(1) Number of pages 10 Sheets

(2) Date of repair 19.2.85

(3) Initials of the Referencer

TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

Revenue DEPARTMENT

G.O. No. / B.P. No: 1913	Press. / Mis.
Dated 25.11.1878	197 .

Not to be folded or roughly handled

Archives I—5,806—24-2-78.

1913
1

GOVERNMENT OF MADRAS.

REVENUE DEPARTMENT.

25th November 1878, No. 1,913.

Read the following paper:—

No. 344. Extract from the Proceedings of the Government of India in the Department of Revenue, Agriculture, and Commerce, (Forests), dated Simla, the 21st October 1878, Circular No. 61-F.

Read the following:—

Memorandum on the rate of growth of Teak by D. BRANDIS, Inspector-General of Forests, dated Simla, the 7th October 1878.

CONTENTS.

	Para.	Page
Introduction	1,	1
Annual rings...	3,	*ib.*
Girth and height at different ages	7,	3
Cubic contents of trees at different ages	16,	6
Number of trees and cubic contents of growing stock per acre	17,	*ib.*

For the Manual of Indian timbers, now under preparation, it was necessary to bring together all information available regarding the rate of growth of Teak, and it appears advisable to circulate the results at once with the view of eliciting further data in order to complete the account that will be given in the Manual. The following data were brought together with the assistance of Mr. A. Smythies, Assistant Conservator of Forests, Forest School Circle, North-Western Provinces.

2. A brief account of what was known regarding the rate of growth of Teak up to 1873, was given on pages 357-359 of the Forest Flora of North-West and Central India. Since then, further data have been collected; but the chief addition to our information on this subject has been made by the publication of Colonel Beddome's Report of 1878 on the Nelambur Teak Plantations. The data here brought together in no way give a complete account of the rate and mode of growth of Teak, and doubtless much more information is available which has not yet been published. It is a most important subject, which should now be taken up separately in each province where Teak is cultivated on a large scale, and its study is earnestly recommended. The following remarks will most conveniently be grouped under the head of Annual rings, Girth and Height at different ages, Cubic Contents of individual trees, and the Number of Trees and Cubic Contents of growing stock per acre. It will be remembered that the rate of growth of every species varies between wide limits according to climate, soil, and numerous other circumstances which affect the development of trees.

3. *Annual Rings.*—It is now established beyond doubt that the concentric rings which are so marked in the wood of Teak correspond each to one year's growth. The following statement exhibits the rings counted on sections of trees grown in the Nelambur Plantations, which were cut in 1877. The sections were taken from the base of the stem, and, with a few exceptions, the number of rings agrees with the age of the tree. The average diameter is the mean of three diameters. The statement shows the gradual increase of the heartwood as the tree grows older, and it also exhibits the number of rings on one inch of average radius

Age.	Mean Girth at Breast high.	Total height of Tree.
Nelambur Plantation.—Gneiss and Laterite.		
7 years ...	13 inches	30 feet.
16 „ ...	14 „	50 „
20 „ ...	21 „	50 „
24—26 „ ...	22 „	52 „
30 „ ...	24 „	50 „

These figures are taken from that portion of Colonel Beddome's report (paragraphs 11—44) which contains his notes on each year's plantation, and the data recorded are stated to be average figures.

8. In another part of his report (paragraph 81), however, he gives data which would seem to show that the average size of the trees in the older plantations (all on alluvial soil) is considerably greater. He there states the dimensions of the largest, smallest, and medium sized trees in four plantations, the results being as follows:—

Age.	Mean Girth (probably Breast high).			Length of Bole.		
	Largest.	Medium.	Smallest.	Largest.	Medium.	Smallest.
	INCHES.	INCHES.	INCHES.	FEET.	FEET.	FEET.
30 years	67	47	29	79	65	50
31 „	69	49	30	80	65	50
32 „	68	46	30	83	67	50
33 „	68	56	43	86	68	50

The first three lines show the average of six trees in each case, and the last line the average of eight trees each. It is distinctly stated that the length is that of the bole, and not of the entire tree.

The plantations made on gneiss and laterite show a much slower rate of growth than those on alluvial soil; the difference being considerable in height, and much less in girth.

9. Up to 10 years of age, the growth in length of Teak on alluvial soil at Nelambur is at the rate of about 6 feet a year, and later on it is at the rate of only about 1 foot a year. On page 358 of the Forest Flora of North-West and Central India, it is stated "that it is probable that, as a rule, Teak attains half its length with a girth of 2—3 feet." This assumption is borne out by the present figures. The trees grown upon alluvial soil in girth between 25 and 34 inches are from 77 to 87 feet high; and from all that is known regarding the growth of Teak in similar localities, it is probable that, unless damaged by storms, disease, insects, or other causes, they will attain a height of 150 feet in soil of this description, and in the climate of Nelambur.

10. From Burma, we have the following data. The figures from Pegu represent averages of plantations in the Rangoon, Toungoo, and Tharawaddee districts, brought together on page 358 of the Forest Flora of North-West and Central India.

——	Age in Years.	Mean Girth, Breast high, in Inches.	Total height of Tree, in Feet.
Pegu	4	5—9	15—27
	10	15	40—45
	15	23	...
Thinganneenoung ...	21	27	50—60
Garden—Moulmein ...	22	40	...

The fourth line is the average of 150 trees in the Thinganneenoung Plantation in the Attaran district of Tenasserim, given in paragraph 146 of the Report for 1876-77 of the Tenasserim forests. Major Seaton gives the average height at 30—40 feet, but this probably means the height to the first branch. The maximum girth was $55\frac{1}{2}$ inches. The average rate of growth of the present plantations in Burma is somewhat less rapid than that of the alluvial portion of Nelambur. The last line gives the average of fifteen trees measured in 1856 in a private garden at Moulmein. An instance of extremely rapid growth was the tree already mentioned, a section of which was sent from Port Blair for the Paris Exhibition, probably six years old (said to have been planted in 1873, but six rings were counted), with a girth of 36 inches and a height of 44 feet.

11. For the Lakvalli Plantation in Mysore, the following data are given in Captain vanSomeren's Report for 1875-76. Age 13—15 years, mean girth 14 inches, height 32 feet. This is a remarkably slow rate of growth, considering that the soil is good, and the climate moist, though of course not so forcing as the climate of Nelambur.

12. The plantations in the Central Provinces and Berar have given the following:—

Plantation.	Age in Years.	Mean Girth, Breast high, in Inches.	Total height of Tree, in Feet.
Machna, Central Provinces	6	7	15—22
Pili, Berar	6	4	10
Sakata, Central Provinces	7	11	20—25
Pili, Berar	8	8	20
Sonawani, Central Provinces... ...	9	12	30—40
Machna, Central Provinces	8—10	9	17—30

Compared with Malabar and Burma, the rate of growth is slow, as may be expected in a dry climate and near the northern limit of the tree.

13. Outside the range of the natural growth of Teak, the following data, regarding its rate of growth, are available:—

Plantation.	Age in Years.	Mean Girth, Breast high, in Inches.	Total height of Tree, in Feet.
Bamunpokri (Sikkim) ...	5	5·5	12—15
Kulsi (Assam)	5	11	29
Makum „	4	9	18
„ „	5	11	27
„ „	7	16	31

in the wood of trees of different ages. But it must be borne in mind that these sections do not represent the average of each year's plantation, but were selected from among the dominant trees. They therefore exhibit a more rapid rate of growth than average specimens would do :—

Year of Plantation.	Number of Rings counted.	Average Diameter of Section (Wood only).	Average Diameter of Heartwood.	Rings per Inch of Average Radius.
		In Inches.	In Inches.	
1844	33	20.8	19·3	3.17
1845	31	21·1	18·7	2·95
1846	31	20·	17·7	3·10
1847	30	23·8	21·5	2·52
1848	28	16·7	15·4	3 34
1849	28	18·1	16·2	3·09
1850	27	14·	12·5	3·85
1851	25	15·2	13·4	3·28
1852	32*	15·2	13·5	Omitted.
1853	24	15·1	12·	3·17
1854	24	17·3	15·2	2·77
1855	23	12 4	10·5	3·71
1856	21	15·2	12·6	2·76
1857	20	12·2	10·6	3·27
1858	19	14·	11·3	2·71
1859	18	14·	10·6	2·57
1860	17	12·9	10·4	2·63
1861	16	13·1	10·5	2·44
1862	15	11·7	9·	2·56
1863	14	13·6	10·4	2·06
1864	13	12·5	9·4	2·08
1865	12	9·4	6·9	2·55
1866	11	10·4	7·3	2·11
1867	10	11·8	8·3	1·69
1868	9	10·5	7·6	1·71
1869	8	7·4	4·8	2·16
1870	7	7·4	4·5	1·89
1871	7	7·7	4·3	1·81
1872	5	6·5	2·6	1·53
				Average 2·62 rings per inch of average radius.

* There is evidently a mistake here. The tree which yielded this section must have been an older tree standing in the plantation of 1852.

4. The sections ranged in age from 5 to 33 years. Dividing them into three groups, two of ten years each, and the third of nine years, we obtain the following as the mean diameter in inches of these three groups :—

			Inches.
Mean diameter of trees	5—14 years old	... ...	9·72
Do. do.	15—24 „ „	... ...	13·79
Do. do.	25—33 „ „	... ...	18·71

A section sent from the Thinganneenoung plantation in Burma, cut from a tree 21 years old, planted in 1856, gave 21 rings on a mean diameter of 16·3″, the heartwood of which occupied 14·5″. This section showed 2·57 rings per inch of average radius.

5. From other plantations also, sections of Teak trees of known age were sent for the Paris Exhibition, but apparently they were not in all cases cut from

the base of the stem; they are, however, instructive as showing the rate of growth and the number of rings on one each of mean radius.

Year of Plantation.	Number of Rings counted.	Average Diameter of Section in Inches.		Rings per Inch of Average Radius.
		Wood.	Heartwood.	
South Canara (Parappa Plantation).				
Not known	10	9·	4·9	2·22
„	5	5·5	2·5	1·81
North Canara (Kalanadi Valley).				
Sulageri, 18 years old	18	8·	6·	4·5
	17	8·8	7·5	3·9
	17	9·	7·	3·7
Murdi, 12 years old	8	7·5	Heartwood not distinct.	2·1
	11	6·		3·7
	11	5·7		3·8
Kadra, 10 years old	8	6·5	...	2·5
	8	7·5	5·	2·1
	7	7·	4·	2·
Bengal (Bamunpokri).				
1868	8	6·5	2·5	2·5
1871	6	6·	1·	2·
1872	4	5·	1·	1·6
Andamans (Port Blair).				
1873*	6	10·1	6·	1·2

* The tree was probably older.

6. It will be noticed that as far as the data go, which are furnished by the sections received, Thinganneenoung and Bamunpokri exhibit an increase of diameter similar to that of Nelambur; while in the samples from North Canara the annual rings are much narrower and the specimen from Port Blair showed an extremely rapid rate of growth.

7. *Girth and Height at different Ages.*—The following measurements illustrate the rate of growth of Teak in plantations in different provinces as nearly as possible from 5 to 5 years. The Nelambur plantation again furnishes the largest amount of information :—

Age.	Mean Girth at Breast high.	Total height of Tree.
Nilambur Plantation.—Alluvial Soil.		
3— 7 years ...	12 inches... ...	29 feet.
8—12 „ ...	17 „	63 „
13—17 „ ...	23 „	68 „
18—22 „ ...	25 „	71 „
23—27 „ ...	27 „	77 „
29 „ ...	34 „	87 „
30 „ ...	35 „	85 „
31 „ ...	32 „	75 „
32 „ ...	34 „	92 „
33 „ ...	37 „	95 „

The growth at that early age is fairly good; but it does not follow from these figures that Teak in Assam and Sikkim will attain a great age, and produce good timber.

14. The following instances of older trees of known age in Assam and Bengal are on record :—

Locality.	Number of Trees measured.	Age in Years.	Mean Girth, in Inches.
Gauhati, banks of the Brahmaputra ...	15	37	85
Royal Botanical Gardens, Calcutta ...	19	6	16
Do. do. do.	8	70	79
Garden at Mohesh, Serampore	27	50	52

The trees at Gauhati were on an average 30—50 feet high.

The trees in the Botanical Garden, Calcutta, were measured in January 1856. The older trees have since been blown down by the cyclones of 1864 and 1867.

On the banks of the Hooghly at Mohesh, below Serampore, stands a grove of Teak trees planted in 1828. Their mean girth, breast high, taken by measuring 27 average-sized trees, was 52 inches. The trees were measured in January 1878, and were therefore 50 years old. They are from 40—50 feet high.

15. In paragraphs 177 and 183 of Dr. Schlich's Report for 1872-73, the dimensions of a large number of Teak trees at different stations of Lower Bengal are given; but unfortunately no trustworthy information regarding their age is available.

16. *Cubic Contents of Trees at different Ages.*—In paragraph 4 of Colonel Beddome's report a statement is given exhibiting the dimensions of the trees, sections of which were sent to the Paris Exhibition. As already stated, these trees were selected as samples of the dominant trees, viz., of those which will eventually be selected to remain on the ground as the ultimate crop; but, with few exceptions, they were not selected from among the largest individuals which had much outrun their neighbors. Arranging them in groups from 10 to 10 years, the following results are obtained :—

Age.	Height of Tree, in Feet.	Girth at Base, in Inches.	Length of Bole, in Feet.	Mean Cubic Contents, in Cubic Feet.
4—13 years	48—75	21—60	32—56	10·6
14—23 ,, ...	65—110	51—69	40—70	23·8
24—33 ,, ...	70—110	60—105	41—72	51·3

This gives us the cubic contents at different ages as follows :—

Mean Age.	Cubic Contents, in Cubic Feet.	Periodical Annual increment, in Cubic Feet.
9	10·6	1·1 to 9 years.
19	23·8	1·3 from 9 to 19 years.
29	51·3	2·8 from 19 to 29 years.

The annual increment increases steadily to the age of 30 years, and probably continues increasing for a considerable time beyond it.

17. *Number of Trees and Cubic Contents of growing Stock per Acre.*—Regarding the number of trees and the growing stock per acre at different ages, we depend almost entirely upon Nelambur for our data. Sample areas of half an acre each were selected in each of seven plantations; each tree was measured, the cubic contents determined, and the following is the result. It is not expressly stated, but it is probable, that these sample areas were all selected on alluvial soil :—*

Name and Year of Plantation.	Age of Plantation in Years.	Number of Trees per Acre.	Average Length of Bole in Feet.	Mean Quarter Girth of Trees, in Inches.	Cubical Contents in Cubic Feet.		Average Annual Increment, in Cubic Feet.	
					Per Tree.	Per Acre.	Per Tree.	Per Acre.
Travelly Kava ... 1844...	33	120	59	9·7	41	4,879	1·2	148
Elanjerry ... ... 1845...	32	158	61	7·9	30	4,742	·9	148
Elanjerry ... ... 1846...	31	156	60	7·4	27	4,204	·9	136
Moolathamanoo... 1847...	30	140	62	7·5	27	3,713	·9	124
Moolathamanoo... 1848...	29	156	60	6·8	21	3,243	·7	112
Elanjerry ... ... 1858...	19	270	45	5·0	8	2,203	·4	116
Wallashary ... 1868...	9	750	40	3·4	3	2,491	·4	277

18. Colonel Beddome estimates that on alluvial soil, the Teak at Nelambur will reach maturity at from 60 to 80 years; that fellings will be spread in each plantation over 50 years; and that at the time of cutting (say at 85 years of age) the mean quarter girth will be 2 feet, the length of bole will be 70 feet, and the mean cubic contents of each tree 280 cubic feet. He also estimates that at that age, there will only be 60 trees to the acre, making the cubic contents per acre 16,800 cubic feet.

No safe speculations can be formed regarding the future of a pure Teak forest like that of Nelambur. In its natural state, Teak does not grow alone, but is associated with bamboos and a variety of other trees; and it is impossible to foresee the risk of damage by storms, insects, disease, or other causes to which pure Teak Forests may be exposed. It may be doubted whether, even on the best alluvial soil, the average mean girth of trees 85 years of age will be as much as 8 feet. On the other hand, it is not impossible that the bole will be longer that 70 feet, and it is probable that it will be advantageous to allow more than sixty trees per acre. On page 155 of the Attaran Report of 1860, a plot in the Tsintsway forests (Yoonzaleen) is described, measuring 3,833 square feet, and stocked with eight Teak trees with clear stems to the first branch of 50 feet, the girth between 4′ 6″ and 6′ 5″; this would give ninety-one trees to the acre. Full stocked forests of Oak and Beech in Europe 130—180 years old under favorable conditions contain 120—140 trees per acre, with a cubic contents (including tops and branches) of about 11,000 cubic feet. A forest of silver fir in the Jura, 180 years old, was found to contain ninety-four trees per acre, with a cubic content of 16,000 feet.

19. The total area now stocked at Nelambur is 3,436 acres, of which 1,787 are stocked with a full crop on alluvial soil, the rest not being expected to yield a full crop. In his estimate of the future value of the plantations, Colonel Beddome only assumes 6,000 cubic feet as the full crop expected on alluvial soil.

* The length of stem to the top of sale measurement, where the head begins, of every tree in the plantations of 1844 to 1848, both inclusive, was measured by sending up a climber with a tape. In the plantations of 1858 and 1868 a large number of felled saplings were available, of which the average was taken.

The mean quarter girth was determined in the following manner: Ten saplings were measured breast high, and in the middle of the stem at half its length, and this gave ⅓ as the reducing factor. Those trees 30 inches in girth, breast high, were found to have a girth of 25 inches in the middle of the bole.

Govt. of [1878] Madras.

REVENUE.

To

THE CONSERVATOR OF FORESTS.

Dated November 25th.

Printed December 4th.

Read.

Encl.

CO., 25th *November* 1878, *No.* 1918.

NOVEMBER.

Nos. 344-345.

Growth of Teak.—Communicating to the Conservator of Forests circular from the Government of India relative to data in connection with the —, and requesting to state whether he communicated a copy of his report on the Nilambur Teak Plantations to the Inspector-General of Forests, and, if so, under what authority.

25-a Nov 1878, etc 1913

1

1913/6

Circular No. 61F.

6344 *Extract from the Proceedings of the Government of India in the Department of Revenue, Agriculture and Commerce,—dated Simla, the 21st October* 1878.

FORESTS.

READ the following—

Memorandum on the rate of growth of Teak by D. BRANDIS, *Inspector-General of Forests,—dated Simla, the 7th October* 1878.

CONTENTS.

	Para.	Page.
Introduction	1,	1
Annual rings...	3,	*ib.*
Girth and height at different ages	7,	3
Cubic contents of trees at different ages	16,	6
Number of trees and cubic contents of growing stock per acre	17,	*ib.*

For the Manual of Indian timbers, now under preparation, it was necessary to bring together all information available regarding the rate of growth of Teak, and it appears advisable to circulate the results at once with the view of eliciting further data in order to complete the account that will be given in the Manual. The following data were brought together with the assistance of Mr. A. Smythies, Assistant Conservator of Forests, Forest School Circle, North-Western Provinces.

2. A brief account of what was known regarding the rate of growth of Teak up to 1873, was given on pages 357-359 of the Forest Flora of North-West and Central India. Since then, further data have been collected; but the chief addition to our information on this subject has been made by the publication of Colonel Beddome's Report of 1878 on the Nilambur Teak plantations. The data here brought together in no way give a complete account of the rate and mode of growth of Teak, and doubtless much more information is available which has not yet been published. It is a most important subject, which should now be taken up separately in each province where Teak is cultivated on a large scale, and its study is earnestly recommended. The following remarks will most conveniently be grouped under the head of annual rings, girth and height at different ages, cubic contents of individual trees, and the number of trees and cubic contents of growing stock per acre. It will be remembered that the rate of growth of every species varies between wide limits according to climate, soil, and numerous other circumstances which affect the development of trees.

3. *Annual rings.*—It is now established beyond doubt that the concentric rings which are so marked in the wood of Teak correspond each to one year's growth. The following statement exhibits the rings counted on sections of trees grown in the Nilambur plantations, which were cut in 1877. The sections were taken from the base of the stem, and, with a few exceptions, the number of rings agrees with the age of the tree. The average diameter is the mean of three diameters. The statement shews the gradual increase of the heartwood as the tree grows older, and it also exhibits the number of rings on one inch of average radius in the wood of trees of different ages. But it must be borne in mind that these sections do not represent

In natural forests, where Teak is associated with bamboos and other trees, the number of first and second-class Teak trees (above 4′ 6″ in girth) rarely attains ten trees per acre over large areas. The following are instances of forests exceptionally well-stocked with Teak :—

Date of Survey.	Forest.	Area.	Number per Acre.		Total.
			Class.		
			Girth above 6 Feet.	Girth 4½ to 6 Feet.	
1876... ...	Bimaram (Central Provinces)	50 acres	4	4·3	8·3
1870-71 ...	Pegu (Prome District).	17 square miles.	3·6	3·0	6·6

RESOLUTION—

The Governor-General in Council directs that the above Memorandum be circulated for the information of all officers of the Forest Department, with the request that those officers who have any experience in the subject will be good enough to communicate any further data which they may possess, and any suggestions which they may wish to make, to the Inspector-General of Forests for incorporation in the Manual of the Structure, Qualities and Distribution of Indian timbers, now under preparation.

ORDER—

Ordered, that a copy of this Resolution be communicated for information and guidance to the Local Governments and Administrations noted in the margin, and to the Superintendent of Forest Surveys: also for information to the Comptroller-General.

Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Central Provinces.
British Burma.
Mysore and Coorg.
Ajmere.
Assam.
Hyderabad.

(True Extract.)

(Signed) C. L. TUPPER,
Offg. Under-Secretary to the Govt. of India.

No. 345. ORDER THEREON, 25th November 1878, No. 1,913.

Forests, No. 31.

COMMUNICATED to the Conservator of Forests who will also state whether he communicated a copy of his report on the Nelambur Teak Plantations to the Inspector-General of Forests, and, if so, under what authority.

(True Extract.)

(Signed) L. A. CAMPBELL,
Under-Secretary to Government.

To the Conservator of Forests.

Exd. W. H. French

1913
5

the average of each year's plantation, but were selected from among the dominant trees. They therefore exhibit a more rapid rate of growth than average specimens would do :--

Year of plantation.	Number of rings counted.	Average diameter of section (wood only.)	Average diameter of heartwood.	Rings per inch of average radius.
		In inches.	In inches.	
1844	33	20·8	19·3	3·17
1845	31	21·1	18·7	2·95
1846	31	20·	17·7	3·10
1847	30	23·8	21·5	2·52
1848	28	15·7	15·4	3·34
1849	28	18·1	16·2	3·09
1850	27	14·	12·5	3·85
1851	25	15·2	13·4	3·28
1852	32*	15·2	13·5	Omitted.
1853	24	15·1	12·	3·17
1854	24	17·3	15·2	2·77
1855	23	12·4	10·5	3·71
1856	21	15·2	12·6	2·76
1857	20	12·2	10·6	3·27
1858	19	14·	11·3	2·71
1859	18	14·	10·6	2·57
1860	17	12·9	10·4	2·63
1861	16	13·1	10·5	2·44
1862	15	11·7	9·	2·56
1863	14	13·6	10·4	2·06
1864	13	12·5	9·4	2·08
1865	12	9·4	6·9	2·55
1866	11	10·4	7·3	2·11
1867	10	11·8	8·3	1·69
1868	9	10·5	7·6	1·71
1869	8	7·4	4·8	2·16
1870	7	7·4	4·5	1·89
1871	7	7·7	4·3	1·81
1872	5	6·5	2·6	1·53
				Average 2·62 rings per inch of average radius.

* There is evidently a mistake here. The tree which yielded this section must have been an older tree standing in the plantation of 1852.

4. The sections ranged in age from 5 to 33 years. Dividing them into three groups, two of 10 years each, and the third of 9 years, we obtain the following as the mean diameter in inches of these three groups :—

		Inches.
Mean diameter of trees	5—14 years old	9·72
	15—24 „	13·79
	25—33 „	18·71

A section sent from the Thingannecnoung plantation in Burma, cut from a tree 21 years old, planted in 1856, gave 21 rings on a mean diameter of 16·3″, the heartwood of which occupied 14·5″. This section shewed 2·57 rings per inch of average radius.

5. From other plantations also, sections of Teak trees of known age were sent for the Paris Exhibition, but apparently they were not in all cases cut from the base of the stem; they are, however, instructive as shewing the rate of growth and the number of rings on one inch of mean radius.

Year of plantation.	Number of rings counted.	Average diameter of section in inches.		Rings per inch of average radius.
		Wood.	Heartwood.	
South Kanara (Parappa plantation).				
Not known	10	9·	4·9	2·22
„	5	5·5	2·5	1·81
North Kanara (Kalanadi valley).				
Sulageri. 18 years old	18	8·	6·	4·5
	17	8·8	7·5	3·9
	17	9·	7·	3·7
Murdi, 12 years old	8	7·5	Heartwood not distinct.	2·1
	11	6·		3·7
	11	5·7		3·8
Kadra, 10 years old	8	6·5	...	2·5
	8	7·5	5·	2·1
	7	7·	4·	2·
Bengal (Bamunpokri).				
1868	8	6·5	2·5	2·5
1871	6	6·	1·	2·
1872	4	5·	1·	1·6
Andamans (Port Blair).				
1873*	6	10·1	6·	1·2

* The tree was probably older.

6. It will be noticed that as far as the data go, which are furnished by the sections received. Thinganneenoung and Bamunpokri exhibit an increase of diameter similar to that of Nilambur; while in the samples from North Kanara the annual rings are much narrower and the specimen from Port Blair shewed an extremely rapid rate of growth.

7. *Girth and height at different ages.*—The following measurements illustrate the rate of growth of Teak in plantations in different provinces as nearly as possible from 5 to 5 years. The Nilambur plantation again furnishes the largest amount of information :—

Age.	Mean girth at breast high.	Total height of tree.
Nilambur plantation.—Alluvial soil.		
3—7 years	12 inches	29 feet.
8—12 „	17 „	63 „
13—17 „	23 „	68 „
18—22 „	25 „	71 „

Age.	Mean girth at breast high.	Total height of tree.
Nilambur plantation.—Alluvial soil—continued.		
23—27 years	27 inches	77 feet
29 „	34 „	87 „
30 „	35 „	85 „
31 „	32 „	75 „
32 „	34 „	92 „
33 „	37 „	95 „
Nilambur plantation.—Gneiss and laterite.		
7 years	13 inches	30 feet.
16 „	14 „	50 „
20 „	21 „	50 „
24—26 „	22 „	52 „
30 „	24 „	50 „

These figures are taken from that portion of Colonel Beddome's report (paragraphs 11—44) which contains his notes on each year's plantation, and the data recorded are stated to be average figures.

8. In another part of his report (paragraph 81), however, he gives data which would seem to shew that the average size of the trees in the older plantations (all on alluvial soil) is considerably greater. He there states the dimensions of the largest, smallest and medium sized trees in four plantations, the results being as follows :—

Age.	Mean girth (probably breast high.)			Length of bole.		
	Largest.	Medium.	Smallest.	Largest.	Medium.	Smallest.
	Inches.	Inches.	Inches.	Feet.	Feet.	Feet.
30 years	67	47	29	79	65	50
31 „	69	49	30	80	65	50
32 „	63	46	30	83	67	50
33 „	68	56	43	86	68	50

The first three lines shew the average of 6 trees in each case, and the last line the average of 8 trees each. It is distinctly stated that the length is that of the bole, and not of the entire tree.

The plantations made on gneiss and laterite shew a much slower rate of growth than those on alluvial soil; the difference being considerable in height, and much less in girth.

9. Up to 10 years of age, the growth in length of teak on alluvial soil at Nilambur is at the rate of about 6 feet a year, and later on it is at the rate of only about 1 foot a year. On page 358 of the Forest Flora of North-West and Central India, it is stated "that it is probable that, as a rule, teak attains half its length with a girth of 2—3 feet." This assumption is borne out by the present figures. The trees grown upon alluvial soil in girth between 25 and 34 inches are from 77 to 87 feet high; and from all that is known regarding the growth of Teak in similar localities, it is probable that, unless damaged by storms, disease, insects, or other causes, they will attain a height of 150 feet in soil of this description, and in the climate of Nilambur.

1913

10. From Burma, we have the following data. The figures from Pegu represent averages of plantations in the Rangoon, Toungoo and Tharawaddee districts, brought together on page 358 of the Forest Flora of North-West and Central India.

	Age, in years.	Mean girth, breast high, in inches.	Total height of tree, in feet.
Pegu	4	5—9	15—27
	10	15	40—45
	15	23	...
Thinganneenoung	21	27	50—60
Garden—Moulmein	22	40	...

The fourth line is the average of 150 trees in the Thinganneenoung plantation in the Attaran district of Tenasserim, given in paragraph 146 of the report for 1876-77 of the Tenasserim forests. Major Seaton gives the average height at 30—40 feet, but this probably means the height to the first branch. The maximum girth was 55½ inches. The average rate of growth of the present plantations in Burma is somewhat less rapid than that of the alluvial portion of Nilambur. The last line gives the average of 15 trees measured in 1856 in a private garden at Moulmein. An instance of extremely rapid growth was the tree already mentioned, a section of which was sent from Port Blair for the Paris Exhibition, probably 6 years' old (said to have been planted in 1873, but 6 rings were counted), with a girth of 36 inches and a height of 44 feet.

11. For the Lakvalli plantation in Mysore, the following data are given in Captain Van Someren's report for 1875-76. Age 13—15 years, mean girth 14 inches, height 32 feet. This is a remarkably slow rate of growth, *considering that the soil is good, and the climate moist,* though of course not so forcing as the climate of Nilambur.

12. The plantations in the Central Provinces and Berar have given the following :—

Plantation.	Age, in years.	Mean girth, breast high, in inches.	Total height of tree, in feet.
Machna, Central Provinces	6	7	15—22
Pili, Berar	6	4	10
Sakata, Central Provinces	7	11	20—25
Pili, Berar	8	8	20
Sonawani, Central Provinces	9	12	30—40
Machna, Central Provinces	8—10	9	17—30

Compared with Malabar and Burma, the rate of growth is slow, as may be expected in a dry climate and near the northern limit of the tree.

13. Outside the range of the natural growth of teak, the following data, regarding its rate of growth, are available :—

Plantation.	Age, in years.	Mean girth, breast high, in inches.	Total height of tree, in feet.
Bamunpokri (Sikkim)	5	5·5	12—15
Kulsi (Assam)	5	11	29
Makúm „	4	9	18
„ „	5	11	27
„ „	7	16	31

The growth at that early age is fairly good; but it does not follow from these figures that teak in Assam and Sikkim will attain a great age, and produce good timber.

14. The following instances of older trees of known age in Assam and Bengal are on record :—

Locality.	Number of trees measured.	Age, in years.	Mean girth, in inches.
Gauhati, banks of the Brahmaputra	15	37	85
Royal Botanical Gardens, Calcutta	19	6	16
Ditto ditto	8	70	79
Garden at Mohesh, Serampore	27	50	52

The trees at Gauhati were on an average 30—50 feet high.

The trees in the Botanical Garden, Calcutta, were measured in January 1856. The older trees have since been blown down by the cyclones of 1864 and 1867.

On the banks of the Hooghly at Mohesh, below Serampore, stands a grove of teak trees planted in 1828. Their mean girth, breast high, taken by measuring 27 average-sized trees, was 52 inches. The trees were measured in January 1878, and were therefore 50 years old. They are from 40—50 feet high.

15. In paragraphs 177 and 183 of Dr. Schlich's report for 1872-73, the dimensions of a large number of Teak trees at different stations of Lower Bengal are given; but unfortunately no trustworthy information regarding their age is available.

16. *Cubic contents of trees at different ages.*—In paragraph 4 of Colonel Beddome's report a statement is given exhibiting the dimensions of the trees, sections of which were sent to the Paris Exhibition. As already stated, these trees were selected as samples of the dominant trees, *viz.*, of those which will eventually be selected to remain on the ground as the ultimate crop; but, with few exceptions, they were not selected from among the largest individuals which had much outrun their neighbours. Arranging them in groups from 10 to 10 years, the following results are obtained :—

Age.	Height of tree, in feet.	Girth at base, in inches.	Length of bole, in feet.	Mean cubic contents, in cubic feet.
4—13 years	48—75	21—60	32—56	10·6
14—23 „	65—110	51—69	40—70	23·8
24—33 „	70—110	60—105	41—72	51·3

This gives us the cubic contents at different ages as follows :—

Mean age.	Cubic contents, in cubic feet.	Periodical annual increment, in cubic feet.
9	10·6	1·1 to 9 years.
19	23·8	1·3 from 9 to 19 years.
29	51·3	2·8 from 19 to 29 years.

The annual increment increases steadily to the age of 30 years, and probably continues increasing for a considerable time beyond it.

17. *Number of trees and cubic contents of growing stock per acre.*—Regarding the number of trees and the growing stock per acre at different ages, we depend almost entirely upon

Nilambur for our data. Sample areas of half an acre each were selected in each of seven plantations; each tree was measured, the cubic contents determined, and the following is the result. It is not expressly stated, but it is probable, that these sample areas were all selected on alluvial soil :—*

Name and year of plantation.	Age of plantation, in years.	Number of trees, per acre.	Average length of bole, in feet.	Mean quarter girth of trees, in inches.	Cubical contents in cubic feet.		Average annual increment, in cubic feet.	
					Per tree.	Per acre.	Per tree.	Per acre.
Travelly Kava ... 1844 ...	33	120	59	9·7	41	4,879	1·2	148
Elanjerry ... 1845 ...	32	158	61	7·9	30	4,742	·9	148
Elanjerry ... 1846 ...	31	156	60	7·4	27	4,204	·9	136
Moolathamanoo ... 1847 ...	30	140	62	7·5	27	3,713	·9	124
Moolathamanoo ... 1848 ...	29	156	60	6·8	21	3,243	·7	112
Elanjerry ... 1858 ...	19	270	45	5·0	8	2,203	·4	116
Wallashary ... 1868 ...	9	750	40	3·4	3	2,491	·4	277

18. Colonel Beddome estimates that on alluvial soil, the Teak at Nilambur will reach maturity at from 60 to 80 years; that fellings will be spread in each plantation over 50 years; and that at the time of cutting (say at 85 years of age) the mean quarter girth will be 2 feet, the length of bole will be 70 feet, and the mean cubic contents of each tree 280 cubic feet. He also estimates that at that age, there will only be 60 trees to the acre, making the cubic contents per acre 16,800 cubic feet.

No safe speculations can be formed regarding the future of a pure Teak forest like that of Nilambur. In its natural state, Teak does not grow alone, but is associated with bamboos and a variety of other trees; and it is impossible to foresee the risk of damage by storms, insects, disease, or other causes to which pure Teak forests may be exposed. It may be doubted whether, even on the best alluvial soil, the average mean girth of trees 85 years of age will be as much as 8 feet. On the other hand, it is not impossible that the bole will be longer than 70 feet, and it is probable that it will be advantageous to allow more than 60 trees per acre. On page 155 of the Attaran Report of 1860, a plot in the Tsintsway forests (Yoonzaleen) is described, measuring 3,833 square feet, and stocked with 8 Teak trees with clear stems to the first branch of 50 feet, the girth between 4′ 6″ and 6′ 5″; this would give 91 trees to the acre. Full stocked forests of Oak and Beech in Europe 130—180 years old under favourable conditions contain 120—140 trees per acre, with a cubic contents (including tops and branches) of about 11,000 cubic feet. A forest of silver fir in the Jura, 180 years old, was found to contain 94 trees per acre, with a cubic content of 16,000 feet.

19. The total area now stocked at Nilambur is 3,436 acres, of which 1,787 are stocked with a full crop on alluvial soil, the rest not being expected to yield a full crop. In his estimate of the future value of the plantations, Colonel Beddome only assumes 6,000 cubic feet as the full crop expected on alluvial soil.

In natural forests, where Teak is associated with bamboos and other trees, the number of first and second class Teak trees (above 4′ 6″ in girth) rarely attains 10 trees per

* The length of stem to the top of sale measurement, where the head begins, of every tree in the plantations of 1844 to 1848, both inclusive, was measured by sending up a climber with a tape. In the plantations of 1858 and 1868 a large number of felled saplings were available, of which the average was taken.

The mean quarter girth was determined in the following manner. Ten saplings were measured breast high, and in the middle of the stem at half its length, and this gave $\frac{8}{9}$ as the reducing factor. Those trees 30 inches in girth breast high were found to have a girth of 25 inches in the middle of the bole.

acre over large areas. The following are instances of forests exceptionally well-stocked with Teak :—

Date of survey,	Forest.	Area.	Number per acre.		Total.
			Class.		
			Girth above 6 feet	Girth 4½ to 6 feet.	
1876 ...	Bimaram (Central Provinces)...	50 acres ...	4	4·3	8·3
1870-71 ...	Pegu (Prome District) ...	17 square miles	3·6	3·0	6·6

Resolution—

The Governor General in Council directs that the above Memorandum be circulated for the information of all officers of the Forest Department, with the request that those officers who have any experience in the subject will be good enough to communicate any further data which they may possess, and any suggestions which they may wish to make, to the Inspector-General of Forests for incorporation in the Manual of the Structure, Qualities and Distribution of Indian timbers, now under preparation.

Order—

Ordered, that a copy of this Resolution be communicated for information and guidance to the Local Governments and Administrations noted in the margin, and to the Superintendent of Forest Surveys: also for information to the Comptroller-General.

Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Central Provinces.
British Burma.
Mysore and Coorg.
Ajmere.
Assam.
Hyderabad.

(True Extract.)

C L Tupper

Offg. Under-Secretary to the Government of India.

F.

The Secretary to the
Government of Madras

Revenue Deptt

No 5036.
1878.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE,
AGRICULTURE AND COMMERCE.

FORESTS.

RESOLUTION.

Circular No. 61F.

Dated Simla, the 21*st October* 1878.

SUBJECT.

CIRCULATES a Memorandum by the Inspector-General of Forests on the rate of growth of Teak, with a request that all Forest officers who have had special experience on the subject will communicate any further data they may possess and any suggestions to Mr. Brandis for incorporation in the Manual on the structure, qualities and distribution of Indian timbers now under preparation.

Govt. Central Branch Press, Simla.—No. 655 R., A. & C.—24-10-78—250.