

REPORT ON THE GOVT.
EXPERIMENTAL RUBBER PLANTATIONS
IN THE BOMBAY PRESIDENCY

S. I. S.

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* Photographs, Map, and Plans, not reproduced.

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‡ Enclosed within an envelope (with MS copy of Report).

REPORT ON THE GOVERNMENT EXPERIMENTAL RUBBER PLANTATIONS IN THE BOMBAY PRESIDENCY.

INTRODUCTORY REMARKS.

1. In accordance with the orders of Government I was deputed to inspect and report on the Experimental Rubber Plantations in the Bombay Presidency. I accordingly left Coonoor on the 4th May 1909, and reached Mangalore at 10 p. m. the following day *en route* to Gairsoppah. Owing, however, to the cyclonic storm which occurred, I was storm-bound at Mangalore till the arrival of a steamer on which I embarked and which sailed on the 13th idem for Kumta. I arrived at Kumta at about 10 p. m. on the 14th and proceeded to Honawar, 12 miles distant, the following morning (15th), where I was met by Mr. Copleston, the Divisional Forest Officer, S. D., Kanara. On the 16th Mr. Copleston took me by boat up the Shrivati river, 20 miles, to Gairsoppah, where the principal rubber plantations are situated, and showed me over them on the 16th, 17th, and 18th May.

2. *Origin of the Plantations.*—The idea of starting rubber plantations in the Presidency originated by the Bombay Chamber of Commerce bringing the importance of the question to the notice of Government. The Government took a favourable view of the matter and decided, in the early part of the year 1906, to open a few experimental rubber plantations in different parts of the Presidency. The necessary arrangements were consequently made for the Forest Department to open plantations at Gairsoppah in the Southern Division, and at Kadra in the Northern Division, of the District of North Kanara; at Mulund in South Thana and at Pelbar in North Thana. Rubber trees were also planted in the Bassein Fort Botanical Garden and a few odd trees in different places in the Presidency about the same period.

GAIRSOPPAH RUBBER PLANTATIONS.

3. *Situation.*—Gairsoppah village is situated at the foot of the Ghats about 20 miles inland from Honawar up and on the north bank of the Shrivati river and about 251 miles by road from Bangalore. Two clearings have been made in the locality for growing rubber — one (*a*) about 70 acres in extent being on the site of Old Gairsoppah, formerly a Jain town of considerable size and importance, and the other (*b*), also about 70 acres in extent, in the Holegar coupe of Kabbinhakkal Forest near the 250th mile, and on the south-eastern side of the road from Bangalore. Old Gairsoppah lies on the south side of the Shrivati river near the tidal limit on a fairly level piece of ground about a mile or more above the present village of Gairsoppah. The new clearing in Holegar coupe is on the north side of the river about one mile from New Gairsoppah and about two and a half miles from Old Gairsoppah. It is chiefly on the irregular north-western and northern slope of a hill, the highest point of which is 390 feet high (*vide* paras 22 to 26 and photo No. 8).

The situation of Old Gairsoppah and Holegar are shown on the accompanying map (*vide* Appendix IV).

4. *Temperature.*—While at Gairsoppah in May 1909, I took the following temperatures:—

By my Thermometer.				By the Plantation Thermometer.			
Date.	Hour.	Temperature recorded.	Remarks.	Date.	Hour.	Temperature recorded.	Remarks.
May 16	8 p.m.	84½°	Outside in the open at the District Officer's bungalow.	...	...	...
	9 p.m.	83°	Do.	...	...	...
	10-25 p.m.	78°	Do.	...	...	...
" 17	6 a.m.	75½°	Do.	...	...	...
	7 a.m.	78½°	Do.	...	...	...
	9 a.m.	88°	In the rubber plantation under the shade of trees.	May 17	9 a.m.	84°	} Under the heavy shade of the verandah of the plantation store, with air blowing through the house.
	11-15 a.m.	91°	Do.	Do.	11-15 a.m.	89°	
	12 noon.	96°	Do.	Do.	12 noon.	92°	
	4 p.m.	92°	In the verandah of the District Officer's bungalow.	...	...	...

Note.—The temperature of Honawar is—Maximum 88°, minimum 84° (*vide* Appendix V).

The following statement shows the monthly minimum and maximum Temperatures, and dates on which they were recorded, at the Government Experimental Rubber Plantation, Gairsoppah (taken from the Register of Weather Observations maintained at Gairsoppah).

Month.	1908.				1909.				Remarks.
	Minimum.	Dates on which minimum temperatures were recorded.	Maximum.	Dates on which maximum temperatures were recorded.	Minimum.	Dates on which minimum temperatures were recorded.	Maximum.	Dates on which maximum temperatures were recorded.	
January ...	60°	24th, 25th	93°	31st	58°	13th, 14th	106°	29th	Mr. Copleston informed me that the temperatures were taken at a place covered with palm leaves in the plantation until quite recently; but, as he considered the readings to be too high, he has had the thermometer placed in the verandah of the plantation store where the temperatures are now taken. * Up to the 17th May only.
February...	58°	12th	108°	26th	58°	3rd	103°	15th	
March ...	58°	2nd	105°	27th	70°	3rd, 7th	110°	3rd	
April ...	70°	14th	106°	6th, 15th, and 30th	74°	24th	106°	3rd	
May ...	76°	5th, 19th	104°	1st	76°	8th	98°	4th*	
June ...	73°	30th	100°	9th					
July ...	72°	24th	87°	9th					
August ...	72°	5th, 30th, and 31st	86°	14th, 27th, 28th, 29th					
September.	72°	11th, 12th	87°	30th					
October ...	70°	23rd	92°	24th, 25th, 26th, 27th					
November.	53°	23rd	91°	3rd, 29th, and 30th					
December.	51°	29th	100°	25th, 26th					

It will be observed that the highest recorded temperature was 110° in March, while the lowest was 51° in December (*vide* also Appendix V).

Upon the whole, Gairsoppah enjoys a temperature suitable for growing rubber.

5. *Rainfall and Humidity*: (a) *Rainfall*.—The following is an abstract showing the rainfall recorded at the plantation since June 1907, up to the middle of May 1909 (taken from the weather observations maintained at the plantation, *vide* also Appendices VI and VII):—

	1907.	1908.	1909.
January	100 (probably).	<i>Nil</i>	<i>Nil</i>
February		<i>Nil</i>	<i>Nil</i>
March	...	<i>Nil</i>	0·09
April	...	<i>Nil</i>	<i>Nil</i>
May	...	1·26	3·90
June	41·26	36·33	...
July	80·40	105·32	...
August	55·65	53·79	...
September	9·85	4·78	...
October	Remark: not much rain.	2·24	...
November		<i>Nil</i>	...
December	<i>Nil</i>	<i>Nil</i>	...
Total	...	203·72	

Note.—The average annual rainfall at Honawar in 11 years (1892—1902) was 140·42 inches, *vide* page 18 of the 2nd edition of the Statistical Atlas of the Bombay Presidency.

(b) *Humidity*.—The Ranger in charge of the plantation has drawn up a comparative statement (*vide* Appendix XII) showing the average rainfall, temperature, and humidity of the undermentioned rubber-growing countries in the East. Provided the figures are correct, the averages are as follow:—

	Singapore.	Malacca (F. M. States).	Kelani Valley, Ceylon.	Gairsoppah.
Rainfall	91 inches	84 inches	161 in.	204 inches (in 1908)
Temperature	79°	79°	80°	82°
Humidity	Average 79° Highest 81 per cent. in Jan. and Nov. Lowest 77 per cent. in March.	Average 93° Highest 94 per cent. in Jan., May, June, July, Aug., Oct., and Nov. Lowest 92 per cent. in Feb., Sept., and Dec.	...	Average 79° Highest 96 per cent. in Dec. Lowest 60 per cent. in March.

It may therefore be taken that the average rainfall and humidity at Gairsoppah are sufficient for the growth of rubber. (The chief drawback however is that they are not very evenly distributed over the different months of the year.)

6. *Soil*.—Mr. Talbot informs me that a great part of Kanara consists of metamorphic schists and outcrops of gneiss with laterite here and there.

The prevailing characteristic of the soil at Old Gairsoppah is that it is chiefly, although not entirely, of laterite origin.

An examination of the list (Appendix II) and of the soil samples submitted shows that they vary from fine, rich alluvium to coarse, gravelly laterite. Nos. 1 to 8 are from the Old Gairsoppah Plantation; No. 9 is from the Para Rubber No. 2 Nursery on an island across the Kalkatti nullah at the south-east side of the plantation (*vide* para 17); Nos. 10 and 11 are from the island which is situated on the opposite side of the Kalkatti nullah to, and a little below, the chief or No. 1 Nursery; while Nos. 12 to 15 are from the 70-acre clearing in Hologar coupe in Kabbinhakkal Forest (*vide* paras 22 to 26) about two miles distant from the Old Gairsoppah Plantation.

Samples Nos. 1, 2, 3, 4, 9, 10, and 11 are all excellent alluvial soils very suitable for rubber; Nos. 5 and 6 are not so good, as they contain a good deal of small gravel; while Nos. 7 and 8 are hard, coarse laterite gravel, which is not good for the growth of rubbers. The alluvial soils are found chiefly along the banks of the Kalkatti nullah, while patches of the poorer laterite soil are found over a considerable area about the central part of the plantation. It would therefore not be advisable to attempt to plant Para rubber in such soil as is shown in samples 7 and 8 unless large pits are made and filled with good soil (*vide* para 30). Ceara rubber would, however, be more likely than Para to thrive in such bad soil (*vide* para 39).

7. *Importation of Seed.*—Operations were commenced at Old Gairsoppah in July 1906 by the importation of 5,400 seeds of *Castilloa elastica* from Ceylon. These seeds were sown in a nursery which was made near the Narayan temple marked No. 1 in the plantation—*vide* para 27 of the plantation book and plan of the plantations (Appendix IV.)

Consignments of 12,900 Para and 6,000 Ceara seed were subsequently imported and sown in the nurseries in September 1906. In 1907 the following seeds were imported and sown: in June 20,000 *Castilloa*; in September 40,000 Para; and in October 10,000 Ceara; while in June 1908, 2,000 Ceara seeds were sown.

In March 1908 a quarter pound of seed of *Cryptostegia grandiflora* was sown. In round numbers 38,300 Para, 18,000 *Castilloa*, and 7,450 Ceara plants resulted from the different sowings of seed (*vide* Appendix VIII).

8. *Fencing.*—The planted and unplanted area of the plantation is enclosed by a wire fence to keep out, as far as possible, animals that are likely to damage the rubber trees. Hares are reported by the Ranger to be troublesome as they cut off the stems of the young Para just above the collar. Porcupines also do damage and so do sambhur when they can gain access to the rubber trees.

9. *Clearing.*—The felling and clearing of the forest was done by contract, as detailed in the plantation book. At first the good timber was removed and the branches and brushwood were burnt. This year, however, Mr. Coppleston has had all the branches and useless material heaped in lines between the lines of pits with the object of allowing them to decay and form vegetable mould. In this way not only will the latter object be accomplished, but the vastly more important one will be gained, of saving the leaf-mould which has gradually been accumulating during the long period since vegetation began to cover the ruins of the old Jain town among which the plantation clearing has been made.

The question of the preservation of vegetable mould, which has taken perhaps a hundred or several hundred years to accumulate, on lands that are to be brought into cultivation, is a very important one that is worthy of greater consideration than it usually receives (*vide* also para 25 below).

10. *Pitting.*—About half the area of the plantation has been pitted at 10' × 10' and about half at 15' × 10' and 15' × 15', respectively. Pitting at the latter distance was in progress at the time of my visit. Where the ruins of the old Jain town are much in evidence (*vide* photo No. 1) pitting is rather difficult on account of the abnormal number of stones that are met with belonging to the old buildings. Prior to the time of my visit, the pits in which failures had occurred had been reopened. I therefore had a good opportunity of seeing the size of the pits as well as seeing the general nature of the soil over practically the whole area of the plantation. It is recorded in the plantation book that the pits were made 24" × 24" × 18", by contract.

I had a good many pits measured and the sizes varied from 16 to 24 inches in diameter at the top and from 10 to 15 inches at the bottom and from 15 to 16 inches in depth. Very few pits, indeed, exceeded these measurements, nor could I find any that was of the size ordered and contracted for, namely, 24" × 24" × 18". Most of the pits I saw were altogether too small, being merely scooped-out cup-shaped holes in which the plants are certainly never likely to have a fair chance, and more especially where the soil is inclined to be hard, gravelly laterite (*vide* para 13). It is chiefly along the banks of the nullah that good alluvial soil is found.

I pointed out to Mr. Copplestone that I thought the pits were altogether too small and that much larger pits should be dug if the rubber trees are to have a proper chance to grow with any prospect of success. On the 17th May, at my suggestion, Mr. Coppleston had a pit dug among the teak trees near the nursery and cooly lines in order that I might give the men a practical demonstration of the approximate size and depth of pit which I recommend should be made for rubber trees (*vide* para 30).

11. *Planting*.—In 1907 the first plantings in the plantation were made 10' × 10', on a comparatively small scale, when only 178 Para and 2 *Castilloa* were put out in June; and in August, 164 Cearas were planted out under the teak trees near the nursery as well as in the nursery.

Clearing and pitting operations were continued and preparations were made for larger plantings in June the following season, when 17,472 Para, 1,827 Ceara, 1,350 *Castilloa*, and 1,128 *Cryptostegia* were put out in the plantation.

Both the 1907 and 1908 plantings were made on the following blocks and areas:—

A	...	15 acres (abandoned).
D	...	10 acres (abandoned— <i>vide</i> para 18 below).
E	...	5 acres.
F	...	40 acres.
G	...	10 acres.
Total		80 acres.

Owing to the secondary jungle undergrowth (*vide* photos Nos. 1, 2, and 3), it was not possible in the short time at my disposal to count the number of rubber trees alive in the plantation.

I was not shown Block D, but Mr. Coppleston informed me that all the 1,350 *Castilloa* rubber trees which were planted in 1908 in the cleared strips in the jungle in this block had been completely eaten up by animals by October last; that the area had become overgrown with jungle, and that it had been decided to abandon it (*cf.* para 19).

Mr. Coppleston informed me that about 15,000 basketed plants, which had been raised from seed sown in October 1907, were planted in June 1908, the resultant plants having been planted in baskets and grown in the nursery for eight months.

Owing, however, to a heavy percentage of failures, estimated by Mr. Coppleston to amount to from 50 per cent on the alluvial to 75 per cent on the laterite soil, the total number of rubber trees existing in the plantation will be very considerably less than the figures quoted above. Mr. Coppleston attributes this heavy mortality to the prolonged drought and to the extreme difficulty of supervising the work efficiently, which, by the way, he informs me, has had to be left in a very large measure to the care of subordinates on the spot (*vide* para 29).

12. *Shade*.—A few rain trees, *Pithecolobium saman*, *Erythrina indica*, and *Cassia siamea*, have been planted between the rubber as shade trees, but I do not think any of them are as suitable as *Trema orientalis* (*vide* para 14) or as *Musa textilis* (*vide* paras 35 and 38).

13. *General appearance of the Plants in the Plantation*.—It was unfortunate that rain had fallen (*vide* the first statement in para 5 above) a short time before I visited the Old Gairsoppah plantation, as I was deprived of the

opportunity of seeing the rubber trees after they had experienced a long period of drought which, Mr. Copleston says, lasts from October to June, and which is the most serious drawback in growing the rubber trees. The greater part of the area which has been planted is covered with a secondary growth of jungle, which made it by no means easy to inspect the rubber trees that are alive (*vide* photos 1, 2, and 3).

Except where they have been planted on alluvial soil, along the side of the nullah, the plants in the plantation generally have, with few exceptions, made rather poor growth. There has been a great number of failures among them, especially on the laterite soil, amounting to about 70 to 75 per cent, while only about 25 to 30 per cent have survived.

In the gravelly, laterite ground about the middle of the plantation a fair number of healthy-looking rubber plants of Para are to be seen, although they have not yet made much growth. In the alluvial soil along the side of the nullah the plants have made better growth and are more promising than those which have been planted in the former kind of ground.

The heavy mortality above referred to is due to a combination of untoward circumstances, such as—

- (a) the gravelly, laterite ground which occurs over an area in the centre of the plantation;
- (b) the small pits in which the plants were planted;
- (c) deficient watering;
- (d) the want of proper shade, cultivation, and individual attention since they were planted (*vide* para 29).

The failures ought to have been filled in as they occurred and the supplies should have been shaded and watered till they became established. Instead of doing so, apparently nothing was done once the monsoon planting was finished, the idea being to fill in all failures during the next monsoon season, which would mean, approximately, a year lost. The old pits had, however, been re-opened just before the time of my visit for the purpose of filling in the past year's failures as soon as the approaching monsoon set in.

14. *Hevea brasiliensis*, Muell, Arg. (Para rubber).—The general appearance of the Para plants that are alive in the plantation (*vide* photos Nos. 3, 6, and 7) is fair, considering that they have had practically little or no attention paid to them since they were planted.

The following are the measurements which I had taken of 50 Para plants in different parts of the plantation as we walked through it, excluding those growing in the teak plantation and in the nursery. The plants had not been watered by hand since they were planted:—

Serial No.	Height.	Serial No.	Height.	Serial No.	Height.
	Ft. in.		Ft. in.		Ft. in.
1	3 3	18	3 6	35	3 3
2	2 6 on a high stony ridge.	19	4 3	36	2 10
3	2 10 near by on level.	20	2 9	37	2 5
4	3 3	21	2 5	38	3 2
5	2 4	22	2 5	39	2 10
6	2 3	23	3 2	40	3 7
7	2 8	24	3 0	41	2 8
8	2 5	25	3 6	42	3 10
9	2 4	26	3 7	43	3 1
10	3 3	27	3 7	44	3 4
11	2 8	28	3 0	45	3 3
12	2 3½	29	3 0	46	4 0
13	2 6	30	3 6	47	3 3
14	3 5	31	1 7	48	3 10
15	2 11	32	3 2	49	4 0
16	2 6	33	2 9	50	2 9
17	2 9	34	3 5		

The average height of the above 50 plants, which are 20 months old from seed, is 3 feet, which is, I think, fair growth under the circumstances mentioned above.

The alluvial flat at the south-east corner of the plantation (*vide* soil samples Nos. 1 and 2) was inundated by a flood last year, but the rubber trees do not appear to have suffered from the effects of it (*vide* photo No. 3).

On the 17th May I took measurements of 25 Para plants which were planted on this alluvial flat in June 1908 and the average height of them was found to be 3'85, the tallest plant being 6 feet 3 inches.

Those which were planted in June 1907, under the teak trees, are quite tall plants and are looking well. They vary in height from 3 feet to about 8 feet, the average being about 5½ feet (*vide* photo No. 7).

I would, however, deprecate planting Para rubber under the shade of other species of trees, such as teak for instance, as the rubber plants are soon likely to become tall and leggy and have small crowns. There are a good many nicely-shaped, healthy plants growing in alluvial soil between the teak trees and the nullah near the nursery (*vide* photo No. 6). Adjacent to the latter and to the rubber among the teak trees is a larger area occupied by Para rubber trees which are shaded by *Trema orientalis*, an indigenous species, which makes an excellent light shade, but it is necessary to keep it under control by judicious thinning and lopping (*vide* para 12 and back-ground of photo No. 6).

15. There is a fine specimen of a Para planted in October 1908 in front of the cooly line on the outer edge of the verandah. The height of the plant is now 6' 10", and its girth at one foot from the ground is 2". Height when planted 4'; growth since, 2' 10". The pit it is growing in was made 2' x 2' x 1½' in depth. The plant has been regularly watered and mulched with leaves. It is a splendid specimen. If every plant in the plantation had been looked after as well as this one, the result would have been thoroughly satisfactory. An effort should therefore be made to treat all the plants in the plantation with similar care and attention.

16. *No. 1 Nursery*.—There is a large nursery, lightly shaded by a few teak and other indigenous forest trees on the side of the Kalkatti nullah. It contains a large number of young Para plants in beds, a few tall Para and a few *Castilloa* trees. The soil is rich alluvial of great depth.

The following are the measurements of a few of the best Para trees that are growing in the nursery (*vide* photo No. 4):—

(a) Raised from seed sown on the 3rd September 1906:—

	Height.		Girth at 4 feet from the ground.	Remarks.
	Ft.	in.	Ft. in.	
Tree No. 1	22	3	0 6½	Looks remarkably well.
Do. 2	20	0	0 6¾	Do do.
Do. 3	10	3	0 2¾	Top eaten off twice by monkeys.
Do. 4	15	9	0 4½	Main shoot died back owing to flood.
Do. 5	Not found			
Do. 6	18	6	0 4¾	Damaged by floods.
Do. 7	30	0	0 6¾	
Do. 8	18	0	0 6¼	
Average ...	19	3	0 5½	

(b) Plants raised from seed received in September 1907, and watered:—

Tree No. 13	11	6	0 2½
Do. 14	10	9	0 2¼
Do. 15	12	3	0 3½
Do. 16	14	0	0 ½
Nil	15	0	0 3¾
Nil	13	2	0 3
Nil	11	9	0 2¾
Average ...	12	7½	0 2¾

The nursery contains, according to Mr. Copleston's estimate, about 8,000 Para plants, which vary from about 2 to 12 feet in height. These plants have been raised from seed sown in September 1907, and present a fine, robust, healthy appearance, as will be seen from photos Nos. 4 and 5. They have not been watered during the past dry season, but have, by Mr. Copleston's orders, had a good top-dressing of good soil, as a mulch, to conserve the moisture in, and to prevent evaporation from the soil during the dry hot weather. This is quite a sound practice and should be carried out in regard to all young rubber plants in the plantation till they become well established. The robust, thriving, healthy condition of these Para plants affords proof beyond all doubt that this species will, if properly looked after in the plantation, succeed in the climate of Gairsoppah.

17. *No. 2 Nursery*.—There is also a nursery containing several thousand plants of Para under the rather dense, high shade of forest trees on an alluvial island (marked 4 on the plan, Appendix IV, *vide* soil sample No. 9,) in the Kalkatti nullah, at the south-east corner of the plantation. The plants look healthy, but would be better if they were not so heavily shaded.

18. *Ceara Rubber (Manihot Glazovii, Muell, Arg.)*—In No. 1 Nursery at Old Gairsoppah there are 18 Ceara trees which have been raised from seed sown on the 11th November 1906. The seed is reported to have germinated in a few weeks. I measured a tree (No. 27) and found it to be 32' in height and 1' 4 $\frac{5}{8}$ " in girth at four feet from the ground. All the trees are looking well, although they are partly shut in by the surrounding forest trees.

I made a few cuts in a tree with a tapping knife to see how the latex would flow. The flow was quite satisfactory, and a small piece of rubber which I obtained from an incision made near the base of the tree is shown as Appendix No. III. It will be observed that the rubber is of normal good quality, such as is obtained from young trees of similar age elsewhere in India.

On a ridge, on which a house stood until it was burnt down recently, in the south-east corner of the plantation, a number of trees were planted in June 1908. They have a normally healthy appearance, are seeding, and are doing quite well. The measurements which I took of two of the best trees are as follow:—

- | | | | |
|------------|--------|------------------------------------|-------------------|
| (1) Height | 16' 9" | girth at four feet from the ground | 7 $\frac{1}{2}$ " |
| (2) " " | 14' 0" | " " " | Not taken. |

In a nursery in Block A₃ in Kabbinhakkal Forest there are about 2,800 to 3,000 tall plants which will be available for planting out this season.

The plants which were planted in Blocks A₁, A₂, and A₃ have practically all died owing to the land being too low and too wet for them during the rains (*vide* para 11 above). Besides the land being too wet, a hard, laterite pan lies at a depth of from 1 to 1 $\frac{1}{2}$ feet beneath the surface over a part of the area. As the ground is unsuitable, it is proposed to abandon it, and, I am in favour of the proposal, unless the area can be properly drained (*cf.* para 39).

19. *Castilloa elastica, Cerv.*—Under the shade of the teak trees in the plantation near the nursery I saw some *Castilloa* which had been planted in June 1908. They had been grown in the nursery for one year previous to being planted out; and as they had not been watered since they were put out in the plantation, a good many had died, while the survivors did not look particularly happy.

In the Para nursery I saw three young trees of *Castilloa* numbered 25, 26, and *nil.* Tree No. 25 was raised from seed received in June 1907, and was planted the following month:—

Height (on the 17th May 1909)	...	13' 9"
Girth at four feet from the ground	...	0' 10"

Tree No. 26 was obtained as a plant from Mysore and was planted in September 1907:—

Height (on the 17th May 1909)	...	10' 6"
Girth at four feet from the ground	...	0' 7 $\frac{1}{4}$ "

The third *Castilloa* referred to was obtained from the same source as the last. It was found to be 8' 9" in height and 4½" in girth at four feet from the ground. All three plants had been watered during the dry weather. They have consequently made good, strong, and luxuriant growth.

On the 17th May I made a few small incisions in two of these trees and I found they contained normal and promising yields of latex.

In beds in the nursery, a short distance to the south of the Para nursery, Mr. Copleston estimated that there are about 12,000 *Castilloa* which have made good growth, many of them being good, sturdy plants. They are from about 4 to 6½ feet, some of the best being about 8 feet in height. They were raised from seed obtained in May 1907, and the seedlings were planted in their present positions in the nursery in June of the same year, the seed having germinated quickly. The seedlings were watered through the dry weather of 1907-1908, but were not watered during the dry season of 1908-1909. The stems of all the plants have been covered with strips of the leaves of the "Talipot" palm to protect them from the sun. All the plants are reported to have dropped their leaves towards the latter part of the past dry season. This being a normal condition need not cause any alarm. Part of them have had a heavy "mandwa" shading erected over them recently, while the remainder have been left unprotected overhead. All the plants have begun to put on their young foliage; but the shaded plants have recently put forth their young leaves much more rapidly than the unshaded ones; and, consequently, they have a healthier and more vigorous appearance than the latter. The 1,350 plants which were planted in Block D failed for the reasons given in paras 11 and 27.

20. *Cryptostegia grandiflora*.—1,198 plants of this semi-procumbent species which has become naturalised in parts of the Presidency were planted in June 1908 in the plantation and many of them are growing fairly well against stakes which have been fixed in the ground for their support. As it grows practically wild in the Presidency I would not recommend the extension of the cultivation of *Cryptostegia* here. Besides, I doubt whether the cost of collecting the rubber from the plants leaves a sufficient margin of profit to encourage anyone to take up its cultivation.

21. Island on the opposite side of the Kalkatti nullah below the chief or No. 1 Nursery. It is marked H on the plan; and I visited it with Mr. Copleston on the morning of the 18th May. It is a fine, rich, alluvial piece of land (*vide* soil samples Nos. 10 and 11), almost level, and about 4 acres in extent, on which the forest has recently been felled. Mr. Copleston informed me that he intended to plant Para rubber on it shortly. If it is planted at 20' x 20'—the distance we spoke about on the spot—and the pits are made of the size I recommended to Mr. Copleston, namely 3' x 3' x 3' (*vide* para 30), I anticipate that the growth of the rubber trees will be very satisfactory. I believe Mr. Copleston gave orders during my visit to Mr. Teggerse, the Ranger who is in charge of the rubber plantations at Gairsoppah, to have the island cleared, pitted, and planted as soon as possible. The rubber trees certainly ought to grow well on this island if they are taken proper care of till they become established.

Holegar Coupe New Clearing

(marked K on the plan, Appendix IV, in Kabbinhakkel Forest).

22. I visited this new clearing with Mr. Copleston on the evening of the 16th and again on the 18th May and walked over the greater part of the area that is to be planted with rubber. It is about 70 acres in extent and is situated on the south-east side of the Honawar-Bangalore road at about the 250th mile from Bangalore and about a mile from Gairsoppah village (*vide* para 3 above). Mr. Copleston proposes to plant a triangular block of 20 acres (which has a south-easterly slope down to the river) with teak and 50 acres with rubber. The latter area, part of which is shown in photo No. 8, lies along the irregular face of a hill which has a north-western and northern exposure with a valley between the base of the hill and the road. The ground is therefore practically all on the slope and comparatively steep in parts.

23. *Soil.*—I took four samples of soil from different parts of the clearing, as shown in exhibits Nos. 12 to 15. The soil on the slopes and ridges is fairly good but somewhat variable. The greater part of it contains an admixture of small laterite gravel as shown in samples 13 and 14. No. 12 is alluvial soil from a narrow flat along the side of the Honehalli-Kabbinhakkal nullah on the eastern side of the clearing, and is very suitable for growing rubber. No. 15 represents a poor, light-coloured, sub-soil laterite-gravel, taken from a depth of three feet from a saw-pit between the entrance gate and the nursery which is being made.

24. The area has been practically clean felled with the exception of a few trees which have been left standing at irregular intervals. I think it would be advisable to have the remaining trees removed, with the exception of those near the spring (marked O on the plan, Appendix IV). This spring and the trees it is recommended should be left are situated near the big tree shown in the centre of the foreground in photo No. 8.

25. *Pitting and disposal of the Branches and Undergrowth.*—The pitting has been done partly at 15' × 15' and partly at 10' × 20'. I however noticed some pits made as close as 10' × 10'. The pits that have been dug are mostly cup-shaped and are far too small. In the case of pits which have been dug at 10' × 20', Mr. Coppleston's idea is to provide space for stocking the cut branches and jungle undergrowth in contour lines between the lines of the rubber plants across the hill, as can be seen in the left background of photo No. 8, in order (1) to prevent soil wash, (2) to preserve the humus on the land, and (3) to allow the branches and brushwood to decay and form leaf-mould instead of burning it, as is most frequently done. Care will however be necessary to prevent the occurrence of fires, otherwise the rubber trees may be seriously injured or destroyed. The common practice of burning felled jungle, except thorny species, is a most destructive method of clearing land and should be avoided as far as possible as it causes an enormous loss of valuable vegetable mould which should be saved; wherever it is possible to do so, for the benefit of the crops that are to be grown on the land (*vide* para 9 above).

26. There is a small nursery being started just below the spring O for the purpose of raising and growing the required stock of rubber plants for this new plantation. As this spring will yield only a very limited supply of water during the dry season, it will not be possible to water all the rubber plants in this plantation, as a large supply of water is not available within a reasonable distance. Only those within a short distance of the spring are therefore likely to be watered regularly. This will therefore be an interesting experiment in trying to grow rubber under natural local conditions. I see no reason why it should not be successful in the case of both Para and Ceara, provided (a) that the pits are made sufficiently large, (b) that the planting is done properly, and (c) that the plants are shaded and looked after properly afterwards.

27. *Opinion of Mr. Coppleston regarding the prospects of Rubber at Gairsoppah.*—I asked Mr. Coppleston on the 18th May what he considered to be the chief drawbacks he has to contend with in growing rubber at Gairsoppah, and the following is what he said:—

(a) "*Castilloa.*—The plants are unable to stand the long drought and sun; even with two years' watering he does not believe the tree will thrive here. In March it begins to look bad. The first lot germinated in July 1906. The resultant plants were watered from October 1st to June 1907, and again they were watered from October 1st, 1907, to June 1908. They were not watered from October (?) to May 1909, with the result that they all died, except 2 trees which are left. 1,350 plants were planted out in June 1908 in strips in the jungle with the result that they were all completely eaten up by animals by October 1908 (*vide* paras 11 and 19 above). He does not think *Castilloa* are going to do here."

(b) "*Para.*—They stand the sun better than *Castilloa* and are doing better; they do only in good, rich, alluvial soil without watering; but even in such areas they have lost about 50 per cent. of the plants. In good soil they might survive with and after one year's watering in the plantation, using strong plants watered for one season in the nursery. In the plantation, on the whole, at least 75 per cent. of the Para plants have failed, the failure being due to the long seven months'

-drought and great heat in March. Again, Para do not grow very well in the very heavy rain, in fact from June to September they don't grow at all."*

(c) "*Ceara*—This grows rapidly during the rains when planted in well-drained, poor, jungle soil, and is the most promising of the three species under trial. They have a set-back in March, generally dying back 3 to 6 inches, and recover in May before the rains begin. This recovery would be due, probably, to a fall in temperature owing to the damp sea breezes. As it seeds early (two years) it is likely to do well in this country. There is a general shortage of water throughout the district during the dry season."

28. *Expenditure*.—Up to the end of April 1909 the sum of Rs. 10,340-3-8 has been spent on the plantations, and details of the expenditure are given in Appendix IX.

29. *Management of the Work*.—Of course it has been impossible for

General remarks.

Mr. Copleston to remain at the plantations for long at a time, as, I understand, he has many other important duties to attend to which keep him busily occupied in different parts of his large district. The rubber work has, consequently, had to a large extent to be entrusted to his subordinates—Mr. Teggerse, the Ranger in charge, and his men—who live on the spot (*vide para 11* above). The work of planting rubber was new to them and consequently they did not know, nor could they be expected to know, very much about it, except what they may have learned from books on the subject, which is quite a different matter from learning work of this kind practically on an established and well-managed rubber plantation. The result has therefore not been as satisfactory as it might have been. Except those in and close to the nurseries, the plants in the plantations upon the whole do not appear to have received as much attention as was necessary to ensure them having a proper chance. The pitting was defective and the important matters of watering and shading the plants should have received more attention than they did.

In fact, the impression I obtained, after going over the plantation and seeing its condition, was that rather more had been taken in hand than could be looked after properly under the circumstances. It would, I consider, have been better, at first, to have planted and attended to a smaller area properly rather than to have planted a comparatively large area imperfectly as has been done (*vide paras 11 and 137*).

30. The chief weak point in the experiment lies undoubtedly in the small pits. The rubber trees are certainly not likely to have a fair chance if planted under such conditions, and the obvious remedy is to give them larger pits, so that their roots can find sufficient room to spread and grow with freedom. Certainly, in the Bombay Presidency, where there is a comparatively long, dry, hot season, good-sized pits are advisable, if not an actual necessity, to enable the roots of the young plants to go down to a good depth in the soil as quickly as possible beyond the influence of ordinary drought. I would therefore recommend that the pits for Para and *Castilloa* should be made, cubical, 3' x 3' x 3', and those for *Ceara* 2' x 2' x 2'. In cases where the soil excavated from the pits is bad (*vide para 10*) it should either have some manure mixed with it or be replaced by good earth cut from the ground around the pits or brought from the nearest source of supply. Another important point is that no pits should be filled in till after they have been examined and passed by someone in authority, in order to ensure that they have been dug according to the specified measurements agreed upon. It is advisable, however, that the pits should be filled in before the end of April to allow the soil time to settle before the main planting is done in May (*vide para 32*).

* *Note*.—A long continued dry season might affect Para rubber grown on poor soils, but over most of the area in the North Kanara District suitable for rubber, the constantly humid atmosphere and a water-level near the surface of the ground effectually compensate for the absence of an evenly distributed annual rainfall. As a proof of the above, ever-green forest, which cannot possibly exist in prolonged dry climatic conditions, grows in North Kanara quite as luxuriantly as in Cochin, Travancore, Ceylon, and Java, where there is no dry season to speak of.—W. A. T.

31. *Paths.*—The area should have decent paths made at suitable intervals, so that it is properly demarcated into blocks of convenient size for systematic working purposes and for easy inspection (*vide* photos 1, 2, and 3). The old streets of Old Gairsoppah could be utilized for this purpose to a considerable extent where they happen to be suitably located. Elsewhere, new paths should be marked out and made.

32. *Basketing of Plants.*—It is advisable to grow and have on hand in the nursery a constant, ample supply of plants in baskets (as described in para 83 and as shown in photo 18) ready for planting out at the early advent of the monsoon, and for filling in all failures as they occur in the plantation. It is a matter of great importance that the plants should be carefully grown under the best conditions while they are in baskets; and that only individually strong, healthy, and good-shaped plants should be selected for planting out. All weak, crooked-stemmed, and ill-shaped plants which are below the standard of a healthy, good-shaped specimen, should be rejected as being neither fit nor desirable to plant out permanently. The main planting, for which basketed plants are recommended in preference to plants lifted from nursery beds, should be done during spells of damp, cloudy weather in May; as, if it is left to be done during the heavy rains which fall in June, it is practically impossible to supervise the work properly. All failures in the plantation should, however, be filled in promptly as they occur with strong, healthy, basketed plants.

33. *Watering.*—It is very important that the watering of the young rubber plants should be carefully and properly attended to all through their first dry season after planting. In fact, the watering should be attended to till each plant has reached the height of $6\frac{1}{2}$ feet; and the watering of all plants which have not attained to this height by the beginning of the second dry season, should be re-commenced and continued till they have grown to the height mentioned. It will be only in exceptional cases that a plant will need to be watered after it has reached the height of $6\frac{1}{2}$ feet (*cf.* para 85). Where water is very scarce during the dry season and the plants are likely to suffer, a combination of mulching with leaf-mould or good soil, watering, and judicious shading, may be adopted with advantage. In Old Gairsoppah there are numerous old wells which could, if necessary, be brought into use at a comparatively small cost.

34. *Protection.*—It is advisable to put a bamboo gabion or ring fence round each rubber plant to protect it from being damaged by animals and to serve as a guide to prevent it from being overlooked or damaged by coolies when watering the plant and when weeding the ground. I would suggest that the gabions be made of stout, split bamboos as follows:—

Full length of pieces 42 inches and to be sharpened at one end so that they can easily be driven into the ground.

Width of strips, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch.

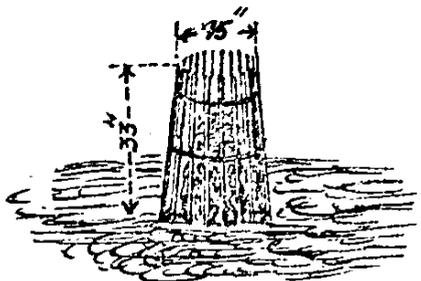
Number of strips required for each gabion, 18.

Height of gabion, 33 inches.

Diameter of gabion at the bottom, 20 inches.

Do. do. top, 15 inches.

In order to secure the bamboo strips in their proper position, pieces of jungle



creeper or thin strips of bamboo may be fastened round the gabion about 4 or 5 inches below the top and about 18 inches from the bottom of each gabion in order to give it the required degree of rigidity and strength (*vide* marginal diagram).

35. *Shade*.—During the monsoon and dull weather the plants are better without shade than with it; but during the first, and, possibly, the second dry season, each plant will need to have the necessary amount of shade given to it. The shade will need to be regulated from time to time according to the condition of the plant and the relative brightness or cloudiness of the atmosphere and state of the weather. A few leafy twigs or plantain leaves will afford suitable shading material where living shade-affording species are not present. "Manila hemp" (*Musa textilis*) is a catch-crop of economic value, which is very suitable for cultivation as a shade species between the lines of rubber trees. It affords (1) a good lateral shade to the young rubber trees; (2) it helps very materially to keep down weeds and jungle-growth which are usually difficult and costly to keep down; and (3) its shoots (commonly called stems, which must be thinned out from time to time in order to regulate the amount of shade which is required by the rubber trees), yield the valuable fibre known in commerce as "Manila hemp." The fibre could be extracted from the stems by contract and thus become a source of revenue. For these three reasons I would recommend the planting of *Musa textilis* as a shade plant among rubber trees (cf. paras 62 and 63).

36. *Cleaning and Weeding*.—Of course, a plantation which is kept clean-weeded and the ground cultivated has a more systematic and neater appearance than a plantation in which the weeds and jungle coppice are allowed to grow up to a certain height; but the cost of upkeep is proportionately greater. Both systems of cultivation have their respective advocates, advantages, and disadvantages. A plantation in which the secondary jungle is allowed to grow up, never looks clean or tidy, and it is, besides, usually difficult to see and often even to find the young rubber trees in it (*vide* photos 1, 2, and 3). In plantations of this kind it is advisable to cut to the ground every year all jungle coppice growth, when the precursory signs of the approach of the S. W. Monsoon show themselves in the form of cloudy weather about the middle to the end of May (*vide* also para 61). This will give the plants a full amount of light which they will need during the monsoon to enable them to make good growth.

It will also enable the officer in charge to obtain an uninterrupted general view and a good idea of the condition of the rubber trees collectively. He will easily see where failures have occurred and be able to judge, generally, what needs to be done. In cases where the jungle-growth has been rampant, a second cutting, probably about August, will be necessary. But, usually, nothing need be cut after September, as it is advisable to have the ground moderately well covered and shaded with vegetation before the next hot weather sets in, in order to conserve the moisture in, and to prevent its over-rapid evaporation from, the soil. In climates which have a long dry season, the question of conserving the moisture in the soil is a highly important one which should always receive careful consideration and attention.

In cases where the system of allowing the weeds and jungle to grow in a rubber plantation is adopted (as at Gairsoppah), it is advisable to have the ground periodically dug and cleaned round each rubber plant for a radius of 4 feet, in order to keep it free of weeds. The first digging should be done with grubbing-picks and *phaoras* to a depth of least 18 inches. Subsequent digging need not be so deep as the first, as it is not advisable that the ramifying, surface-feeding roots of the young rubber trees should be injured (*vide* paras 60 and 86).

37. *Para* should be the principal species to be planted at Gairsoppah, to the extent of, say, 100 acres at present. It should be planted, preferably, in well-drained alluvial soils or at the bases and on the slopes of low hills where the soil is good. The pits should be made not closer than 17' × 17' or about 150 trees to the acre; but the distance of 20 feet apart is not too wide for *Para* when planted on deep, rich, well-drained alluvial soil in such places as is described in paras 16 and 21 above. From the tenth to the twelfth year after planting it will, in all probability, be found advisable to thin the plantation if the trees have made good growth.

38. *Castilloa*.—This species is largely grown in Mexico, but it has not yet found much favour with rubber planters in the East. It is not likely to do well, except in rich alluvial land without irrigation or watering, at Gairsoppah.

Good soil and a sufficiency of water during the dry season are necessary for growing *Castilloa* successfully. Moreover, as it does not stand prolonged drought with impunity, unless it has good lateral shade, and as there are certain slightly tedious operations connected with the collection of its latex and preparation of the rubber, I would not at present recommend it for extensive cultivation in the Presidency. I would, however, recommend that an area limited to, say, about 10 acres of good alluvial land be planted with this species at 15' × 15' apart. The plants will have to be lightly shaded and watered occasionally according to their requirements till they become established. They will also require to be interplanted with something like *Musa textilis*, which will afford them lateral shade and keep the ground cool during the hot weather (*vide* para 35).

39. *Ceara Rubber*.—This species is growing rapidly and is very promising at Gairsoppah. It should be planted on well-drained soils about 24' × 24' apart in pits not less than 2' × 2' × 2' in size. Abandoned "komried" areas, for instance, might, with prospective advantage, be planted up or sown with Ceara. As it is sure to do well, it is certainly worth planting on an extensive scale in the district, as it is not so exacting in its soil, temperature, and moisture requirements as the Para and *Castilloa* rubber trees are. In fact, it is hardier than either of these species; and once a plantation of it were well established, it would reproduce itself quite freely, and all that would be necessary would be to keep down the undergrowth and thin out the superabundant seedlings. I would recommend that 50 acres should be planted with this rubber at Gairsoppah for the present.

40. The total area which I recommend to be planted at present with Para, *Castilloa*, and Ceara rubbers at Gairsoppah and Hulegar will, therefore, amount to 160 acres. This area will, if the trees are properly treated and looked after, be quite sufficient to demonstrate whether these rubbers will grow and prove commercially successful or otherwise there.

BARGUDDA RUBBER PLANTATION, KADRA.

41. I arrived at Karwar on the 24th May by steamer from Kumta and on the following day I left by boat for Kadra, 20 miles up the Kali naddi. I arrived early in the afternoon at Kadra and met Mr. Bell, the Divisional Forest Officer, N. D., Kanara, who showed me the rubber plantation which is in his charge. The scenery in going up the river is beautiful and exceptionally fine.

42. Kadra, like Gairsoppah, is situated at the tidal limit of the river and lies in a large, irregular basin or valley several miles wide at the foot of the Anshighat.

43. *Situation and Surroundings of the Rubber Plantation*.—The rubber plantation is situated in the basin referred to, on the north side of the Bargudda or Sakri nullah or stream at Bargudda, about 2½ miles west of Kadra, on the north side of the Kali naddi, and is almost encircled by hills. The hill to the north is called Arabitemb, and is about 1,600 feet high. In the direction of the river to the southward it is comparatively flat and open. The hill to the east is the Anshighat about 1,600 feet, while the hill to the west is called Bargudda and is also about 1,600 feet high (*vide* photo No. 11). To the north-west, between Bargudda and Arabitemb, at a distance of probably 25 or 30 miles, may be seen the mountains in Portuguese territory (*vide* photos Nos. 12 and 14).

44. *Area*.—The area of the plantation is about 16 acres and is securely enclosed by a good, neat bamboo fence. A plan prepared by the Ranger is shown as Appendix X.

45. *Nature of the Site*.—The site has been well chosen by Mr. Bell. The surface of the land is fairly even with a general slope down the valley. There are, however, slight minor easy graded differences of level of only a few feet in different parts. In fact, the land is practically on the flat.

46. *Soil*.—The soil is a rich alluvial deposit, chiefly of disintegrated laterite, of considerable depth; while about the middle and near the south-east end of the area the underlying material is largely composed of sand and gravel deposit mixed with large stones, overlaid with good alluvial soil to the depth of from one to several feet. The soil, upon the whole, is excellent, as will be seen from samples Nos. 16

to 24 (*vide* Appendix II), and is highly suitable for growing rubber. The soil shown in the nine samples referred to were taken from different parts of the plantation and are practically all fine, rich, reddish alluvium. Samples Nos. 19 and 20, taken from a depth of five feet from two pits, are much the same as the other samples, except that they contain a good deal of gravel in association with water-worn stones of various sizes, evidently indicating the course of an ancient river-bed. On the other hand, samples Nos. 21 and 23 are darker soils, indicating that they contain a higher percentage of organic matter than the other samples.

47. Sample No. 25 shows a collection of stones I made in going up the Anshihat, which will show the geological character of the rocks on the surrounding hills from which the soil in the valley below has, in past ages, been and is still being formed.

48. *Temperature.*—The following are the temperatures which I took during my visit :—

Date.	Time.	At the Forest Bungalow, Kadra.	In the rubber plantation at Bargudda, 2½ miles distant from the Forest Bungalow.
25th May 1909	8-30 p. m.	84°	
	10-30 "	82°	
26th May 1909	6-0 a. m.	74°	
	8-0 "		85°
	2-30 p. m.	92°	
	6-30 "		87½°
	8-30 "	85°	
	10-15 "	82°	
27th May 1909	6-0 a. m.	75°	
	8-0 "		83°
	1-0 p. m.	92°	
	2-0 "	95°	
	3-0 "	96°	

Note.—The average annual temperature at Karwar is 79°·5.

49. *Rainfall*—No records of the rainfall have been maintained at the plantation. The average annual rainfall at Karwar, the nearest station, is 118·87 inches (*vide* Appendices VI and VII). The rainfall is not likely to be materially different to what it is at Karwar, and it may therefore be considered to be ample for growing rubber.

50. *Clearing.*—The clearing work was begun in January and the planting was done in June 1908. A few spindly trees have been left in the clearing here and there to give light shade to the rubber trees (*vide* photos Nos. 9, 10, and 11). The secondary growth of coppice from the felled jungle trees has been allowed to grow up to an average height of about 6 to 7 feet, but it is not very thick, *i.e.*, it is not standing very close together (*vide* photos Nos. 9 to 14).

The following are a few of the species which form the coppice and undergrowth :—*Terminalia tomentosa*, *T. bellerica* and *T. paniculata*, *Lagerstræmia parviflora*, *Thespesia Lampas*, *Xylia dolabreiformis*, *Grewia tiliæfolia*, *Dillenia pentagyna*, *Adenantha Favonina*, *Albizzia Lebbek*, *A. odoratissima*, *Flemingia sp.*, *Bridelia obtusa*, *Bombax malabarica*, *Saccopetalum tomentosum*, *Leea sambacina*, *Dalbergia latifolia*, *Schleichera trijuga*, *Spondias mangifera*, *Stereospermum sp.*, *Odina Wodier*, *Glochidion sp.*, *Hemingyrosa sp.*, *Strychnos nux-vomica*, *Bauhinia sp.* Between the clumps of jungle growth, the ground is occupied by a mixture of smaller-growing species (the principal of which are grasses) and the felled and charred remains of tree trunks, as well as with tree stumps which have been left in the ground. The grass and weeds between the coppice growth have been cut to facilitate getting about the plantation to see the rubber plants. A general idea of the appearance of the plantation can be obtained from photographs Nos. 9 to 14.

51. *Pitting*.—The average size of pits dug was only from 8 to 12 inches in diameter and 18 inches deep. As the soil is excellent many of the plants have made good growth; but the results would have been more satisfactory if the plants had been given larger pits, like the sample pit I had dug at the north-west corner of the plantation. I would recommend that the pits for Para should be dug 3' × 3' × 3' at 17 × 17 feet apart; those for *Castilloa* 3' × 3' × 3' at 15 × 15 feet apart; and those for Ceara 2' × 2' × 2' at 24 × 24 feet apart.

52. *Planting*.—According to the information contained in the plantation register, the whole area, which is reported to be 16 acres, was planted between the 11th and 29th June 1909, at 10' × 10' with the following rubber plants, which were about 9 months old at the time they were planted.—

2,820 Para.
3,541 *Castilloa*.
1,538 Ceara.

Total ... 7,899

Since these were planted, many failures have occurred, chiefly among the *Castilloa* and Para. Among the Cearas there are very few failures. Mr. Bell estimates the failures in the plantation to amount to 50 per cent., and his opinion is that rubber will not be a success in Kanara. Many of the surviving plants look well; in fact, numbers of them look remarkably well and promising (*vide* photos 12, 13, and 14).

53. The following are the measurements of the heights of some of the best rubber trees in the Bargudda Plantation, Kadra, taken on the 26th May 1909:—

50 plants of Para.	50 plants of <i>Castilloa</i> .	50 plants of Ceara.	50 plants of Para.	50 plants of <i>Castilloa</i> .	50 plants of Ceara.
Feet in.	Feet in.	Feet in.	Feet in.	Feet in.	Feet in.
*8 3	5 7	10 0	6 8	5 3	13 7
5 10	6 4	10 0	5 10	4 3	10 6
9 4	5 2	10 5	7 0	6 1	11 10
5 5	3 8	9 6	5 9	4 10	12 2
6 11	5 1	9 9	5 10	5 0	11 7
6 10	4 10	11 2	5 10	4 2	11 8
6 9	4 10	10 7	5 11	5 4	12 9
7 4	5 4	11 10	5 8	5 6	13 11
7 4	4 0	13 0	6 7	4 9	13 1
5 11	4 0	11 4	5 9	5 4	11 3
6 10	6 3	11 6	6 6	4 4	12 4
7 11	4 6	10 0	6 11	3 10	13 4
†10 1	5 0	10 5	6 2	4 0	12 6
8 8	5 0	12 2	6 2	3 9	12 5
7 4	4 3	10 5	5 6	5 1	11 9
7 9	5 6	10 0	8 4	4 10	11 11
7 0	4 6	13 2	6 7	3 9	11 9
6 4	4 9	11 5	9 7	4 6	12 2
8 0	4 10	10 0	6 11	4 3	10 8
5 9	5 0	10 3	6 10	5 10	12 1
5 8	5 0	12 11	5 8	4 0	11 8
5 1	6 0	10 7	6 8	5 3	11 6
6 10	3 11	11 5	7 10	4 10	12 0
5 0	5 4	11 6	8 8	6 0	12 7
5 10	5 5	12 10	7 7	4 3	12 10

* This tree was dug round 4 feet radius.

† Tallest tree (*vide* photo No. 12).

54. *Pests*.—Rats, monkeys, and other animals as well as insects are reported to have done damage to the rubber plants since they were planted, and I believe measures have been taken to prevent, as far as possible, any further serious damage being done.

55. *Water-supply*.—During the rainy season the Bargudda nullah becomes a broad, swift-flowing, mountain stream. At the time of my visit, however, water was scarce, as the nullah was dry, except in places where there were a few pools. Water

for watering the rubber plants was being obtained from pits which had been dug to the depth of a few feet at three or four suitable places in the bed of the nullah. The coolies carried the water to tubs near the fence, from whence it was conveyed in channels, made of the hollowed-out stems of the "supari" palm, to tubs and pits inside the plantation. The water was then distributed to the rubber plants in water-cans by means of a staff of 15 coolies which is employed on the plantation.

56. *Nursery*.—This is situated near the Forest Officer's bungalow at Kadra about $2\frac{1}{2}$ miles from the rubber plantation. It was used for raising and growing the rubber plants which were planted out last year, but has been practically abandoned since. At present, however, it still contains about 200 Para and about 1,000 Ceara plants which are available for filling in failures in the plantation.

57. *Expenditure*.—The expenditure on the rubber plantation up to the end of April 1909 amounted to Rs. 2,035-14-5.

58. *Pruning*.—Many of the plants require the dead wood, wrongly-placed and low side shoots cut off with a sharp knife, in the way I gave a practical demonstration on the spot.

Recommendations.

59. *Protection*.—I would recommend each young rubber plant to be protected by a bamboo gabion as described in para 34 above.

60. *Cultivation*.—Where the system of leading the secondary jungle-growth among the rubber trees is adopted, it is advisable to cultivate the ground immediately surrounding each plant. In order that this may be done, the ground, up to a radius of 4 feet from each plant (*i.e.*, a diameter of 8 feet), should be deeply hacked with a grubbing-pick and a *khodialie* or *phaora* to a good depth, as recommended in para 36 above. I had a Para tree, 8' 3" in height, treated in this manner in Mr. Bell's presence as an example to demonstrate practically what I would recommend should be done round all the rubber trees in the plantation (*vide* paras 36 and 86).

61. *Treatment of Secondary Jungle-growth for Shade purposes*—I would recommend that all the secondary jungle should be cut down at the end of May each year in order that the rubber plants may have all the light they can get during the monsoon (*vide* para 36 above). I had a portion of the Para trees in the south-east corner cleared of jungle-growth to show what I recommend should be done and to enable Mr. Bell to judge how the trees will grow without shade (*cf.* para 85 below). I also took a photo of the Para trees after the ground had been cleared, looking west-north-west (*vide* photograph No. 11). Towards the end of the season the jungle might be allowed to grow up again to afford shade to the ground and lateral shade to the rubber plants during the ensuing dry season.

62. *Clean-weeding and Planted Shade*.—Another method of treating the plantation would be to remove all the jungle-growth and to dig and keep the ground clean-weeded. As shade is necessary during the hot season, *Musa textilis* might be tried (*vide* para 35).

63. As the plantation at Bargudda is only a small one, half of it might be planted with "Manila hemp" and half as mentioned in paras 60 and 61 above, until it is seen which method gives the most satisfactory results.

64. *Para*.—This promises to be quite successful once it becomes established at Kadra, as exemplified by the fine specimen shown in photo No. 12. I would recommend that a block of 10 acres should be planted with this species. Extensive areas of good land in the district might however be planted with this rubber, as I think there is every prospect of it proving successful.

65. *Ceara*.—This species also promises to do well at Kadra; and I would recommend that 10 acres should be planted with it. It is recommended for extensive cultivation in the district (*vide* para 39).

66. *Castilloa elastica*, Cerv.—I am not in favour of recommending this species for extensive cultivation at present (*vide* para 38); nor, on the other hand, would I advise its abandonment. I would accordingly suggest that only a small area, say 5 acres, should be planted with it at present.

67. As there are extensive areas of splendid land in the neighbourhood of Kadra which are suitable for rubber, and as I consider the climatic conditions are no unfavourable (although the long dry season has to be taken into careful consideration), I am of opinion that Kadra would be a fine centre for starting rubber plantations on a large scale.*

THE CANTONMENT GARDEN RUBBER PLANTATION, BELGAUM.

68. I visited and inspected this plantation on the 31st May 1909. 246 *Castilloa*, 10 *Hevea* and 6 *Ficus elastica* were planted by Colonel Wyllie between the years 1904 and 1906.

69. The grass field in which the rubber plants have been planted is quite open and the soil is mostly a gravelly laterite.

70. The *Castilloa* are planted on mounds of earth thrown up to the height of 9 inches to a foot, 20' X 20' apart, in lines and squares, thus. --

..... The ground round each tree for a radius of about
 3 feet is dug or kept fairly clear of weeds. Something
 should however be grown between the lines of trees
 to shade their stems from the hot sun and to conserve
 the moisture in soil during the hot weather. Many of
 the trees are flowering and seeding.

The average height of the trees is about 7½ or 8 feet. The highest one was measured and found to be 13' 9"; others are of lesser heights; while one is only about 3 feet, evidently a replacement.

The general appearance of the *Castilloa* shows that they are not altogether quite happy and they badly need attention; but although not growing under very favourable conditions, I consider they have made wonderfully fair growth. It was however a mistake perhaps to plant them on mounds, as the climate is already dry enough.

71. Only 5 Para trees are alive. They have not made much growth and do not appear to be very happy and are most likely to die unless they are lifted and put into large, well-manured pits, watered and shaded. They have been planted like the *Castilloa* and are certainly in need of immediate attention if it is desired to give them another and a fairer chance than they have had. On the whole, they are not nearly so promising as the *Castilloa*, the climate being evidently too dry for them during the hot weather and too cold perhaps in the cold weather.

72. Mr. Easey, the man in charge, told me that cattle graze over the ground regularly and eat the young shoots of *Castilloa* and Para and thereby damage the rubber trees. He also told me that rats do a deal of damage to the roots of *Castilloa* and that a lot of plants were lost at first from this cause.

73. I did not see any trees of Ceara rubber, but I think it would be more likely than either Para or *Castilloa* to succeed at Belgaum.

MULAND RUBBER PLANTATION, NEAR THANA.

74. *Arrival at Thana.*—I arrived at Thana on the 3rd June where I was met by Mr. R. H. Madan, the Divisional Forest Officer.

75. *Visit to the Plantation.*—On the morning of the 4th, Mr. Madan drove me to see the rubber plantation, which is situated at Muland near the south end of Tulsu hill about three miles from Thana.

76. *Area and Topographical features of the Plantation.*—The area of the plantation is 25 acres and a plan of it is shown as Appendix XI. The central part of it consists of a steep, conical hill on which stands an old disused "tower of silence." On the slopes of this hill and on the irregular ground adjacent thereto the rubber trees have been planted (*vide* photo No. 15).

77. *Features of the Indigenous Vegetation.*—The surface is lightly covered with small scrub jungle trees of different species, chiefly deciduous, of which

* If I may venture to deviate from the subject of rubber, I believe that mahogany would also grow well at Kadra, and that it might be advisable to consider the question of starting an experimental plantation of it there.

"babul" (*Acacia Arabica*) is the one most in evidence (*vide* photos. Nos. 15 and 16). These have been thinned and the lower branches and undergrowth have been cut to suit the shade requirements of the rubber trees—Para, Ceara, *Castilloa*, and *Ficus elastica*—which have been planted among them over practically the whole area.

78. *Temperature*.—According to the "Thana Gazetteer" the mean annual temperature taken at the Thana Civil Hospital is 79°98:—

Lowest minimum, in January	...	...	61·8
Lowest maximum, in August	...	...	83·8
Highest minimum, in May	....	...	79·9
Highest maximum, in April	...	...	95·2

Mr. Madan kindly prepared the following statement for me showing the monthly minimum and maximum temperature for five years (1904 -1909) at Thana:—

Month.	1904.		1905.		1906.		1907.		1908.		1909.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
January	64	87	57	84	58	82	64	92	62	85	60	86
February	66	87	57	94	59	83	59	88	61	91	62	89
March	73	97	67	96	60	90	74	94	65	97	73	95
April	79	96	67	95	72	103	79	95	77	103	78	103
May	86	94	81	96	83	105	83	95	81	102	85	102
June	80	94	82	96	79	103	76	95	82	101	...	...
July	79	87	80	86	75	92	77	87	78	87	...	...
August	78	85	79	87	77	95	79	85	79	87	...	...
September	77	86	76	88	77	93	80	86	78	87	...	...
October	72	94	77	96	73	96	73	89	79	87	...	...
November	64	88	72	88	65	100	67	90	66	86	...	...
December	63	85	60	86	62	89	62	85	64	83	...	...

I took the following temperatures while at Thana on the 4th June 1909—

At 8 a. m.	...	79°, weather dull after a shower.
" 9 "	...	72°, heavy rain.
" 12 noon	...	80°, cleared up.
" 9-30 p. m.	...	84°, fair.

79. *Rainfall*.—According to the "Thana Gazetteer" the average rainfall registered at the Thana Civil Hospital, for 30 years ending 1880, was 99 inches 98 cents. The highest fall recorded was 156·25 inches in 1851 and the lowest 64·78 in 1871. The combined average rainfall for the *District of Thana* from 1860 to 1888 was 102·c7 (*vide* also Appendixes VI and VII).

80. *Soil*.—The seven examples of soil shown in samples Nos. 26 to 32 indicate a different class of soil to what is found at Gairsoppah and Kadra. They are classed as "moorum" soils and have been formed chiefly from disintegrated "trap." The soil generally is of no great depth. Beneath is rock and "moorum" in varying quantities mixed with soil of different qualities. The general character of the surface soil in the plantation is shown in samples 26 to 30. The darker soils, shown in samples 26, 27, and 28, indicate the best soils which are found in the valley at the base of the hill in the plantation; while samples 29 to 30 are fairly representative of the soil about half the way up the hill. No. 31, taken from a depth of four feet from a pit made about half way up the hill is fairly representative of the average nature of the light-coloured subsoil in the plantation. No. 32 is also a light-coloured soil evidently allied to the last and is occasionally, but not very commonly, found on and close to the surface in different parts of the plantation. Samples 26 to 30 will all grow Para and Ceara rubber, but more particularly Nos. 26, 27, and 28. Example No. 33 shows a specimen of hard "moorum" from which the soils in the plantation have chiefly been formed by disintegration.

31. *Early operations*.—The early history of the rubber experiment at Muland is given in detail in a report by Mr. Madan contained in his letter No. 49 of 1908-09, dated 29th April 1909, to the Conservator of Forests, N. C. The subject is also referred to in paras 43 to 49 of the Forest Administration Report for the year 1907-08 of the South Thana Division, and in Government Resolution No. 6759, dated 6th July 1908, Revenue Department.

82 *Planting*.—The first plantings were made in June 1907, when the following plants, which had been raised in the nursery and were from 6 to 9 months old, were planted on an area of two acres :—

Ceara	...	...	118 plants.
Castilloa	...	...	13 "
Para	...	...	17 "
<i>Ficus Indica</i>	...	...	81 "

These plants and the subsequent plantings to the extent of 23 acres, in June 1908, are referred to in the following "Monthly Progress Report on the condition of the Rubber Plantation in Salsette Range for the month of April 1909," by the Divisional Forest Officer :—

Serial No.	Name of Forest.	Area.	Kind of plants.	Date of planting.	Number of plants.	Remarks.
1	Mulanid 1906-07.	2 acres.	Ceara	June 1907	115	} All are in good condition.
			India	"	30	
			Para	"	15	
			<i>Castilloa</i>	"	8	
	Do. 1907-08.	23 acres.	Ceara	June 1908	2,388	
			India	"	905	
			Para	"	215	
			<i>Castilloa</i>	"	370	

The plants in the higher parts of the plantation, where the soil is shallower and poorer than it is nearer the base of the hill, are not doing as well as they are in the lower parts.

83. *Para Rubber*.—2,000 Para seeds were sown in the nursery on the 22nd August 1908 and the resultant seedlings were put in large 15-inch planting baskets on the 17th September 1908 and kept under a bamboo thatched shade (*vide* Progress Report, para 92 below). There are about 1,000 of these individually well-grown, healthy-looking, basketed plants in stock (*vide* photo No. 18). Their condition shows that they have received careful cultural treatment; and I would strongly advise that all plants that are required for permanent planting should be selected from similarly well-grown nursery stock, as recommended in para 32 above.

84. Many of the Para plants which have been planted in the lower parts of the plantation are doing well (*vide* photos Nos. 15, 16, and particularly No. 17).

85. I had the jungle cut down among the Para rubber plants on a small area near the store (shown in photo No. 17) in order that Mr. Madan may be able to observe and judge whether or not the plants will henceforward thrive better with a full amount of light, as they have practically all reached the height at which watering may be discontinued, namely 6½ feet (*vide* paras 33 and 61).

86. The tree shown in the foreground of photo No. 17 is growing near the store. It is in vigorous health and is 7' 4" in height. I had this tree dug round deeply for the purpose of giving a practical demonstration of what I have recommended in paras 36 and 60.

87. I also had a bamboo gabion made for the same purpose, according to the specification given in para 34 above.

88. The following are the measurements which I took of ten of the best Para plants on the 4th June 1909 :—

6' 10"	girth at 4 feet, 1¼"	7' 6"
7' 9"		8' 0"
7' 2"		6' 10"
7' 2"		7' 10" <i>vide</i> photo No. 17.
7' 3"		6' 6"

The average height of these ten plants is about 7 feet 3½ inches or 7.21 feet, which is, I consider, fairly satisfactory. They are planted at 30 x 30 feet apart

under small deciduous forest trees (*vide* para 77) and were watered, at first, once a week, and then, as the dry season advanced, twice a week.

89. *Ceara Rubber*.—Plants of this rubber have been planted chiefly on the steep slopes in the upper part of the plantation at 12' x 12' apart. They appear to be doing fairly well, but would have done better if they had been planted in better land at the foot of the hill and in larger pits (2' x 2' x 2') as recommended in para 30. They may be planted at 17' x 17' apart. I measured six of the best plants and their measurements were:—

Height.	Girth at 4 feet from the ground.
13' 0"	4"
12' 9"	4½"
12' 0"	3"
12' 11"	4"
11' 6"	3½"
14' 2"	4½"

90. *Castilloa*.—There are a good number of *Castilloa* about 1 foot high, in beds in the nursery, raised from seed sown on the 28th June 1908. They are looking fairly well. In the plantation the *Castilloa* have been planted at 30' x 30' and at 12' x 12'. A plant, two years old, is 4' 3" in height. The plants of this species are not looking well upon the whole and certainly they are not so promising as they are at Gairsoppah or at Kadra. They require better pits, proper shade, efficient watering, and regular attention if they are to succeed here. I would not however recommend any further extension of *Castilloa* here, where Ceara and Para are likely to succeed better.

91. *Ficus elastica*, Roxb.—There is a stock of about 1,500 healthy-looking seedlings of various sizes of this rubber growing in boxes in the nursery. The seed was sown on the 10th and 21st October 1908. The soil compost used for sowing the seed in boxes consisted of charcoal, broken brick, and a little topmixture of dead leaves and cow-dung pounded up. When the seedlings appeared, a layer of fine coir or moss was put over them.

In the plantation there are some nice, healthy plants, varying up to about 3 feet, of this species, which were planted in June 1907 and in June 1908. The plants have been planted in pits and on small mounds at about 30 feet apart. The distance of 30 feet apart is rather too close for this species: 40 to 50 feet apart would be quite close enough to plant them. They appear to be doing better on mounds than in pits. The following are the height measurements which I took of six of the best plants on the 4th June 1909:—

3' 6" 3' 7" 3' 6" 3' 0" 3' 9" 3' 0"

The average height of these plants is 3'4 feet.

This rubber promises to do well here—the chief drawback, from a planter's point of view, being the long time that has to elapse (said to be from 15 to 20 years) before it is fit to tap. This is not, however, a very weighty reason why the species should not be planted by Government in the district, as, besides yielding rubber, it is useful as a shade-tree.

92. The following is the monthly progress report, prepared by Mr. Madan, on the condition of the rubber seeds sown in the nursery at Muland for the period ending 30th April 1909:—

Serial No.	Kind of seed.	Quantity sown.	Date of sowing.	Date of germination.	No. of seedlings germinated.	No. of seedlings planted out into baskets, etc.	Date of transplanting.	Remarks.
1	<i>Castilloa</i>	500	28 June 08.	7 July 08.	325	315	June 1908	Pricked out in nursery beds, 10 plants sent to Central Thana. 10 plants have died.
2	<i>Ficus elastica</i> .	5 lbs.	10 Oct. 08.	Jan. 1909.	1,500	Nil	Nil	Sown in 17 boxes; all are in good condition.
	Do. ...	4½ lbs.	21 Oct. 08.	Do.	70	Nil	Nil	Sown in 18 boxes; all are in good condition.
3	Para ..	2,000	22 Aug. 08.	5 Sept. 08.	1,023	1,023	Sept. 08	Pricked out in bamboo baskets. 50 plants sent to Vada on 28th November 1908.
				Oct. 1908.	34	34	Oct. 08	
							Jan. 09	

93. *Expenditure.*—According to the monthly statement for April 1909, prepared by the Divisional Forest Officer, the expenditure on the nursery and plantation amounted to Rs. 2,365-6-0.

94. *General remarks.*—The chief defect at Muland also is the small pits in which the plants have been planted; and they should be made of the sizes recommended in para 30. If this is done and the plants are given proper attention, I see no reason why rubber should not grow well at Muland.

95. I do not consider that the land on the steep, conical hill in the middle of the plantation is very suitable for rubber, being steep, rather bare and stony; and excessively dry during the dry season. I would therefore not recommend the planting of rubber on such places.

96. Good "warkas" lands in the district, such as are to be seen between the plantation and Thana town, are very suitable for rubber. The distances recommended for planting the different species of rubber in the Thana District are given in paras 37, 38, and 89.

97. If planted under proper conditions, Para and Ceara rubber are likely to succeed in the district. I do not however think that the growth of the trees will be so rapid as at Gairsoppah or elsewhere along the foot of the North Kanara ghats, including Kadra; but if growth can be obtained like that of the Para rubber shown in photo No. 17, I see no reason why the trees should not commence to yield profitable returns from about the seventh or eighth year after planting.

KAVESAR, NEAR THANA.

98. In the afternoon of the 5th June Mr. Madan took me to see a block of land 92 acres in extent at Kavesar about four miles north of Thana. The land is undulating and inclined to be hillocky; and, with the exception of a few large trees in parts, it is covered with small forest and scrub-jungle. A few Ceara trees were planted on this area about two years ago, but they look very poor on the whole owing to want of attention. A few however are fairly good, as shown by the following measurements which I took of the three best plants:—

Height.	Girth at 4 feet from the ground.
8' 10"	4"
7' 3"	2½"
8' 10"	3"

With pits made of the sizes recommended in para 30, and with the proper shade and watering during the first two years or so, I see no reason why *Ficus elastica*, Para, and Ceara rubber should not succeed on the greater part of this area.

PELHAR RUBBER PLANTATION, BASSEIN TALUKA.

99. I visited this small plantation in company with Mr. Madan from Thana and Mr. Gilbert, the Divisional Forest Officer in charge of the plantation, on the 6th June 1909.

100. The plantation is situated on an easy slope along the base of a hill (*vide* photos Nos. 19 and 20) about five miles inland from Bassein Road station and about eight or nine miles from the sea, and is very little above sea-level. Its area does not exceed 2 acres at present, most of which has been planted; and it is enclosed by a rough 4-railed fence.

101. *Temperature and Rainfall.*—At Bassein the average annual temperature is 81° and the average annual rainfall is 82.36 inches (*vide* para 18 of the 2nd edition of the "Statistical Atlas of the Bombay Presidency," and Appendices VI and VII). The temperature and rainfall are both suitable for growing rubber.

102. *Water-supply.*—A new well has been made in the plantation to meet this requirement.

103. *Soil*.—The soil in the plantation (*vide* Appendix II) is shown in five samples (Nos. 34—38). Nos. 34, 36, and 37 are taken from the surface in different parts of the plantation and show that the soil is fairly good. No. 35 is lighter in colour and was taken from a depth of 18 inches from a pit in the south-east corner of the clearing; while No. 38 was taken from a depth of 3 feet from the same pit as No. 37 was taken and represents the nature of the sub-soil at that depth at the north-east corner or top of the plantation. It will be observed that samples 35 and 38 are both lighter in colour than 34, 36, and 37, and are not so good or so rich as they are. The Pelhar soils are suitable for the growth of rubber.

104. The seeds and plants of the different rubbers which have been planted in the plantation were obtained chiefly from the Muland nursery and from Bassein Fort Botanical Garden.

105. *Number of Rubber Trees planted*.—On the area, 80 *Cearas* were planted in 1907 and 1908; 157 *Castilloa* in July and in September 1908; 12 *Para* on the 20th November 1908; 9 *Ficus elastica* on the 20th July 1908 and 59 on the 10th January 1909.

106. *Distances of planting*.—The *Para*, *Ceara*, and *Castilloa* plants have been planted 12' × 12', and *Ficus elastica* at 30' × 30' apart.

107. The 12 *Para* which were planted in November 1908, at the beginning of the last dry season, are alive and healthy, although they have not made much growth yet. Many failures have occurred among the *Castilloa* and *Ceara* plants from various causes. These failures should, of course, be filled in without delay (*vide* paras 13 and 32.) In the first place, the pits were made too small, being mere holes about 12 × 12 × 18 inches deep, very few indeed being larger; secondly, the young plants required more shade during the dry hot season; thirdly, they appeared to lack proper watering and general cultural attention; fourthly, animals, ants, and insects also did damage to the plants to some extent. The plants of *Ficus elastica* have fine glossy leaves and are looking well, although they have not made much growth yet.

108. Several of the rubbers need pruning, especially the *Castilloa*. All dead and misplaced shoots should be removed by means of a sharp pruning knife.

109. The following are the measurements of 12 plants each of *Ceara*, *Para*, and *Castilloa* which were kindly taken for me by Messrs. Gilbert and Madan while I was present on the 6th June 1909 (*vide* photos Nos. 19, 20, 21):—

Ceara.			Para.		Castilloa.	
Label No.	Height.	Girth at 4 feet from ground.	Label No.	Height.	Label No.	Height.
	Ft. in.	Inch.		Ft. in.		Ft. in.
3	12 5	5	85	0 11	Nil	1 3
4	12 1	5	86	1 8	Nil	1 7
13	7 0	3½	87	1 8	Nil	1 5
18	7 9	2¾	88	1 9	Nil	1 7
20	10 6	3½	89*	2 0	Nil	2 8
21	10 11	4½	90	1 9	Nil	1 5
22	12 4	4½	91	2 2	Nil	2 6
23	9 10	4	92	1 4	Nil	2 4
24	10 7	4¾	93	2 2	Nil	2 5
25	10 6	4½	94	0 11	Nil	3 4
26	12 4	4¾	95	1 2	Nil	2 5
27	11 5	4	96	2 3	Nil	2 3

* Shown in photo No. 21. As the wind was blowing strongly, a good photograph of the plant was not obtained.

110. *Expenditure.*—The expenditure on this plantation from the commencement up to the 31st March 1909 has been as follows:—

			Rs.	a.	p.
1906-07	...	...	65	2	0
1907-08	...	...	143	0	6
1908-09	...	...	240	3	9
			<u>448</u>	<u>6</u>	<u>3</u>

111. If any extension of the plantation is contemplated, it would be well to practically clean fell the area and either allow the secondary jungle to grow up for shade or keep the plantation clean-weeded. The respective advantages and disadvantages of these two systems are referred to in paras 35, 36, 60, 61, 62, and 63. Ceara, Para, and *Ficus elastica* might then be planted as suggested below. *Castilloa* I do not recommend, except on a very limited scale, say a couple of acres at present (*vide* my remarks in paras 38, 66, 90, and 122).

The plantings suggested may be as follows:—

Area already planted with mixed species of rubber...	2	acres.
Suggested to be planted with Para	...	10 "
Do. do. Ceara	...	12 "
Do. do. <i>Ficus elastica</i>	...	4 "
Do. do. <i>Castilloa</i>	...	2 "
Total	...	30 acres

I would suggest Para and Ceara to be planted at 17' X 17', *Castilloa* at 15' X 15', and *Ficus elastica* at 40' X 40' apart, and that the different species of rubber should be grown pure.

The plants will, however, need lateral shade, and other needful attention in their early years, especially during the hot season, till they become well established and have grown large enough to form their own shade.

BASSEIN FORT BOTANICAL GARDEN.

112. Late in the afternoon of the 6th and again on the forenoon of the 7th June I visited this interesting old fort, the land within the walls of which has in recent years been made into a Botanical Garden.

113. The chief object of my visits was to see the rubber trees which were planted there on the 16th July 1906 by Mr. Gammie, who was Government Botanist, Bombay, and in charge of the garden at that time, but now Imperial Cotton Specialist.

This Fort is near and within the mouth of the Bassein Creek. -

114. The temperature and rainfall are given in para 101 above.

115. The soil in this garden (*vide* Appendix II) is fine and contains a good percentage of sand. No. 39 was taken from a depth of 3 feet and is fairly representative of the soil in the garden; while No. 40 was taken from the surface among the *Castilloa* rubber trees (*vide* photo No. 23). It contains a good deal of old lime-rubbish and stones from the ruins of the old buildings.

116. The rubber trees represented are Para, Ceara, and *Castilloa*. These were raised from seeds introduced from the Nilgiris in May 1906, and the plants were planted on the 16th July of the same year. Ceara has made the best growth up to date, while Para and *Castilloa* have not made such rapid progress.

117. I took the measurements of all the planted out trees of Para and Ceara, but not of all the *Castilloa* trees, and they are given in the following table:—

Measurements of Rubber Trees growing in the Bassein Fort Botanical Garden, near Bombay.

Ceara.				Para.	Castilloa.
Height.	Girth at 4 feet from ground.	Remarks.		Height.	Height.
In Group (A)				In Group (A)	In Group (C)
Ft. in.	Inches			Ft. in.	Ft. in.
24 5	8½			4 4	3 10
20 9	12½			5 11	4 4
6 0	6¼*	*Broken top.		4 7	3 10
15 10	8				3 11
15 5	8				4 8
10 5	4½				4 10
18 9	8				3 6
20 11	11				3 9
14 11	5¼				4 0
6 3	2½				3 6
14 3	3½				3 2
13 8	6¼				3 2
16 5	8¼				4 2
19 5	12½				3 8
16 5	7				3 10
7 9	3				4 5
7 2	3½				4 1
1 11	...†	† Top ded back.			3 11
5 6	6 †	† Girth at 3 feet. Broken top.			3 11
5 9	1½				3 5
15 3	5½				3 2
15 8	6½				2 10
11 7	4				3 3
10 11	5½				3 4
10 1	6				4 1
13 4	8½				3 3
10 10	4½				4 0
10 3	4¼				
In Group (B)				In Group (B)	In Group (B)
17 8	17			7 8	5 4
17 4	9			5 9	3 10
16 4	10			3 8	4 2
13 6	5¾			3 11	4 2
				4 1	3 8
				10 1 1/2	3 4
				4 8	
				6 0	

118. The picturesque old ruin seen in photo No. 25 is fairly characteristic of the general style and condition of the buildings in the Fort.

119. The rubber plants may be divided into three groups or sections according to their respective situations in the garden.

In Group (A) there are 28 Ceara and 3 Para trees. The former are shown in photo No. 25 and the 3 Para are against the wall to the right, just out of sight. The crop that is to be seen growing between the Ceara trees is cotton of different varieties. It will be observed that 3 Cearas have leaves on them and the rest are deciduous.

120. In Group (B) there are 8 Para; several *Castilloa* plants, 6 of which I measured, growing under the shade of the walls of one of the old buildings; and 4 Ceara trees. The best Para tree is growing close to an old wall. This tree is 10' 1" in height and is shown in photo No. 22, with Mr. Sampson, Range Forest

Officer, Bassein, standing by it. It is in excellent health and has made very fair growth. The smallest one is $3\frac{1}{2}$ feet in height; while the average height of the 11 plants in the garden is about 5.52 feet.

The *Castilloa* do not look particularly happy on the dry bare ground. They would certainly do better if they were watered sufficiently and if the ground were shaded.

The best shaped Ceara in the garden is 17' 8" in height and 17" in girth at 4 feet from the ground. It is a double-stemmed tree, as shown in photo No. 24, with Mr. Joshi, the Curator of the garden, standing near it. This tree has been tapped and the tapping marks on the stem can be seen in the photograph. It has a fine, broad, well-shaped crown and is in full leaf. The young thin stem, which springs from the base of the main stem, should be removed and the wound tarred to prevent decay, the ingress of fungi, white ants, species of "borer," and other insect pests.

121. In Group (C), some little distance away from the plants in Groups (A) and (B), a number of *Castilloa* have been planted among and between trees (Tamarind, Phoenix, etc.), standing at irregular intervals, which afford moderate shade to them (*vide* photo No. 23). The ground on which they are planted is full of old lime rubbish and stones from the fallen walls of some of the old buildings.

The plants were planted in May 1907, and are doing fairly well, having made fairly even, though not very quick, growth. They need immediate cultural attention in regard to (a) digging of the ground round each plant as deeply as possible without damaging the roots, for a distance of at least four feet away; (b) manuring; and (c) watering. The tallest plant is 5' 4" in height. The average height of the 33 trees measured—6 trees being in Group (B) and 27 in Group (C)—is about 3' 10" or 3.82 feet.

122. Upon the whole, Ceara is the most promising species and is likely to prove successful in the district. Para also is likely to do well, but not so well as Ceara; while *Castilloa* will not be likely to do well except in rich, friable, well-drained, moderately-moist soil with good lateral shade.

VICTORIA GARDEN, BOMBAY.

123. On the 8th June, while in Bombay, I had the pleasure of meeting Mr. Millett, Conservator of Forests, N. C., and Messrs. Thompson and Gilbert, Divisional Forest Officers, when the prospects of growing rubber in the Thana District were discussed.

124. On the 9th of June I visited the Victoria Garden for the purpose of seeing any rubber trees which might be growing there. I found and was shown only a few trees of the following different species.

125. *Para Rubber*.—Only three plants, bearing a label numbered 15142, were found growing in pots in the nursery. I was informed that they had been received from the Muland nursery. They are about $2\frac{1}{2}$ feet high and are looking well.

126. *Castilloa elastica*.—I noticed only a few small plants in the nursery. In the garden I was shown a specimen 18' 3" in height and 1' 2" in girth at 4 feet from the ground. The stem had been badly injured some years back and the tree is certainly looking not well in consequence. The bark is, however, trying (vainly I fear) to grow over and heal the long wound on the stem. I was informed that this was the only *Castilloa* tree they have in the garden. Given similar conditions in regard to climate, soil, water-supply, and environment, *Castilloa* is likely to grow well in Bombay.

127. *Ficus elastica*.—There are a few good-sized, strong, healthy-looking trees of this species in the garden. One I measured was a fine young tree 2' 2" in girth, and another, a large, well-established tree, was 5' $6\frac{1}{4}$ " in girth at 4 feet from the ground. The latter is old enough to be tapped, and if it could be tapped by an experienced Assam rubber tapper, the result would furnish information of real practical value. The yield and market value of the rubber obtained would furnish fairly reliable figures as to the yield and return that might be expected per acre from land in the district if planted with this species of rubber.

128. *Ceara Rubber*.—In the nursery I saw only a few young plants of this species. In the garden I was shown a tree which I measured and found to be 4' 3" in height and 2' 6" in girth at 4 feet from the ground. It appeared to be in a normally-healthy condition, but rather drawn up as it is growing among other trees of different species.

GANESHKHIND BOTANICAL GARDEN, NEAR POONA.

129. On the 15th June 1909 I visited this garden in company with G. A. Gammie, Esq., F.L.S. He kindly showed me the rubber trees under cultivation there. In one plot I saw cotton was being grown along with Ceara. Here the rubber was not looking well. The plants had made comparatively slow growth, and many of them showed signs of a seasonal die-back of their leading shoots to a variable extent.

In another group the trees, which were planted in July 1903, are taller, but they do not seem to be doing very well. I took the girth measurements of 7 of the best trees; they were $10\frac{1}{2}$, $10\frac{3}{4}$, $11\frac{1}{8}$, $11\frac{3}{4}$, $10\frac{3}{8}$, $11\frac{1}{2}$, and $11\frac{1}{2}$ inches respectively at 4 feet from the ground. They are from about 20 to 25 feet in height and are shown in photo No. 26. Mr. Gammie is to be seen standing in the right of the photograph.

130. Mr Gammie is of opinion that the climate is unsuitable for Ceara.

I noticed (a) that the trees are growing in medium black cotton soil; (b) that the land had been ploughed; and (c) that there were an unusual number of cases where the stems of trees were injured.

131. Cotton soil contracts, and wide, deep fissures are formed in it before the end of each dry season; and during the rainy season these fissures close up owing to the expansion of the soil that takes place consequent on the absorption of water. The effect of this periodical alternating contraction and expansion of the soil probably causes mechanical injury to the young, tender, and delicate feeding roots of the rubber trees by tearing them to a certain extent. Or, it may be that during the dry season the dry, hot air gains access to the young roots by means of the deep fissures in the soil and the roots consequently suffer from the effects thereof.

The ploughing of the land may injure or destroy the roots of the trees that happen to be near the surface; and if important roots are broken, the injuries to the stems referred to may be caused thereby.

In almost all cases the injuries to the stems commenced apparently at ground level and extended up the stem a short distance varying from one to several feet. Probably the injury extends to below the ground if injury to the roots is the real cause, as I suspect it to be. The injured strips varied from 1 to 2 or 3 inches in width. The injury might also be caused by carelessness on the part of the ploughman in letting the plough graze the stems.

All the above - the climate, the soil, and the ploughing between the trees—may possibly be contributory causes as to why Ceara is not growing very successfully at Poona. The subject however requires further investigation as to why Ceara does not succeed well at Ganeshkhind. In this connection it will be advisable to bear in mind the above remarks when any enquiry may arise as to the prospect of growing, or when any proposal may be made to grow, Ceara rubber on cotton soils.

CONCLUDING REMARKS.

132. The chief drawback to the successful growth of rubber in the Bombay Presidency is said to be the long annual drought that is experienced. Mr. Coppleston's views are given in para 27 and Mr. Bell's in para 52. At Thana Mr. Madan is hopeful, while Mr. Gilbert is, I think, likely to do his best with his small plantation at Pelhar. Mr. Gammie's opinion is given in para 130.

133. The rubber plantations which I inspected recently in the order given below are situated at—

- (1) Gairsoppah in the Southern Division of North Kanara.
- (2) Kadra in the Northern Division of North Kanara.
- (3) Belgaum.
- (4) Thana.
- (5) Pelhar.
- (6) Bassein.
- (7) Bombay.
- (8) Poona.

These may be classified under three groups according to the relative suitability of the localities for growing rubber :—

Group I.—Gairsoppah, below the Ghats, in the Southern Division of North Kanara.

Bargudda, Kadra, below Ghats, in the Northern Division of North Kanara.

Group II.—Thana, Pelhar, Bassein, and Bombay in the Thana District.

Group III.—Belgaum and Poona.

The best district in the Presidency for rubber is Kanara. In the fine evergreen forest region along the foot of the Ghats from near Bhatkal to Kadra, where the climate is hot and moist for a good part of the year, the conditions are, upon the whole, favourable for the successful growth of rubber, especially for Ceara and for Para.

Next to Kanara comes Thana, where the climate is also hot and moist and fairly suitable for rubber.

I do not, however, think that the Thana District is quite so promising as Kanara for growing rubber ; but still the conditions are not altogether unfavourable. The growth of the trees is not likely to be quite so rapid as it will be, nor will they yield such early returns as they will in Kanara.

With regard to Belgaum and Poona I would not recommend them as rubber-growing districts.

134. It is quite a mistaken idea to think that any kind of land or any kind of treatment is good enough for rubber, and the sooner this is realised and understood the better will it be for the rubber trees, for the planters concerned, and for the Government.

135. The re-pitting and re-planting of all the plantations is necessary if success is to be looked for. All plants which are doing well need not be disturbed ; but it is advisable that they should be dug round as recommended in paras 36, 60, and 86. On the other hand, all sickly plants and those that are not growing well or do not appear to be in a thriving or promising condition should be taken out ; and all plants that are worth re-planting may be re-planted in full-sized pits as recommended in para 30.

In this connection I would recommend the carrying out of the suggestion contained in para 32 about planting only selected, strong, vigorous plants.

During the first two or three years after they are planted, vigilance and care will be necessary in looking after the plants properly till they become independent of being watered by coolies and well established. The needful directions for giving the rubber plants the conditions and attention they require are given in the different paragraphs in the Report.

136. *Suggestions as to terms on which land may be granted to planters for growing Rubber.*—In para 96 of my "Report on the Rubber Trees at Nilambur and at Calicut, South Malabar," I made certain suggestions for granting lands to planters for growing rubber, which may be taken into consideration in connection with the subject under reference. I would suggest that blocks of good land suitable for rubber should be selected and demarcated into convenient-sized blocks of 250, 500, or 1,000 acres each, or in lots to suit applicants for land. As all the land within a block, either on account of the quality of the soil, or steepness, or other causes, is not likely to

be suitable for rubber, it would be advisable to reserve the forest on such areas (except where they may be required by the lessee for building upon or for other purposes) and grant intervening pieces of suitable land till the total area of any given concession is made up. The blocks of land might then be offered to the public. This could be done by advertising in the Government gazette, in the leading Indian daily and planting papers, and in the Ceylon, Singapore, London, Dublin, Edinburgh, and New York papers, briefly mentioning the terms on which land is to be granted. By giving wide publicity to the matter, capital would be attracted to the country. By way of caution I would strongly recommend that every planter who may be thinking of planting rubber in the Bombay Presidency should inspect the country along the foot of the Ghats in the North Kanara District and satisfy himself as to the suitability and prospects of the country for growing rubber before he submits his application for a grant of land. Sufficient time, say 6 to 9 months, should be given between the date of the announcement in the papers offering lands on certain terms, briefly specified in the notice, and the time when applications for grants would be considered.

The terms on which the Madras Government has granted lands to rubber planters are briefly as follow. Lands planted and to be planted with rubber will be granted free of assessment for five years in the Nilgiris and for three years in certain other districts. On the expiry of the free-assessment periods, planters have to pay the ordinary assessment levied on cultivated lands.

I venture to propose, for consideration, that land be granted to prospective rubber planters on the following terms:—

- (1) That Government will fell and remove all the timber it may decide to fell and remove from the land before handing it over to the grantee.
- (2) That the grantee shall be free to dispose of, as he thinks fit, any timber that may be on the land after it has been made over to him.
- (3) That the grantee shall pledge himself not to burn felled jungle and brushwood (except thorny species) on the land granted to him (*vide* paras 9 and 25).
- (4) That rubber shall be the principal crop to be grown.
- (5) That the minimum number of rubber trees shall not be less than 50 to the acre.
- (6) That no rubber trees shall be cut down that will have the effect of leaving fewer than 50 evenly-planted trees to the acre, except with the sanction of Government or its authorised agents.
- (7) That the grantee shall, after having, to the satisfaction of Government, planted the land with rubber trees, have full liberty to grow suitable catch-crops on the land between the rubber trees. It should, however, be understood that these must be considered to be of secondary importance to that of the rubber trees, and their cultivation must be discontinued when it is detrimental to the rubber plants.
- (8) That Government will in all cases, as far as may be convenient, practicable, or advisable, grant permission or facilities to the grantee to obtain a supply of water, from streams or other sources beyond the boundaries of the land granted to him, for the use of his plantation.
- (9) That the land shall be granted free of assessment; but, in lieu of assessment, a royalty or export duty of four annas per pound shall be paid by the grantee to the Government on every pound of rubber that is obtained from the rubber trees, used, manufactured, or sold on his plantation, or exported.
- (10) That all rubber plantations, factories, stores, sheds, and buildings of any kind whatsoever shall be open to inspection by duly authorised Government officers at any time.
- (11) That any evasion, neglect to carry out, or contravention of the aforesaid conditions shall be dealt with by the Government as the circumstances of each case may warrant.

✓137. It cannot be expected that Forest officers, who have large districts to look after, can devote the time that is necessary for the proper maintenance and success of the Government Experimental Rubber Plantations which have been placed in their charge and which they are made responsible for (*cf.* paras 11 and 29). The best way would appear to be to appoint a qualified special officer to take entire charge of the management of the plantations if it is desired that the rubber trees should have a fair and proper chance of becoming established and of showing to what degree they will prove successful. In this connection, my remarks in para 97 of my "Report on the Nilambur Rubber Trees" (referred to in para 136 above) may be referred to and noted.

138. The opinion I have formed is that rubber will grow successfully and prove financially profitable in Kanara, if the suggestions I have made in different paragraphs in this Report are carried out.

My remarks in the preceding paragraphs which relate to the rubber trees in the Thana District will show that rubber, if properly grown, gives promise of being successful there; but the growth will be somewhat slower than what may be expected in Kanara.

I therefore recommend Kanara as being the best district, and Kadra, which is situated therein, as being the best centre which I have seen in the Presidency, for establishing rubber plantations on a large scale.

139. In conclusion, I desire to acknowledge the kind help which I received from Messrs. Copleston, Bell, Madan, and Gilbert, and from their subordinates, in affording me facilities and information in connection with my inspection of the different plantations. I also specially wish to acknowledge the ready assistance I have all through received from Mr. Talbot, the Conservator, C. C., under whose orders I was placed while I was on duty in the Presidency.

August 7th, 1909.

R. L. PROUDLOCK,
Curator,
Government Botanic Gardens and Parks,
The Nilgiris.

APPENDICES.

- I, IV, X, and XI—Photographs, Map, and Plans (not reproduced).
- II—List of Soil samples (not printed).
- III—Specimen of Ceara (enclosed in an envelope).
- V, VI, VII, XII—Temperature and Rainfall Statements (printed).
- VIII—Statement showing number of Rubber Seeds sown, germination results, and disposal of the Seedlings (printed).
- IX—Statement showing Expenditure on the Gairsoppah Rubber Plantation up to the 3rd March 1900 (printed).

APPENDIX V.

Statement showing the Average Monthly and Annual Minimum and Maximum Temperatures at the following Stations on the West Coast of India, at Colombo, and at Mergui in Tenasserim.

[Corrected figures kindly furnished by the Director-General of Observatories, India Meteorological Department, Simla.]

Station.	Distance between each station approximately in miles.	Period over which observations have been taken.	January.		February.		March.		April.		May.		June.	
			Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.
Bombay	1875-99	67.9	82.6	68.7	82.6	73.4	85.7	77.7	88.5	80.7	90.7	79.5	87.6
Ratnágiri	1877-99	66.2	87.7	67.3	86.4	72.4	87.8	77.4	90.1	79.6	91.1	77.2	86.6
Marmagao	1890-99	68.9	85.8	71.2	84.9	75.5	86.9	80.0	90.1	81.1	90.0	77.9	87.0
Kárwár	1877-99	65.5	86.9	67.3	86.3	73.0	87.8	77.9	90.0	79.7	89.8	76.1	85.3
Mangalore	1880-99	69.5	88.5	72.3	88.1	76.0	89.4	78.7	91.1	78.8	90.3	75.0	85.0
Calicut	1880-99	69.6	87.6	72.6	88.7	76.1	90.3	77.9	91.3	77.9	90.4	74.7	84.6
Cochin	1875-99	71.5	89.1	73.7	89.9	77.0	91.2	78.4	91.5	77.6	89.6	74.7	85.0
Trivandrum	1879-99	72.4	83.4	74.0	85.0	76.7	87.1	78.3	87.5	78.5	86.3	76.2	82.9
Colombo	1875-99	72.1	87.5	72.9	88.3	74.9	89.4	76.0	88.9	78.4	88.0	77.5	85.7
Mergui	66.9	88.1	69.1	89.6	71.9	91.2	73.7	91.9	73.8	89.1	73.1	85.7

	July.		August.		September.		October.		November.		December.		Average Annual Minimum.	Average Annual Maximum.	Mean Annual Temperature.
	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.			
Bombay ...	77.5	84.4	77.0	84.0	76.5	84.5	76.5	87.5	73.3	86.9	69.8	84.5	74.9	85.8	80.4
Ratnágiri ...	75.7	83.9	75.2	83.7	74.4	84.2	74.0	88.2	70.0	90.5	67.2	89.5	73.1	87.5	80.3
Marmagao ...	76.2	83.7	75.8	83.4	75.1	83.5	75.6	86.0	72.8	87.0	70.3	86.3	75.0	86.2	80.6
Kárwár ...	75.1	83.0	74.6	82.5	73.9	82.7	73.4	85.4	69.4	87.4	66.2	87.7	72.7	86.2	79.5
Mangalore ...	74.2	83.0	74.0	82.8	74.1	83.3	74.6	85.7	72.8	88.3	70.0	89.5	74.2	87.1	80.7
Calicut ...	73.9	82.5	74.1	82.8	74.4	84.3	74.5	86.2	73.1	87.4	70.5	87.6	74.1	87.0	80.6
Cochin ...	74.1	83.5	74.3	83.7	74.5	84.6	74.6	86.2	74.4	87.5	72.9	88.5	74.8	87.5	81.2
Trivandrum ...	75.2	82.1	75.4	82.3	75.3	82.9	75.2	82.7	74.4	82.6	73.4	83.0	75.4	84.0	79.7
Colombo ...	77.6	85.4	77.5	85.6	77.0	86.0	75.4	85.7	74.1	86.4	73.0	86.9	75.5	87.0	81.3
Mergui ...	72.5	84.5	72.6	84.2	72.2	84.4	72.1	87.2	69.7	87.4	66.7	87.3	71.2	87.6	79.4

APPENDIX VI.

Statement showing latest normal values of Rainfall at the following Stations.

[Corrected figures kindly furnished by the Director-General of Observatories, India Meteorological Department, Simla, with his letters Nos. 2814-S., dated 30th July 1909, and 2931-S., dated 6th August 1909.]

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total for the year.	Minimum rainfall.	In the year	Maximum rainfall.	In the year
Bhatkal ...	In. 0·10	In. 0·01	In. 0·07	In. 1·15	In. 4·42	In. 44·43	In. 47·09	In. 31·04	In. 14·04	In. 8·48	In. 2·14	In. 0·19	In. 153·16	In. 108·32	1899	In. 195·03	1897*
Honávar ...	0·16	0·01	0·10	0·60	3·44	41·73	43·04	27·65	14·48	7·16	1·15	0·12	139·64	89·25	1881	192·69	1892
Kárwár ...	0·12	0·01	0·04	0·44	3·12	35·83	37·98	22·15	11·87	5·72	1·48	0·11	118·87	72·44	1899	193·33	1878
Thána ...	0·17	0·06	0·06	0·01	0·36	23·79	37·16	21·84	12·64	2·72	0·28	0·04	99·13	41·87	1899	152·09	1878
Bassein ...	0·15	0·05	0·01	0·01	0·37	19·76	30·56	16·07	12·86	2·26	0·18	0·08	82·36	30·76	1899	95·88	1897*

* *Note.*—The maximum and minimum values of Bhatkal and Bassein are derived from the records of the years 1897—1908. The periods covered for the other stations are from 10 to 40 years.

Statement showing the Monthly and Annual Average Rainfall and number of Rainy Days

[Corrected figures furnished by the Director-General of

District.	Station.	Distance between each station approximately in miles.	Period over which observations have been taken.	January.		February.		March.		April.		May.	
				Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.
Thána	Umbargson	...	...	0.1	0.02	...	0.09	...	...	...	...	0.3	0.13
	Dabánu	...	...	0.1	0.09	0.1	0.05	...	...	...	...	0.6	0.23
	Máhinu	...	...	0.2	0.10	0.1	0.03	...	0.01	0.1	0.02	0.4	0.44
	Baasein	...	...	0.2	0.15	0.1	0.05	...	0.01	...	0.01	0.6	0.37
	Thána	...	...	0.3	0.17	...	0.06	0.1	0.06	0.1	0.01	0.7	0.36
	Bombay	Colaba	0.2	0.12	0.1	0.02	...	0.01	0.1	0.35	0.6
				0.1	0.03	0.1	0.01	0.1	0.01	0.7	0.22
Kolaba	Alibág	...	...	0.3	0.09	0.1	0.02	...	0.01	0.3	0.16	1.0	0.74
	Roha	...	...	0.1	0.06	0.1	0.06	...	0.01	0.2	0.21	1.0	0.72
	Mángaon	...	...	0.1	0.06	...	0.02	...	...	0.3	0.45	1.0	0.88
Ratnágiri	Dápoli	...	...	0.1	0.07	...	...	...	...	0.2	0.45	1.4	1.37
	Gnhágar	...	...	0.2	0.15	...	0.1	...	...	0.2	0.25	1.0	1.31
	Ratnágiri	...	...	0.2	0.60	0.1	0.02	0.1	0.05	0.1	0.15	1.5	1.27
	Rájápur	...	...	0.2	0.15	0.1	0.03	...	0.02	0.2	0.07	1.9	2.07
	Máivan	...	...	0.2	0.14	0.2	0.12	...	...	0.5	0.20	1.8	2.23
	Vengurla	...	...	0.2	0.19	0.1	0.02	0.1	0.03	0.6	0.23	2.6	2.05
Sávantvádi	Sávantvádi	...	...	0.2	0.18	0.2	0.05	0.1	0.01	1.1	0.69	2.2	2.22
Goa	Marmagao	...	...	...	...	...	0.05	...	...	...	1.04	...	2.57
North Kánara	Kárwár	...	...	0.1	0.12	...	0.01	...	0.04	0.9	0.44	3.6	3.12
	Ankola	...	...	0.1	0.09	...	0.06	...	...	0.8	0.48	3.6	3.30
	Honávar	...	...	0.1	0.16	...	0.01	0.2	0.10	1.1	0.60	3.9	3.44
	Bátikal	...	...	0.1	0.10	...	0.01	0.1	0.07	1.6	1.15	4.2	4.42
South Kánara	Coondápur	...	...	...	0.19	...	0.01	...	0.10	2	0.70	6	5.77
	Mangalore	...	...	...	0.17	...	0.08	...	0.08	3	1.69	7	6.49
	Kasárgod	...	...	...	0.28	...	0.06	...	0.18	3	1.84	7	7.49
Malabar	Camenore	...	...	...	0.28	...	0.23	1	0.24	4	2.75	7	7.43
	Badagara	...	...	...	0.38	...	0.35	1	0.48	5	3.48	8	7.87
	Calicut	...	...	...	0.25	...	0.21	1	0.72	5	3.66	9	9.32
	Nilambar	...	...	...	0.09	...	0.19	1	0.57	5	2.38	8	5.32
	Ponani	...	...	...	0.25	...	0.50	1	1.14	6	4.22	11	10.17
Cochin	Trichar	...	...	0.1	0.02	0.4	0.43	1.3	0.73	7.6	5.95	10.4	8.53
	Ernacolam	...	...	0.5	0.33	1.5	1.21	2.9	2.09	8.8	5.65	12.7	9.55
	Cochin	...	...	1	0.74	2	0.98	3	2.13	7	5.13	13	11.78
Travancore	Kotayam	...	...	0.6	0.33	1.5	0.51	3.5	3.37	8.4	5.91	10.1	8.44
	Alleppey	...	...	0.9	0.77	2.8	1.23	4.5	2.72	9.9	7.03	11.6	9.07
	Quilon	...	...	0.5	0.37	1.9	1.20	3.5	2.30	9.2	6.10	11.5	8.24
	Trivandrum	...	...	1.3	0.64	1.1	0.62	2.6	1.58	7.1	4.76	10.2	8.91
	Kolschal	...	...	...	...	...	...	...	...	...	...	...	...
	Nagercoil	...	...	0.7	0.93	1.4	0.89	1.4	0.97	5.2	4.32	2.1	1.32
	Cape Comorin	...	...	...	...	...	...	...	...	...	...	...	...
	Colombo	...	...	7.4	3.24	5.6	1.89	10.6	4.75	17.5	11.43	20.5	12.10
Nagri (Sembilava Maiaya).	...	...	...	...	...	...	...	...	...	...	...	No	
Mergui	...	...	1.4	0.72	2.8	1.60	4.7	2.73	6.7	6.05	18.0	18.34	

* Mean of 76 years.

DIX VII.

at the following Stations on the West Coast of India, at Colombo, and at Mergui in Tenasserim.

Observatories, India Meteorological Department, Simla.]

June.		July.		August.		September.		October.		November.		December.		Average Annual	
Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Average number of rainy days.	Average rainfall.	Number of rainy days.	B. rainfall.
10.5	15.10	20.7	24.89	18.1	14.38	10.7	11.08	2.1	1.30	0.3	0.08	0.02	0.02	62.8	67.05
11.6	16.80	22.2	27.04	18.3	14.36	12.0	11.16	2.5	1.44	0.4	0.18	0.2	0.04	68.0	71.37
12.7	15.59	22.3	22.37	19.0	12.94	12.3	10.07	3.0	1.80	0.6	0.32	0.1	0.05	70.8	68.73
13.4	19.76	22.9	30.53	20.4	16.07	13.3	12.86	3.1	2.28	0.5	0.18	0.1	0.08	74.8	82.36
17.3	23.79	27.3	37.16	26.3	21.84	16.0	12.34	4.6	2.72	0.9	0.28	0.1	0.04	93.7	99.18
15.3	20.56	21.5	24.56	18.5	14.91	12.9	10.93	2.9	1.78	0.7	0.47	0.1	0.05	73.1	73.00
14.7	22.24	23.0	27.19	19.5	15.83	14.0	11.53	2.7	1.55	0.6	0.13	0.1	0.01	75.6	78.75
16.7	23.85	24.3	30.44	22.5	17.17	15.1	14.64	3.4	2.88	0.7	0.49	0.2	0.05	84.4	90.54
19.0	27.40	28.3	46.01	27.3	29.02	17.7	15.99	5.6	4.49	1.0	0.91	0.1	0.03	103.4	121.91
19.9	25.66	27.8	48.54	27.4	31.08	19.1	18.58	6.3	5.03	1.1	0.76	0.1	0.10	103.1	131.16
21.0	35.04	28.7	49.23	27.5	31.48	17.6	16.43	4.7	3.18	1.0	0.63	0.1	0.12	102.3	136.06
19.1	26.67	25.3	34.91	23.3	19.28	15.3	10.85	2.6	3.01	0.8	0.46	0.1	0.01	89.5	97.41
20.5	31.32	25.9	34.36	23.7	20.19	15.6	12.53	5.0	3.62	1.0	0.65	0.1	0.06	93.8	101.71
22.7	37.02	29.0	48.23	26.7	23.52	16.3	13.72	7.5	6.10	1.7	1.06	0.2	0.07	107.0	137.08
18.2	26.08	23.0	31.05	21.8	15.76	14.7	11.01	4.3	3.77	1.4	0.91	...	...	86.6	91.83
21.2	33.87	25.9	35.45	22.7	21.11	14.4	10.93	6.7	4.55	1.6	0.97	0.1	0.15	96.2	109.82
22.5	42.34	29.2	57.69	27.5	33.44	17.8	13.12	9.0	6.67	2.1	1.37	0.2	0.07	112.4	157.85
...	23.63	...	31.38	...	13.59	...	8.34	...	6.17	...	1.16	...	...	...	93.43
23.3	35.83	27.4	37.93	24.0	22.15	15.1	11.87	3.5	5.72	2.5	1.48	0.1	0.11	105.5	118.97
23.0	39.23	23.0	41.43	24.5	25.05	15.6	12.25	3.1	7.36	2.1	1.57	0	0.02	106.7	130.83
24.0	41.73	23.3	43.04	25.2	27.65	17.3	14.43	3.9	7.16	2.3	1.15	0.3	0.12	112.1	139.64
24.3	44.43	23.8	47.09	25.8	31.04	16.6	14.04	9.5	8.43	2.8	2.14	0.3	0.19	114.1	153.16
24	39.69	23	44.35	24	26.43	17	14.76	9	7.63	2	1.68	0	0.30	112	141.71
25	37.81	27	39.24	24	22.75	17	12.18	10	7.58	4	2.36	1	0.47	113	130.90
25	37.82	28	38.40	23	21.16	15	10.61	10	6.96	4	2.68	1	0.39	116	125.76
25	37.84	27	34.79	21	13.42	14	8.91	10	7.39	4	3.46	1	0.61	114	122.35
25	38.21	27	34.74	21	17.20	13	8.31	10	7.79	5	4.01	1	0.59	113	123.41
24	35.71	26	30.05	19	15.16	12	8.27	12	9.98	6	4.22	2	1.14	116	115.69
22	25.17	23	33.43	19	15.92	14	8.16	13	9.09	7	4.55	2	0.87	117	109.24
24	28.53	24	23.49	18	12.27	11	6.77	12	10.18	6	4.58	1	0.96	114	103.63
24.5	39.56	26.3	30.74	20.6	18.30	11.4	7.70	13.6	14.15	5.7	3.97	0.4	0.08	122.3	130.16
23.7	25.62	24.6	20.00	20.2	12.95	13.4	7.17	16.2	14.95	7.2	4.16	0.9	0.65	132.8	107.33
24	23.28	24	22.15	18	12.05	14	9.73	14	13.27	8	5.94	3	1.59	131	115.07
23.7	26.02	24.1	20.59	19.3	14.22	11.7	6.03	16.0	12.77	8.2	5.7	2.6	1.94	130.2	105.68
21.7	28.51	23.7	20.19	18.2	10.53	11.2	5.71	17.0	17.69	3.6	3.31	2.7	2.21	133.3	115.37
21.3	21.17	20.0	11.19	16.4	8.15	9.2	4.13	14.6	17.54	8.4	6.62	2.2	1.39	118.7	88.45
16.5	12.40	13.1	6.32	9.3	4.13	7.1	8.56	11.9	10.48	9.1	6.05	3.6	2.21	92.9	62.19
...
9.8	5.88	7.0	8.17	8.0	2.20	1.0	0.64	10.1	7.54	7.8	6.04	2.4	2.57	51.9	36.47
...
19.6	8.35	12.3	4.46	13.5	5.81	15.6	4.96	22.1	14.36	19.0	12.55	13.5	6.35	177.7	83.27
information.															
24.2	30.58	25.6	30.61	25.0	29.31	23.4	20.73	16.1	12.57	5.6	3.20	0.7	0.40	154.2	162.93

APPENDIX VIII—(para 7)

Statement showing the results of Rubber planting operations at Gairsoppah, Kanara, since the commencement in June 1906.

No.	Date of sowings of seed.	Kind of Rubber.	Number of seed sown.	Number of plants which resulted.	Growth in Nurseries at the end of the first hot season.		Surviving plants and their growth, in November 1908.						
					Height.	Girth.	In Nurseries.			In the Plantation.			
							Number.	Average height.	Average girth.	When put out.	Number.	Average height.	Average girth.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	July 1906	Castilloa	5,400	2	Ft.	In.	...	Ft.	In.	June 1907	2*	Ft. In.	In.
2	September 1906	Para	12,900	300	4	3	8	23	8	Do.	178	4 0	4 ½
3	Do.	Ceara	6,000	260	6	2	18	30	19	August 1907	164	14 0	10
4	June 1907	Castilloa	20,000	18,000	10	4	14,000	8	8	June 1908	1,350†	20 0	3
5	September 1907	Para	40,000	38,000	6	2	19,000	9	3	Do.	17,472‡	3 6	3
6	October 1907	Ceara	10,000	6,000	8	4	5,356	8	4	Do.	644§	3 0	3
7	June 1908	Do	2,000	1,183	...	...	...	...	...	Do.	1,183||	6 0	...
8	March 1908	Cryptostegia	¼ lb.	Several thousands	...	...	...	...	...	Do.	1,128¶	0 9	...

* Of these 2 *Castilloas* 1 plant has died.

† Many were eaten by wild animals, including hares, which cut the plants through near the bottom of the stem.

‡ Only basket plants were transplanted. These did not grow well in Nurseries where they were for 7 months of dry season.

§ Plants from Nurseries—7 months old—watered in the dry season for 7 months.

|| Germinated on beds, before planting.

¶ Sown in boxes very thickly. Seed obtained from the Conservator of Forests, C.C., Poona.

M. S. TEGGERSE,
Ranger in charge of Rubber Plantations, Gairsoppah, Kanara.

APPENDIX IX (para 28)

Statement showing the several items of Expenditure on the Gairsoppah Rubber Plantation up to the 3rd March 1909.

Item No.	Head.	By me.			By the Range Forest Officer, Honawar.			By the Divisional Forest Officer or the Conservator.			Grand Total.		
		Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
1	Nurseries	537	15	0	279	1	6	.....	.....	817	0	6
2	Seeds	65	9	0	21	7	0	696	1	0	783	1	0
3	Watering	1,520	6	2	71	2	0	.....	.....	1,591	8	2
4	Shade	412	2	10	.....	.....	.....	.....	.....	412	2	10
5	Clearing	1,702	1	6	.....	.....	.....	.....	.....	1,702	1	6
6	Bamboo guards	37	0	0	.....	.....	.....	.....	.....	37	0	0
7	Bamboo baskets	408	8	0	27	8	0	.....	.....	436	0	0
8	Lining and holing	804	12	3	.....	.....	.....	.....	.....	804	12	3
9	Planting	415	8	3	.....	.....	.....	.....	.....	415	8	3
10	Fencing	411	14	8	297	8	3*	.....	.....	709	6	11
11	Buildings	210	3	0	.....	.....	.....	.....	.....	210	3	0
12	Roads	92	0	0	.....	.....	.....	.....	.....	92	0	0
13	Wells	37	0	0	.....	.....	.....	.....	.....	37	0	0
14	Establishment	589	5	8	.....	.....	.....	.....	.....	589	5	8
15	Stores, tools and plant...	541	6	1	4	12	0	.....	.....	546	2	1
16	Manures (mulching, etc.)	131	3	0	.....	.....	.....	.....	.....	131	3	0
17	Carpenter	111	14	0	.....	.....	.....	.....	.....	111	14	0
18	Weeding	261	14	3	.....	.....	.....	.....	.....	261	14	3
19	Sundries	135	3	0	3	0	0	.....	.....	138	3	0
20	Coolies' expenses (on the way).	12	0	8	.....	.....	.....	.....	.....	12	0	8
21	Extras (not on Plantation).	25	4	7	.....	.....	.....	.....	.....	25	4	7
Totals		8,463	3	11	704	6	9	696	1	0	9,863	11	8
After the 3rd March and up to the end of April 1909											476	8	0
Total											10,340	3	8

* Steamer freight from Bombay.

Gairsoppah, Kanara :
3rd March 1909.

M. S. TEGGERSE,
Ranger on Rubber Plantations, Gairsoppah.

APPENDIX XII [para 5 (b)]

Weather Reports of other Countries in the Tropics growing Rubber compared with the climatic conditions of Gairsoppah in India.

No.	Month.	Singapore.			Malacca, F. M. S.			Ceylon (Kelani).			India (Gairsoppah).			Remarks.
		Rainfall.	Temperature (May 1).	Humidity.	Rainfall.	Temperature.	Humidity.	Rainfall.	Temperature.	Humidity.	Rainfall, 1908.	Temperature.	Humidity.	
		In.	Deg.	Per ct.	In.	Deg.	Per ct.	In.	Deg.	Per ct.	In.	Deg.	Per ct.	
1	January	13	78	81	4	79	94	161	80	1	...	79	64	The rainfall in India is not well distributed throughout the year, though the total rainfall is more than in any other country in the tropics. But there is a deluge of rain during July, August and September.
2	February	7	78	78	5	79	92				...	82	62	
3	March	6	79	77	3	79	93				...	85	60	
4	April	11	80	80	6	79	93				...	89	66	
5	May	5	81	78	6	79	94				1.26	89	68	
6	June	6	81	79	6	79	94				36.33	84	82	
7	July	7	80	78	7	79	94				105.32	78	94	
8	August	9	80	78	10	77	94				53.79	80	93	
9	September	5	80	78	8	79	92				4.78	80	90	
10	October	6	80	79	13	79	94				2.24	81	87	
11	November	9	79	81	11	79	94				...	77	92	
12	December	7	78	80	5	79	92				...	79	96	
Totals or Averages.		91	79	79	84	79	93	161	80	...	203.72	82	79	

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May 1909.

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