication of the above, but under III quality teak. Stocking was 90 per cent in February 1932. Average height 18".

96. *Experimental plot 99, Nilambur (Cedrela Toona under Teak).*—Opened in 1930. *Cedrela Toona* was introduced by direct sowing under 37 year old II quality teak. Germination was good and in February 1931 success was 79 per cent. But the young plants suffered heavily in the hot weather and by June 1931 stocking had fallen to 24 per cent. Failure were resown in June 1931. In February 1932, 54 per cent of the stakes had seedlings. Survivors of 1930 sowings are flourishing, up to 4½ feet in height.

97. *Experimental plot 103, Nilambur.*—Similar to the above, but under III quality teak. The results are similar.

98. *Experimental plot 83, Nilambur (Dalbergia latifolia under teak).*—This plot was opened in 1930 to see whether, by sowing rosewood close beside the teak stems in a young plantation, the damage from "drip" to the young rosewood seedlings could be minimized. In part of the plot rosewood seed was sown in this manner and elsewhere it was sown between the teak lines. The teak varies from 1 to 3 years old.

In February 1932 stocking was much poorer in the area where rosewood had been sown between the teak lines (17 per cent against 40 per cent), but the plants growing beside the teak stems were less robust than the others, and distinctly smaller. Unless the results of sowing close beside the teak are overwhelmingly in favour of this method (which is not the case at present) the obvious difficulties of future treatment will rule it out.

99. *Experimental plot 98, Nilambur (Swietenia macrophylla under teak).*—Seed of *Swietenia macrophylla* was sown in May 1930, 6' × 6' under 37 year old II quality teak. Germination was excellent and in July 1930, 95 per cent of the stakes had seedlings. In February 1931 stocking was 90 per cent and plants averaged a foot in height, but by the end of the hot weather (June 1931) stocking had fallen to 60 per cent. Blanks were resown in June 1931. In February 1932 stocking was 60 per cent and plants averaged 15 inches. Growth is slow and shade appears to be insufficient. There is much browsing damage.

100. *Experimental plot 102, Nilambur.*—Similar to the above, but under III quality teak. The results are similar.

101. *Experimental plot 50, Nilambur.*—(*Trewia nudiflora* under teak).—This species was introduced under 8 year old teak on deep river alluvium in 1927 by three methods—(1) sowing, (2) planting out nursery plants a few weeks old and (3) cuttings 3 to 4 feet long and 1"-2" thick. None of these methods has yet produced anything approaching a satisfactory underwood, but direct sowing has given easily the best results. In February 1932 :—

Planted	..	12 per cent survive with average height of 4 feet.
Sown	..	49 per cent survive with average height of 6 feet.
Cuttings	..	12 per cent survive with average height of 7 feet.

102. *Experimental plot 37, Palghat (Mesua ferrea).*—This plot was opened in 1924 and has been fully described in earlier reports. *Mesua ferrea* was introduced under virgin evergreen rain forest by three methods—(1) sowing in filled-in pits, (2) sowing at stake and (3) planting out natural forest seedlings. Both direct sowing methods resulted in more or less complete failure. Planting was successful and the area is well stocked with thriving plants. In January 1932 success is 80 per cent and the appearance of the area is very encouraging. Light was admitted in 1927 by cutting

out the lower storey. A careful examination of the plot gives no reason to suppose that the plants require more light at this stage.

103. *Experimental plot 36, Palghat (Calophyllum tomentosum)*.—Similar to Experimental plot 37, above. Here again direct sowing failed almost completely. The planted area is tolerably well stocked and looks promising. In August 1928 in part of the planted area light was admitted, the canopy in the rest of the area remaining undisturbed. There is no indication in January 1932 that growth of the poon differed in the two areas. There are plants at 47 per cent of the stakes with average height of 27 inches.

104. *Experimental plot 121, Nilambur (Cassipouia coriaria)*.—Divi-divi and *Tephrosia candida* were sown in separate parts of this plot in May 1931 under six year old teak in which there was no undergrowth, but dense elephant grass throughout. The object is to see whether these species are able to establish themselves in such conditions and suppress the elephant grass. In a third part of the area the grass was uprooted. By the close of the year the stocking of Boga (*Tephrosia*) was satisfactory over most parts of the area with healthy plants up to four feet high. It has not, so far, had any appreciable effect in suppressing the grass. Stocking of Divi-divi is almost complete, but the plants are very small and switchy. In the area in which the grass was uprooted there was no sign of its re-appearance and a composite weed had taken possession of the ground but the expense of uprooting is of course prohibitive.

II. WORKING PLANS AND STATISTICS.

(i) WORKING PLANS.

105. The Provincial Silviculturist has been in touch, through the Working Plans Conservator, with Working Plans officers in various districts, and proposed prescriptions regarding silvicultural and statistical work have been referred to him for criticism from time to time.

(ii) YIELD TABLES.

106. The following permanent sample plots were maintained :—

Species.	The Nilgiris.	South Coimbatore.	Nilambur.	Wynad.	South Mangalore.	North Mangalore.	South Cuddalore.	Ganjam.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Number of Plots.								
Eucalyptus Pillularis ..	1	..	..	..	..	..	..	..
" eugenioides ..	1	..	..	..	..	..	..	..
" propinqua ..	1	..	..	..	..	..	..	..
" acmenoides ..	1	..	..	..	..	..	..	..
" paniculata ..	1	..	..	..	..	..	..	..
" punctata ..	1	..	..	..	..	..	..	..
" globulus ..	1	..	..	..	..	..	..	..
Tectona grandis ..	..	1	36	9	..	..	..	..
Xylia xylocarpa ..	..	..	2	..	..	..	..	..
Hopea parviflora ..	..	..	*1	..	6	3	..	..
Lagerstrœmia lanceolata ..	..	..	1	..	..	..	..	..
" Flos Regi- nac ..	..	..	1	..	..	..	..	..
Acacia catechu ..	..	..	..	..	..	*3	..	..
Red sanders ..	..	..	..	..	..	..	1	..
Shorea robusta ..	..	..	..	..	..	..	..	10
Total ..	7	1	41	9	6	6	1	10

NOTE.—* Denotes plots re-measured during the year.

(iii) VOLUME TABLES.

107. The Silviculturist, Forest Research Institute, kindly arranged for the compilation at Dehra Dun from figures supplied by this office, of local volume tables of the following species for South Coimbatore and Nilambur :—

For Nilambur.

Tectona grandis.
Lagerstrœmia lanceolata.
Terminalia paniculata.
Terminalia tomentosa.
Xylia xylocarpa.

For South Coimbatore.

Tectona grandis.
Dalbergia latifolia.
Pterocarpus marsupium.
Terminalia tomentosa.
Terminalia paniculata.

108. Separate local volume tables were prepared for differing localities in the South Coimbatore Division as follows :—

Lagerstrœmia lanceolata—Mount Stuart—based on 311 trees.

Dalbergia latifolia—Mount Stuart—based on 102 trees.

Dalbergia latifolia—Punachi—based on 245 trees.

Tectona grandis—Punachi—based on 908 trees.

Tectona grandis—Mount Stuart—based on 1,171 trees.

Terminalia tomentosa—Mount Stuart—based on 793 trees.

109. From figures supplied by the Working Plans Officers, Palghat and Wynad local volume tables were prepared in this office for :—

Dichopsis elliptica—Silent valley (Palghat Division) based on 706 trees.

Dichopsis elliptica—Kalladikote (Palghat Division)—based on 436 trees.

Mesua ferrea—Silent valley (Palghat Division)—based on 686 trees.*

Mesua ferrea—Silent valley (Palghat Division)—based on 714 trees.*

Mesua ferrea—Silent valley (Palghat Division)—based on 1,128 trees.*

Mesua ferrea—Kalladikote (Palghat Division)—based on 387 trees.

Mesua ferrea—Perya Reserve Forests (Wynad)—based on 619 trees.

110. Progress has been made in the collection of data for the compilation of local volume tables for—

<i>Lagerstrœmia lanceolata</i>	(Punachi, South Coimbatore)
<i>Adina cordifolia</i>	(Mount Stuart, South Coimbatore)
<i>Albizia odoratissima</i>	(" " ")
<i>Pterocarpus marsupium</i>	(" " ")
" "	(Punachi, " ")
<i>Pterocarpus santalinus</i>	(Chittoor)
<i>Shorea talura</i>	(" ")
<i>Terminalia paniculata</i>	(Mount Stuart, South Coimbatore)
<i>Grewia tiliaefolia</i>	(" " ")

* Three different localities.

(iv) BARK MEASUREMENTS, ETC.

111. Apart from those made in the regular sample plot work nothing has been done.

(v) MISCELLANEOUS.

112. Ring countings on stumps of teak in felling areas at Mount Stuart have been begun. Figures from about 100 stumps have been tabulated during the year.

III. MISCELLANEOUS.

113. *Records*.—The Specific and General Ledger files, now numbering 344 and 60 respectively, have all been re-arranged in accordance with Howard's system. In the course of re-arrangement a considerable number of duplicated and irrelevant entries were weeded out of the files. The re-arrangement of the plot files and of the photographic collection remains to be done.

114. Twenty-eight new experimental plot files were opened during the year, and 63 were closed, final summaries being posted in the appropriate ledger files.

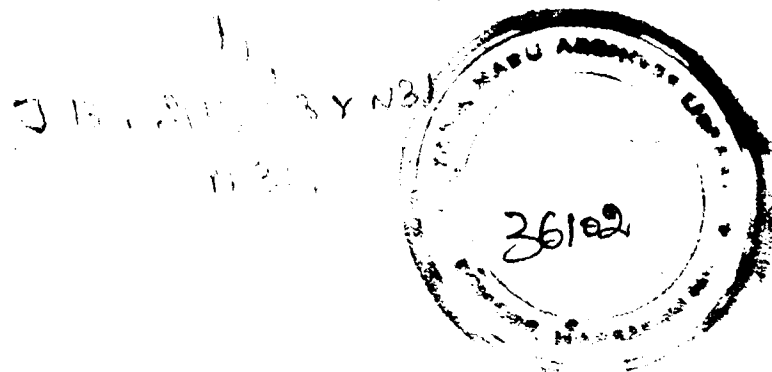
115. Following a resolution of the Silvicultural Conference held at Dehra Dun in 1929 two areas of Evergreen rain forest, one in the Wynaad and one in the Palghat Division have been set apart, in Working Plans under preparation, for preservation as types of this class of virgin forest. Action is also being taken to preserve an area of natural teak bearing forest in its virgin state.

116. The District Forest Officer, North Salem, has worked in collaboration with the Indian Institute of Science and the Forest Entomologist in connexion with their investigation into the "Spike" disease of Sandalwood. Progress reports are published periodically by the Institute.

W. G. DYSON,
Provincial Silviculturist (Madras),
Ootacamund.

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