

MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No.	273	Press
		~~Mis.~~
	192-193	
Dated	9-2-	186s.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Revenue Department,
9th February 1865.*

No. 192. Read the following letter from W. G. McIVOR, Esq., Superintendent Government Chinchona Plantations, to the Honorable A. J. ARBUTHNOT, Chief Secretary to Government, dated Ootacamund, 9th July 1864, No. 103:—

SIR,

1. I have the honor to forward herewith the Report on the Government Chinchona Plantations and Botanical Gardens for the official year 1863-64.

2. As modifications in our system of cultivation have been found necessary, and as it may be inconvenient to print the whole of the report in pamphlet form 6×9½ inches, I would respectfully solicit the favor of 300 copies of paragraphs 9 to 13 and 24 to 38 inclusive be printed and furnished to me, in order that they may be attached to "Notes on Cultivation" published in 1863, and distributed to Cultivators.

Report on the Government Chinchona Plantations and Botanical Gardens for 1863-64.

Introductory observations.

1. Notwithstanding the unusually trying seasons of the past official year, it affords me much satisfaction to be able to state, that our Chinchona plants have, in every respect, made most satisfactory progress. In the propagation still

Increase of propagation.

greater results have been obtained than those previously described, the maximum monthly produce of 32,408 plants were obtained in February last, the average being 15,326. The oldest

Height and growth of plants.

plants, viz., those permanently planted out in August 1862, have attained heights varying from 6 to 9 feet with thick stems well furnished with lateral branches, and presenting as robust and healthy appearance as could be wished. Like most trees of their age these plants are not now making so much perpendicular growth as they did in the first year, in consequence of the number of branches thrown out, whereby the direct

Increase in thickness of stems and growth of lateral branches.

flow of sap is diverted from the leading shoots, the plants nevertheless are gaining in thickness more than they have hitherto done. The Chinchona Officinalis, Bonplandiana, and Cresspilla

Condition of plants on Dodabetta plantation, elevation 8,000 feet.

Make less perpendicular growth, but more robust than at lower elevations.

have been found to succeed best on the Dodabetta plantation (about 8,000 feet elevation), where the plants are robust and luxuriant, although not making so great perpendicular growth as at lower elevations. The 1st Dodabetta

Grow well in all exposures on this site.

Analysis of bark show great increase in Alkaloids.

plantation possesses every exposure and many varieties of soil, and over the whole of this site these three species have been found to thrive well. The result of this year's analysis has also established an extraordinary increase in the yield of alkaloids, showing the product to be 6 per cent. of rough alkaloids, while the previous analysis gave 4.3 per cent. From these observations it is plain that Peruvian bark will now be secured to India as one of its products. The cultivation of these very valuable plants has produced

Progress of the plants exceeds original expectations.

results far beyond our original expectations, and now that we have obtained considerable experience in their management, greater progress may reasonably be expected. With these preliminary remarks I proceed to particulars which, for the sake of convenience, are arranged under the following heads:—

Heads of Report.		Paras.	
1.	Growth and condition of plants...	...	2 to 13
2.	Cultivation, results obtained by private planters in the...	...	14 to 15
3.	„ prospects of its spread and increase...	...	16
4.	„ influence of woods on rain-fall and climate...	...	17 to 23
5.	„ modification of former treatment ...	...	24 to 28

	Paras.
6. Cultivation under the shade of living trees and in the open ground ...	29 to 30
7. „ effects of storms and of wet and dry weather on ...	31 to 33
8. Gathering of the bark and treatment of plant for this purpose...	34 to 38
9. Chinchona Pitaycus's attempt to introduce value, &c., ...	39 to 40
10. Establishments ...	41
11. Progress of operations ...	42 to 46
12. Botanical Gardens ...	47 to 48
13. Concluding remarks ...	49

Appendix A.—Accounts from commencement of operations to 30th April 1864.

Do. B.—Meteorological observations. Neddivuttum.

Do. C. Ditto do. Ootacamund.

Growth and condition of plants on the 1st and 2nd Denison Plantations at Neddivuttum.

August 1862. Eleven plants of *C. Succirubra* selected for measurement, planted on the 30th idem by His Excellency Sir William Denison and other gentlemen, have made an average growth of

Attained 3 feet in height in first 9 months.

2 feet 11 inches in the preceding 12 months.

excess of the average growth of the whole of the plants of this species throughout the plantations; the older plants have gained much in thickness during the last year, and thrown out many strong branches varying from 1 to 5 feet in length.

Favorable appearance of bark.

transverse marking characteristic of the finest Peruvian bark becoming very apparent and rudimentary lichens and mosses have begun to develop themselves on the bark of the older plants, while their sturdy and robust habit, indicates beyond all doubt, that the Chinchona, in its new home, has found conditions quite as favorable to its growth and full

Robust habit indicating existence of as favorable conditions to growth in this locality as on the Andes.

development as in the most favorable localities on the Andes. The above remarks refer principally to the *C. Succirubra*, that species being more extensively planted on the Denison plantations, and found to thrive well at elevations varying from 4,000 to 6,000 feet.

C. Succirubra or red bark flourishing at elevations of 4,000 and 6,000 feet.

4. The *C. Calisaya* on the same plantations give an average annual perpendicular growth of 2 feet 4 inches, or 7 inches less than that of *C. Succirubra*, the stems however have not increased in proportion; in fact the stems of this valuable species do not give one-half the average diameter of plants of *C. Succirubra* of the same age, and consequently not more than one-half the quantity of bark in the same period of growth, the plants are nevertheless healthy and robust; yet in a commercial point of view its comparative slow growth will, I fear, operate against its extensive cultivation.

Producing only half quantity of bark in the same period. Plants healthy and robust.

The *C. Micrantha*, *Peruviana*, and *Nitida* or grey barks made annual growth of 2 feet 8 inches.

2 feet 8 inches, but the bark formed by these species is fully $\frac{1}{5}$ th thinner than that of the *C. Succirubra*.

C. Officinalis or crown bark on Markham plantation.

2. Our first plants were permanently planted on the Neddivuttum plantation in

3 feet from the date of being planted to the 30th April 1863, (nine months) and from the 1st May 1863 to 30th April 1864, 2 feet 11 inches; this it may be estimated is 3 inches in

the older plants have gained much in thickness during the last year, and thrown out many

3. The bark has also much improved, the thickness having increased considerably; the transverse marking characteristic of the finest Peruvian bark becoming very apparent and rudimentary lichens and mosses have begun to develop themselves on the bark of the older plants, while their sturdy and robust habit, indicates beyond all doubt, that the Chinchona, in its new home, has found conditions quite as favorable to its growth and full

development as in the most favorable localities on the Andes. The above remarks refer principally to the *C. Succirubra*, that species being more extensively planted on the Denison plantations, and found to thrive well at elevations varying from 4,000 to 6,000 feet.

4. The *C. Calisaya* on the same plantations give an average annual perpendicular growth of 2 feet 4 inches, or 7 inches less than that of *C. Succirubra*, the stems however have not increased in proportion; in fact the stems of this valuable species do not give one-half the average diameter of plants of *C. Succirubra* of the same age, and consequently not more than one-half the quantity of bark in the same period of growth, the plants are nevertheless healthy and robust; yet in a commercial point of view its comparative slow growth will, I fear, operate against its extensive cultivation.

5. The *C. Micrantha*, *Peruviana*, and *Nitida*, have maintained an average growth almost identical with that of *C. Succirubra*, viz. 2 feet 8 inches, but the bark formed by these species is fully $\frac{1}{5}$ th thinner than that of the *C. Succirubra*.

6. About 25,000 plants of *C. Officinalis*, planted on the Markham plantation (elevation

5,000 to 6,000 feet) have grown taller, but not so robust as plants at higher elevations. Here

C. Succirubra and *Calisaya*.

On the Wood plantation at Pykara only two species planted, viz., *C. Succirubra* or red bark, and *C. Officinalis* or crown bark.

1st Dodabetta plantation, elevation 7,830 to 8,350 feet.

Too cold for *C. Micrantha* and *C. Succirubra*.

Here all species of crown bark thrive better than at lower elevations.

plantations, that is, the plants have grown more robust and luxuriant, and this even on the most exposed parts of the plantation, and the important fact is now established, that these three species can, with ordinary care and skill, be successfully cultivated over the whole of the plateau of the Neilgherries, thus opening out an immense field for the development of enterprise and energy with profitable employment of time and capital, and in addition the cultivator will be placed in perhaps the most healthy and invigorating climate in the world.

The important fact is established that these species may be successfully cultivated all over the plateau of the Neilgherries.

Thus opening an extensive field for enterprise.

And places cultivator in healthy and invigorating climate.

9. Forming an opinion on our experience up to the present time, the elevations best suited to the growth of the different species of Chinchona appears to be in this latitude for the *Succirubra* from 3,000 to 6,000 feet, probably thriving best at altitudes from 4,500 to 6,000. This is perhaps the hardest species in cultivation bearing, without material injury, greater extremes of heat and cold than any of the other species yet introduced.

C. Succirubra grows at elevations from 3,000 to 6,000 feet.

The most hardy of all the species.

extremes of heat and cold than any of the other species yet introduced.

5,000 feet the best elevation for *C. Calisaya* or yellow bark.

a high temperature, although in the Wynad District it grows at 3,000 feet.

Grey barks thrive best at elevations of about 4,500 to 6,000 feet.

Crown barks at elevations from 7,000 to 8,500 feet.

Makes more perpendicular growth at lower elevations, but is not so robust.

Two plants of *C. Lancifolia* Fitayo bark planted out at an elevation of 7,600 feet appears to require the same elevation as the crown barks.

injury, and the species may probably be found to require the same elevations as *C. Officinalis* and its varieties.

Results obtained by private planters in the cultivation of Chinchona.

with varied results; the efforts of some being highly successful, while others met with comparative

however the *C. Succirubra* and *Calisaya* have made growth quite equal to any of the plants of these species on the Denison plantation.

7. On the Wood plantation at Pykara the *C. Succirubra* and *Officinalis* only have been planted, and have made progress equal to the plants at Neddivuttum.

8. On the 1st Dodabetta plantation (elevation varying from 7,830 to 8,350 feet), the progress of the *C. Succirubra*, and *C. Micrantha* has been unsatisfactory, the elevation being apparently too great; but the *C. Officinalis*, *Bonplandina*, (*Condamenia*) and *Cresspilla* have succeeded better than on any other of our plantations, that is, the plants have grown more robust and luxuriant, and this even on the most exposed parts of the plantation, and the important fact is now established, that these three species can, with ordinary care and skill, be successfully cultivated over the whole of the plateau of the Neilgherries, thus opening out an immense field for the development of enterprise and energy with profitable employment of time and capital, and in addition the cultivator will be placed in perhaps the most healthy and invigorating climate in the world.

10. *C. Calisaya* thrives best at an elevation of about 5,000 feet, it appears not to bear a high temperature, although in the Wynad District it grows at 3,000 feet.

11. The *C. Peruviana*, *Nitida*, and *Micrantha* grow well at elevations of 4,500 feet, and in sheltered localities at 6,000 feet.

12. *C. Officinalis* and its varieties flourish best at elevations from 7,000 to 8,500 feet; it makes rapid perpendicular growth at lower elevations, but is not so robust and luxuriant.

13. Of the *C. Lancifolia* only two plants have been tried at an elevation of 7,600 feet, these stood the cold of last winter without

14. Upwards of sixty persons have, in a greater or less degree, undertaken the cultivation of Chinchona, but, as was to be expected,

failures; among the most unsuccessful attempts may be mentioned those of Professor Lees, and M. deFacien, both of these gentlemen in the first instance lost nearly $\frac{3}{4}$ ths of their plants either in transit or in the nurseries. Experience however has pointed out a remedy, and I learn from Mr. Lees' Superintendent that his plants are now doing well, and that he is propagating them at the rate of 200 per mensem. Mr. deFacien also writes that his plants "are, since the shade has been removed, growing as they never did before."

Successful also in North-West Provinces.

Mahableshwar, Belgaum, and Honore.

Darjeeling.

Assam and Cachar.

Wynaad.

On the eastern slopes of the Neilgherries.

In Coorg and Nuggur the cultivation most successful and encouraging.

31,000 Chinchona plants supplied from Ootacamund to every District in India suitable to their growth.

Ootacamund to every District in India considered suitable to their growth.

Prospects of the spread and increase of Chinchona cultivation.

Inducements to cultivate Chinchona in preference to other products.

plants when once established are easily managed, the preparation of the bark is much more simple than that of the manipulation of Tea, and after three years' growth the plantations can be maintained at little cost. These advantages are sufficiently understood and recognized to induce a number of cultivators to enter the field, consequently the applications for plants have been numerous, many of these however to the extent of upwards of 50,000 plants have lately been relinquished in consequence of the applicants being unable to procure the land they had selected, being informed that it was reserved. The loss of time and trouble thus incurred has had the effect of discouraging further applications, the more especially as an impression prevails that no forest land on the Neilgherries will in future be sold. I submit that this impediment may be removed by the reserved lands being marked on a map kept in the Collector's Office for reference, this would facilitate the extension of Chinchona cultivation as parties would then select unreserved land with a certainty of its being put up to auction three months after date of application. I make these remarks as all the lands on the slopes and on the plateau of the Neilgherries is well suited to the growth of the different

Many speculators have undertaken the cultivation of Chinchona.

50,000 plants relinquished by applicants in consequence of difficulty in procuring land.

On application, informed it was reserved.

Suggests that the lands reserved be marked on a map kept in the Collector's Office for reference.

Chinchona cultivation as parties would then select unreserved land with a certainty of its being put up to auction three months after date of application. I make these remarks as all the lands on the slopes and on the plateau of the Neilgherries is well suited to the growth of the different

All the lands on the Neilgherries suitable to the growth of Chinchona.

15. In the North-West Provinces considerable success has been obtained, as also in Mahableshwar, Belgaum, Honore, and elsewhere in the Bombay Presidency. From Darjeeling, I learn that Mr. Fitzgerald received all his plants in excellent condition. From Assam and Cachar, the accounts are varied. The Wynaad Coffee Planters have been generally successful with the plants forwarded to them, and on the eastern side of these hills a similar success has been gained. I learn from Mr. Mullaly that the plants he received have made great progress. In Coorg and Nuggur, the success seems to be general, and several Planters there contemplate embarking largely in the cultivation. It will be observed that in little more than two years, upwards of 31,000 Chinchona plants have been supplied from Ootacamund to their growth.

16. The cultivation is one in which planters are eager to embark, as in fact it offers advantages which no other on the Neilgherries possesses. It promises a greater return on the capital invested than Coffee, while the cultivation can be carried on in a healthy climate; the preparation of the bark is much more simple than that of the manipulation of Tea, and after three years' growth the plantations can be maintained at little cost. These advantages are sufficiently understood and recognized to induce a number of cultivators to enter the field, consequently the applications for plants have been numerous, many of these however to the extent of upwards of 50,000 plants have lately been relinquished in consequence of the applicants being unable to procure the land they had selected, being informed that it was reserved. The loss of time and trouble thus incurred has had the effect of discouraging further applications, the more especially as an impression prevails that no forest land on the Neilgherries will in future be sold. I submit that this impediment may be removed by the reserved lands being marked on a map kept in the Collector's Office for reference, this would facilitate the extension of Chinchona cultivation as parties would then select unreserved land with a certainty of its being put up to auction three months after date of application. I make these remarks as all the lands on the slopes and on the plateau of the Neilgherries is well suited to the growth of the different

Desirable to remove impediments and encourage extension of the cultivation.

every legitimate encouragement afforded to bring all available lands under cultivation.

17. In the preceding paragraph it has been stated that upwards of 50,000 Chinchona

Influence of trees on rainfall and climate.

Forest land reserved in consequence of an impression that clearing the trees causes a deficiency of rain on the Hills and the Coimbatore District.

is stated does not now extend so far into the Coimbatore District as formerly, owing to the forests on the Neilgherries having been felled for the cultivation of Coffee and other products.

Impression erroneous.

of the Coimbatore District by preserving the natural forests on the Neilgherries. But, theory and observation, combined with experience of practical effects, prove this conclusion to be erroneous. The Neilgherries like other high mountain ranges generate and are covered by a cold stratum of air which condenses the moisture contained in the warm atmosphere in its passage from the sea, hence, if our hills were 4,000

In south-west monsoon rainfall in the Coimbatore District dependent on the elevation and temperature of Neilgherries.

Coimbatore would be nearly as copious during the western monsoon as on the Malabar coast. On the contrary were the Neilgherries 7,000 or 7,500 feet above their present elevation, then not a drop of rain would pass over the hills as every particle of moisture in the heated air from the sea would be precipitated by coming in contact with a freezy atmosphere, in this case not only Coimbatore, but the whole of the eastern side of the Hills would be devoid of rain, while torrents

Examples.

greater or less degrees on all mountain ranges according to their elevation. On the sea face of the Scandinavian Alps, there is an annual rainfall of 80.12 inches, while on the other side the mean annual fall is only 20 inches.

Trees increase rainfall by increasing cold stratum of air.

More effectually deprive clouds of moisture in passing over the Neilgherries.

The more trees on the Neilgherries the less rain at Coimbatore.

the Neilgherries, the more effectually is the Coimbatore District deprived of the western rains.

19. Evaporation is in fact the principal cooling agent on the globe, being always in proportion to the amount of exposed surface.

Evaporation great cooling agent.

A tree of 45 feet in height covering 100 square feet of ground adds 80 times to the evaporating surface without completely destroying the evaporation from the ground it covers.

present an evaporating surface of at least 8,000 square feet, as evaporation goes on from every leaf and green shoot, and unless under very dense shade, the evaporation and radiation from the 100 square feet of ground it covers would not be entirely destroyed, thus a tree increases 80 times the evaporating surface, and would perspire from two to three times the amount of water that would be evaporated from the ground were the tree felled, as the average evaporation from

Leaf evaporates $\frac{1}{4}$ th part of water raised from the same surface of moist ground, and $\frac{1}{16}$ th part of that raised from the surface of water.

species of Chinchona, and in a philanthropic, as well as revenue point of view, it seems desirable that all obstructions be removed, and

every legitimate encouragement afforded to bring all available lands under cultivation.

17. In the preceding paragraph it has been stated that upwards of 50,000 Chinchona

plants have been relinquished owing to the

difficulty of procuring land, in consequence I am

informed of an opinion that felling the forests

on the Neilgherries causes a deterioration of

climate and deficiency in the rainfall, which it

is stated does not now extend so far into the Coimbatore District as formerly, owing to the

forests on the Neilgherries having been felled for the cultivation of Coffee and other products.

If this impression could be shewn to be correct,

it would be important to maintain the fertility

of the Coimbatore District by preserving the natural forests on the Neilgherries. But, theory

and observation, combined with experience of practical effects, prove this conclusion to be

erroneous. The Neilgherries like other high mountain ranges generate and are covered by a

cold stratum of air which condenses the moisture contained in the warm atmosphere in its passage

from the sea, hence, if our hills were 4,000

feet lower, the temperature of the stratum of

air would be increased, consequently its condensing powers reduced, and thus the rains at

Coimbatore would be nearly as copious during the western monsoon as on the Malabar coast. On

the contrary were the Neilgherries 7,000 or 7,500 feet above their present elevation, then not a

drop of rain would pass over the hills as every particle of moisture in the heated air from the

sea would be precipitated by coming in contact with a freezy atmosphere, in this case not only

Coimbatore, but the whole of the eastern side of the Hills would be devoid of rain, while torrents

would fall on the western face, as exemplified

in many parts of the Andes, and the Himalayas, in short the same effect takes place in a

greater or less degrees on all mountain ranges according to their elevation. On the sea face of the

Scandinavian Alps, there is an annual rainfall of 80.12 inches, while on the other side the mean

annual fall is only 20 inches.

18. That trees do exercise considerable

influence on the rainfall is undoubted, as by

offering a large evaporating surface they

increase the cold stratum of air which causes

condensation. In this way they aid more

effectually to wring the clouds of moisture in

their passage over the Neilgherries. Hence, it

is evident that the more abundant the trees on

the Neilgherries, the more effectually is the Coimbatore District deprived of the western rains.

19. Evaporation is in fact the principal cooling agent on the globe, being always in proportion to the amount of exposed surface.

Suppose, for example, a tree of 15 feet in height

covering 100 square feet of the surface of the

ground, this tree will, at the lowest calculation,

present an evaporating surface of at least 8,000 square feet, as evaporation goes on from every

leaf and green shoot, and unless under very dense shade, the evaporation and radiation from the

100 square feet of ground it covers would not be entirely destroyed, thus a tree increases 80

times the evaporating surface, and would perspire from two to three times the amount of water

that would be evaporated from the ground were the tree felled, as the average evaporation from

the surface of a leaf is only $\frac{1}{4}$ th part of that

from a similar surface of moist ground, and $\frac{1}{16}$ th

from the same surface of water, all being under

the same relative conditions. However, as the air becomes charged with moisture, evaporation from the surface of the leaves becomes less active, and ceases entirely at saturation, when another function directly the reverse commences; the leaves now beginning to imbibe moisture.

20. From the above point of view it is obvious that trees exercise considerable influence on the rainfall and deposit of dew. But there exists another and counterbalancing effect too frequently overlooked, which makes trees in a climate like ours a far greater drain on the moisture than they prove a source of supply. It has been shewn that trees by expending moisture (evaporation) convey to the air the power (cold) of condensing moisture, hence, it becomes an object of enquiry to ascertain how far the waste exceeds the supply gained by this process, especially on these hills where we have about three months of continuous clear weather, and dry atmosphere with a difference of from 8° to 13° Fahrenheit between the wet and dry bulb thermometers. Here large extents of evaporating foliage throw off daily an enormous quantity* of moisture, drawn from a depth of the soil so far as the roots penetrate, this moisture which would otherwise have supplied the springs, is thrown off by the leaves into the dry and arid atmosphere where it is dissipated and driven by currents of air into higher latitudes.

Tree covering 100 superficial feet of surface evaporates 6 cubic feet of water every warm and dry day. 21. A tree 45 feet high and covering 100 superficial feet throws off at least 6 cubic feet of water every warm and dry day. An acre would contain 433 of such trees, but reduce this number to 300; and it gives a daily evaporation from every acre of forest of 1,800 cubic feet, or the enormous quantity of upwards of 11,000 gallons; yet, incredible as this may appear, it does not represent one-half the moisture thrown off daily by an acre of forest on the Neilgherries during the months of January, February, and March. In each year the average number of warm and dry days exceeds 190, but reduce this number to 150, and we have upwards of a million and a half gallons of water extracted from the soil and dissipated by every acre of forest. The practical effect of an agency so enormous is very apparent on the streams and springs and streams on the Neilgherries, as all springs arising in, and passing through, valleys destitute of trees, maintain their flow throughout the dry season far better than those which arise in, and pass through, wooded valleys; it being obvious

* "Vegetable Statistics" by Doctor Hales, quoted in Lindley's "Introduction to Botany," Volume II, p. 288, 289, 291.
"July 3rd, 1834, in order to find out the quantity imbibed and perspired by the sunflower, I took a garden pot with a large sunflower, 3½ feet high, which was purposely planted in it when young. I covered the pot with a plate of thin milled lead, and cemented all the joints fast, so as no vapour could pass, but only air, through a small glass tube nine inches long, which was fixed purposely near the stem of the plant, to make a free communication with the outward air, and that under the leaden plate. I cemented also another short glass tube into the plate, two inches long and one inch in diameter. Through this tube I watered the plant and then stopped it up with a cork, I stopped up also the holes at the bottom of the pot with corks. I found the greatest perspiration of twelve hours in a very warm dry day to be one pound fourteen ounces, the middle rate of perspiration one pound four ounces. The perspiration of a dry warm night without any sensible dew was about three ounces."

"From July 3rd to August 3rd, I weighed for nine several mornings and evenings, a middle size cabbage plant, which grew in a garden pot, and was prepared with a leaden cover as the sunflower. Its greatest perspiration in twelve hours was one pound nine ounces, its middle perspiration one pound three ounces, 32 cubic inches.

that the roots of the trees intercept and drink up the water in its descent through the soil to the streams. Many extraordinary convincing proofs of this potent agency are to be met with on the Neilgherries, and I give, as an example, the spring that supplies the Botanical Gardens here, which has its rise in the valley partially cleared of forest two years ago for the 1st Dodabetta plantation, the flow of water in the stream during the last excessively dry season was fully twice as much as prior to the forest being felled.

22. The foregoing favors the opinion that if the Neilgherries were destitute of forest, the streams in the dry season would carry to the low country a flow of water twice as much as they do at present. But the great advantages which trees bestow cannot be overlooked, they improve the soil on which they grow, render the temperature more equable, reduce the violence of storms, afford shelter and shade very grateful to man, and their presence gives a pleasing effect to the eye, while their gaseous emanations are highly beneficial to animal life. These advantages apart from their economical uses require (so far as is consistent with general cultivation) the presence of trees in every locality where they can be produced.

Object of foregoing remarks. 23. In the above observations the important fact has not been taken into consideration, that the trees forming the natural forests on the plateau and upper slopes of the Neilgherries are quite useless except for firewood, and that planting Chinchonas would be substituting valuable for worthless trees. My object in introducing this subject is to show the reservation of the natural forests to be unnecessary so far as they affect the local rainfall and that of the Coimbatore District.

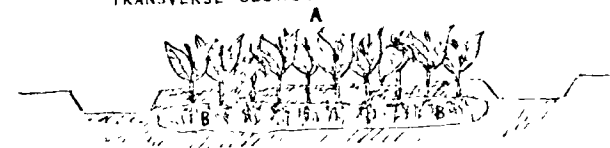
Cultivation. Modification of former treatment. 24. The treatment described in previous reports and "Notes on cultivation, 6th March 1863," has been found generally adapted to the requirements of the plants, especially as regards their propagation. In transplanting from the propagating houses into the nurseries a modification has been found necessary. In order to enable the plants to be removed without damage to their roots, a layer of moss is introduced under each line of plants. A. represents a transverse section of the nursery bed with moss B. introduced, C. being the longitudinal section. The manner in which the plants are planted being the same as described in paragraph 26, it being essential to success not to catch the roots of the plants in the hand, as the least bruise destroys them, therefore the plants should invariably be lifted by the leaves.

NURSERY BEDS.

LONGITUDINAL SECTION SHEWING THE ENDS OF THE LINES OF MOSS UNDER THE SOIL



TRANSVERSE SECTION SHEWING THE LINES OF MOSS.

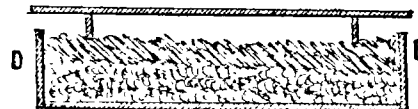


Permanently in the plantations

feet to 6 and 7, and a modification of our former method of planting has also been found necessary.

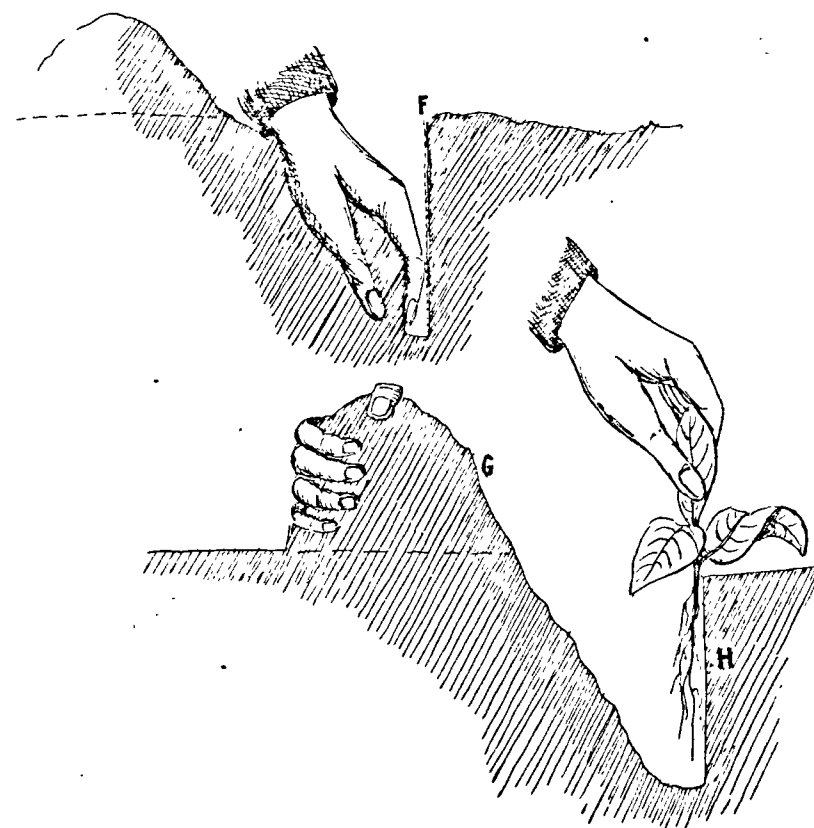
Removing plants from nurseries to plantation.

SECTION OF BOX FOR CONVEYANCE OF PLANTS FROM NURSERIES TO PLANTATIONS, THE COVERING BEING RAISED ABOUT 2 INCHES ON CROSS BARS TO ALLOW A FREE CIRCULATION OF AIR OVER THE TOPS OF THE PLANTS, WHILE IT SHELTERS THEM FROM THE SUN.



Manner in which they are planted.

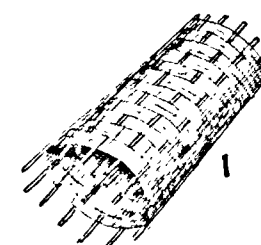
26. Each plant is lifted from the box by catching the leaves between the forefinger and thumb of the left-hand, while with the right-hand the roots are freed from any obstruction,



it is then carried to the spot where intended to be planted, the right-hand being thrust into the soft prepared soil in a sloping direction, and gently raising the back of the hand to the dotted line shown at F., the earth is then drawn forward as at G. leaving a straight bank behind the hand at H, the plant is now placed by the left-hand against the face of the bank, the collar or top of the root being held on a level with the ground, the roots are now spread out with the right-hand and the hole deepened should the length of the roots require it, the earth from G. is then brought forward with the right-hand against

the roots, but not pressed, and thus the operation of planting is completed, in this way a man can plant from 400 to 500 plants daily

And shaded.



27. The young plants immediately after being planted (instead of being sheltered as formerly by a screen made by bamboo branches) are covered by a cylindrical basket open at both ends, 12 inches in diameter, and 14 inches long as at I., made out of the common wattles so plentiful on these hills, one man making from 8 to 10 of such baskets daily, this is found the most efficient as well as the most economical Method of shading plants.

as the most economical way of protecting the plants, as when they are established the baskets can be removed and are available for further use.

Usual mode of staking the plants proves to be injurious by the ties cutting into the bark.



Adopted method of staking by which the cutting is avoided.

for large, or willow. twigs for small, plants is placed around the branches and tied to the

stakes at both ends when two are used as at J. In stormy situations, and steep lands, it would appear desirable, instead of staking to secure the plants to the ground by bending them forward and pegging them against the face of the hill, the plants would then throw up numerous shoots, and these shoots would protect each other from the force of the wind.

Cultivation under shade of living trees and in the open ground.

29. Cultivation under living trees has been entirely abandoned, the plants having been found to suffer from the effects of the drip, and want of light, while the roots of the trees in the neighbourhood penetrate the holes and draw up all the nourishment from the young plants; they are also liable to damage from the branches as well as the trees being broken and falling during storms.

Partially cleared forests quite unsuited to the cultivation of the plants.

30. Partially cleared forests have also been found quite unsuited to give shelter, as the high gales of wind being caught by the tops of the trees are driven down in strong eddies, as the current from the top of one tree meets that from another, and thus twists the plants in all directions producing much greater injury than a steady gale. In short, the more exposed the situation in which the plants are growing, the more healthy and robust they appear, although they do not attain so rapid growth, as in more sheltered localities, thus establishing beyond all doubt, that the more the plant is exposed to light and air, the more perfectly it performs its functions, thus the juices being more effectually elaborated, we may expect a large proportion of alkaloid, which may counterbalance the comparative slower growth.

Plants fully exposed to light and air more perfectly perform their functions.

Effect of storms, and wet and dry weather on cultivation.
Plants suffer from, when young.

the leaves are frequently blown to pieces, and occasionally in very exposed situations the branches are broken, and the plants twisted out of the ground. As the plants grow older, their leaves become smaller and consequently not so much affected by the wind; the yellow and crown barks do not suffer so much from storms, their leaves being much smaller, they are however occasionally injured in heavy gales. The storms of hail so frequent here in March and April, although productive of temporary damage by cutting the leaves, yet the plants have not materially suffered from this cause.

As attain age, less liable to injury.

Hail storms break the leaves, but do no permanent damage.

Continuous wet weather, effects of.

contracted around the margin towards the under surface, causing rough undulations in the texture of the leaf along the midrib and between the lateral veins. It also induces a succulent and unhealthy condition of the plant, in some instances causing an unnatural development of pith, rendering the plant liable to disease, 25 plants having died from the effects of the continued rain of last season. The grey barks suffer most from the constant stream of water thrown down their channelled leaf stalks, communicating rot to the bark which occasionally penetrates to the stem, and thus permanently injures the plant. The heavy rains have been found to carry down a large quantity of earth, which covered the plants and caused much time to be occupied in its removal, this has been effectually obviated by a system of surface drains.

Showers alternated with sunshine, prove most favorable to the growth of plants.

most favorable for the growth and full development of the Chinchona under cultivation. The plants however when established bear a considerable amount of drought without injury.

Bear considerable drought without injury.

During the first two months of last severe dry season, the plants maintained their growth and healthy appearance, the drought then began to make itself felt, the leaves of the plants assuming by degrees the contracted form and yellow tint as during the continuous rains. After three months continuous drought a few of the plants on the more exposed parts of the plantation began to droop, in a few days this tendency increased, and on the 98th day it became necessary to water the plants by the hand. These were plants of one year's growth, and probably plants of two years' growth, in good soil, would bear greater drought without injury.

98 days of continuous drought necessary to hand water young plants.

Gathering the bark and treatment of plants for this purpose.

to within a few inches of the ground has been found the most advantageous. Removing the bark in strips from the stems of the plants has been discontinued, for although new bark is formed over the spaces, it is not until more or less decay has been communicated to the wood, and thus the stems are prevented from expanding.

Removing bark in strips, injures growth of plants.

"Red," "grey," and "yellow" barks throw out shoots from the stools when cut down between March and August.

August have uniformly thrown strong shoots from the stools, these shoots have grown with great vigour, and this may be found a profitable way of treating the plants, particularly in exposed situations, as the number of shoots thrown from the stools afford mutual protection.

But not when cut between September and February.

31. The large leaved species of Chinchona (red and grey barks) suffer considerably from high winds, especially when young. As the plants grow older, their leaves become smaller and consequently not so much affected by the wind; the yellow and crown barks do not suffer so much from storms, their leaves being much smaller, they are however occasionally injured in heavy gales. The storms of hail so frequent here in March and April, although productive of temporary damage by cutting the leaves, yet the plants have not materially suffered from this cause.

32. During continuous wet weather the leaves assume a yellow tint, and become contracted around the margin towards the under surface, causing rough undulations in the texture of the leaf along the midrib and between the lateral veins. It also induces a succulent and unhealthy condition of the plant, in some instances causing an unnatural development of pith, rendering the plant liable to disease, 25 plants having died from the effects of the continued rain of last season. The grey barks suffer most from the constant stream of water thrown down their channelled leaf stalks, communicating rot to the bark which occasionally penetrates to the stem, and thus permanently injures the plant. The heavy rains have been found to carry down a large quantity of earth, which covered the plants and caused much time to be occupied in its removal, this has been effectually obviated by a system of surface drains.

33. As observed by early writers "the condition of showers and sunshine" has proved most favorable for the growth and full development of the Chinchona under cultivation. The plants however when established bear a considerable amount of drought without injury.

34. In collecting our samples of bark, lopping the branches or cutting down the plants to within a few inches of the ground has been found the most advantageous. Removing the bark in strips from the stems of the plants has been discontinued, for although new bark is formed over the spaces, it is not until more or less decay has been communicated to the wood, and thus the stems are prevented from expanding.

35. The plants of "red," "grey" and "yellow" barks cut down between March and August have uniformly thrown strong shoots from the stools, these shoots have grown with great vigour, and this may be found a profitable way of treating the plants, particularly in exposed situations, as the number of shoots thrown from the stools afford mutual protection.

36. It is however important to note that of the plants cut down between September and

February (although of the same species) not one in five threw shoots from the stools; of these "Crown" barks an exception, as they throw shoots at any plants two retained life for a few days then gradually died away. The varieties of "crown" barks however form an exception, as these possess sufficient vitality to produce strong shoots at whatever season of the year they are cut.

If cut during dry weather, plants must be prepared.

37. From the above it is obvious that if the harvest of bark is to be obtained by cutting down the plants in the dry season or between December and March, they must be prepared during the preceding wet weather as described and illustrated at paragraph 21, Plate VI in "Notes on cultivation, &c., dated March 1863."

Lopping and pruning adopted, species readily produce fresh branches.

38. When the system of lopping and pruning is adopted, all the species are found readily to produce fresh branches at any season of the year.

Chinchona Pitayocasis, attempt to introduce.

39. On the 4th of April 1864, I received from Mr. Markham of the India House a small packet of seeds of C. Pitayocasis, these were sown on the same day; a large packet received on the 20th idem, through the Government, were also sown on their receipt, and I regret to add that up to the present date not one seed has germinated, and fear there is now no hope of their doing so. This is much to be regretted as the species is one of great value, and although we possess the C. Lancifolia from Java a Pitayo bark, yet there being three varieties the Lancifolia may not be the most valuable kind, it is therefore desirable that another attempt should be made to procure fresh seeds of these plants.

40. Mr. Cross* collected the seeds in July and August 1863, and conveyed them to the port of Guayagnil with the intention of forwarding them to Mr. Markham. By some mistake the sum which Mr. Cross was to have received for collecting the seeds had not reached Her Majesty's Consul, this gave offence, and Mr. Cross returned carrying the seeds with him into the interior of the country. After a delay of five months, and in compliance with the entreaties of Mr. Markham, the seeds were ultimately despatched, apparently after having lost their germinating powers.

Establishments.

41. The difficulties previously experienced in procuring efficient men has been severely felt this year, in consequence of the number of Coffee and Tea plantations lately opened in the neighbourhood (no less than 36 having been commenced within the last eighteen months), many of our best men have left either to open plantations for themselves, or to fill situations where

* EXTRACTS FROM MR. CROSS' LETTERS:—

Bogota, September 16th, 1863.

"There are three varieties of Pitayo Chinchona, white, yellow, and red, of which the latter is by far the finest and most valuable, having actually in several instances, yielded five per cent. of sulphate of quinine. It rarely falls below 3 per cent. but its general yield is 3½ to 4. This variety has been much sought for, and at the time I write it scarcely exists. It is dug up, roots and all, whenever found. After searching through mountains, ravines, and wild broken ground near Popayan, I found a splendid clump owned by an Indian, and made a clean sweep of all the seeds that were on the trees. On returning to my encampment I carefully dried the precious collection. I say precious, for neither I nor any one else can ever make a similar collection again, simply because the species will very soon be entirely annihilated. The Indian was about to dig up the roots of the clump and when this is done the valuable species will be lost for ever. I have seen plants of this variety dug up in the surrounding forests whose stems were not thicker than a writing quill, but these are rarely to be met with, for the plant, as already stated, is nearly exterminated. On drying the collection I found I had secured nearly a million and a half, a million of which I considered to be the finest seeds I had yet collected in the Andes."

January 20th, 1864. "I believe the seeds to be as fresh for purposes of germination as the day they were collected on the Pitayo mountains. I send a few seeds in this letter because I find I will not be able to get down in time for the Steamer. The rest will certainly come by the following Mail. The seeds were well ripened, carefully dried, and have been carefully protected up to the present time. Give the seeds on the Neilgherries about the same temperature as the Loxa seeds until they germinate. Then treat them as hardy as possible. Care must be taken that this species does not get overloaded at the roots with moisture. It is the most rapid growing of all the Chinchonas and perhaps the best."

(Signed) CLEMENTS R. MARKHAM.

greater inducements are offered. Mr. Batcock, the Deputy Superintendent, has given great satisfaction in carrying out the work entrusted to his charge. Lieutenant Nichol, recently placed in charge of the Neddivuttam plantations, has shewn energy and activity in pushing forward the operations. I have also reason to be satisfied with the diligence and care shewn by Mr. Smith, Assistant Superintendent of the Dodabetta plantation. Overseers Burrows, Ramsey, and Wilkinson have been attentive and careful in conducting the work. In the office Establishment Narrainsawmy Naidoo and Mr. McNair have given every satisfaction in the performance of their duties as Pay Clerk and Accountant.

Progress of operations.

Propagation and nurseries.

the five propagating houses described in previous reports give ample appliances for the production of between 20,000 and 30,000 plants monthly. The total number of plants produced up to

4,16,909 Plants propagated.

31,662 Plants distributed to the public.

Nurseries formed for 3,50,000 young plants.

Neddivuttum Plantations.

the temporary buildings for the coolies; the wood covering the drains and culverts formed in 1862, have been renewed and re-placed by stones; the surface drains on the Denison plantations widened and increased in number, in order to prevent the severe wash occasioned by the heavy

220 Acres planted; roads, drains, &c., finished.

205 additional acres cleared and in a forward state of preparation for planting.

205 additional acres have also been cleared and are in a forward state of preparation for planting, the earth-work of the roads and bridges completed; though here and there interrupted by rocks which are being removed; the propagating house on this plantation has been extended and affords sufficient space for 20,000 cuttings.

Wood plantation at Pykara works made less progress.

165 acres more or less prepared.

8 acres only planted.

8 acres only have been planted. The permanent buildings finished, and comfortable lines for coolies, erected.

Dodabetta plantations, 95 acres planted.

being planted and 60 additional acres in progress; here upwards of 500 acres have been enclosed with

And commenced on 60 additional acres.
Total extent of 500 acres enclosed by a trench.

the removal of the firewood and thus increase its market value. The wood has realized Rupees 5,050 and paid to the credit of the Forest Department.

New plantation on Koondahs.

Koondahs, great difficulty has been experienced in pushing forward the operations, owing to the

42. A range of hardening pits has been added to our propagating departments which affords shelter for 75,000 plants, and these with the five propagating houses described in previous reports give ample appliances for the production of between 20,000 and 30,000 plants monthly. The total number of plants produced up to 31st May 1864 being 4,16,909, of this number 31,662 have been distributed to the public. Extensive nurseries have been formed on the different plantations for the accommodation of the plants produced during the current year, in all sufficient to contain 3,50,000.

43. On the Neddivuttum plantations, it has been found necessary to renew several of the temporary buildings for the coolies; the wood covering the drains and culverts formed in 1862, have been renewed and re-placed by stones; the surface drains on the Denison plantations widened and increased in number, in order to prevent the severe wash occasioned by the heavy rain of last monsoon; there 220 acres are already planted; roads, drains, trenches, &c., finished; on the 1st Denison plantation the plants have attained considerable size and promise to rise rapidly into a luxuriant forest. On the Markham plantation, the plants have only recently been planted and are necessarily small;

44. On the Wood plantation at Pykara, the work has not made such satisfactory progress, owing to the difficulty in obtaining an efficient Assistant. Here however 165 acres of land have been more or less prepared, of which 8 acres only have been planted.

45. On the Dodabetta plantations, the work has progressed satisfactorily, 95 acres being planted and 60 additional acres in progress; here upwards of 500 acres have been enclosed with a trench, and 11,000 yards of road cut intersecting this extent of land, the object in cutting these roads prior to planting, being to facilitate

46. In opening the new plantation on the Koondahs, great difficulty has been experienced in pushing forward the operations, owing to the

160 acres felled.

75 lopped and burned.

Temporary Buildings finished.

want of roads; here 160 acres have been felled, of this 75 acres have been lopped and burned, and is at present in course of preparation for planting; cooly lines and other temporary buildings have been completed, and a contract entered into for making the road, I therefore trust shortly to be able to procure sufficient labor to complete the permanent buildings.

Botanical gardens.

47. In the Botanical Gardens the prevailing scarcity of labor has been much felt especially towards the end of the year, notwithstanding considerable improvement has lately been effected. Between the upper and lower gardens an ornamental piece of water has been formed

Improvements effected.

enclosed by a revetment wall raised so as to form a parapet to the adjoining terrace, this terrace is in the form of a crescent, and is now being laid out into parterre, with a band-stand in the centre and three fountains on each side. In the upper portion of the garden three fountains have been erected and are working well, here also parterres and ornamental vases have been introduced, and the whole made as attractive as possible by planting with choicest flowers and shrubs. In the lower garden a labyrinth has been formed on the plan of that at Hamton Court, the hedges of Rose floire de Rosamere and Blairü, here also an ornamental piece of water has been added; in this portion of the garden the plants suffer much from the attacks of the grubs of the cockchafer, rendering it difficult to secure that luxuriance of vegetation which prevails in the upper garden.

Plants introduced.

48. During the year many valuable plants have been added to our collection. To His Excellency Sir William Denison, Governor of Madras, we are indebted for the very valuable Araucarias Bidnellii and Cookii, the beautiful Clanthus Dampieri, twelve varieties of Australian grapes, and numerous seeds of valuable timber trees as Eucalypti, Acacias, &c., and to Mr. Lascelles for the Cupressus Macrocarpa, Dammara Brownii and a few species of unnamed Japan Conifera. From Dr. Anderson of the Calcutta Botanical gardens, Podocarpus longifolia; to Messrs. E. B. Thomas, and E. Thomas for a collection of European fruit trees and shrubs; to Mr. J. D. Sim, for Amherstia Nobilis Stigmaphyllon Ciliatum, Meyenia erecta, and the white variety of Lagerstræmia Indica; to Major Hutton for four fine varieties of Fuchsia and a few British forest trees; to Mrs. Arbuthnot for numerous ornamental plants, and to Dr. Birdwood of Bombay for Strelitzia Angustifolia.

Distribution.

The following table exhibits the distribution of garden plants, seeds, &c., for 1863-64.

Months.	Fruit trees and shrubs.	Timber trees.	Shrubs and flowers.	Collections of seeds.	Amount.
1863.					RS. A. P.
May	...	74	...	19	186 4 0
June	53	10	58	17	139 0 0
July	77	56	138	23	248 1 0
August	86	33	58	33	246 1 6
September	44	47	134	31	217 15 6
October	168	5	250	15	238 3 6
November	6	22	202	17	138 4 0
December	...	122	165	12	117 0 0
1864.					
January	...	...	...	1	1 14 0
February	...	...	3	2	3 10 0
March	...	...	9	11	45 14 0
April	50	245	343	2	152 2 0
Total Distribution ...	484	614	1,310	186	1,784 5 6

Concluding remarks.

49. From the above observations it will be observed that during the past official year, we have made great progress, still the scarcity of labor has been severely felt rendering it difficult to perform the different operations at the proper seasons. In conclusion, I beg to tender my grateful acknowledgments to His Excellency Sir William Denison, Governor of Madras, for the liberality with which he has met every suggestion tending to facilitate the progress of this important undertaking. To Mr. Markham of the India House, my best thanks are due for much valuable assistance, and the deep interest he has evinced in the progress of the Chinchona plantations, also to Mr. Howard, for the very important information he has so liberally furnished on the formation of alkaloid in the bark.

(Signed) G. W. McIVOR,
Supt. Govt. Chinchona Plantations.

OOTACAMUND, 7th July 1864.

A.

Estimated cost of each Chinchona Plantation from

Particulars.	Operations preparatory to receipt of plants.	Superintendent and Writer Establishment.				Nursery Department.			Dodabetta Plantations.		
	1860-61.	1861-62.	1862-63.	1863-64.	1861-62.	1862-63.	1863-64.	1861-62.	1862-63.	1863-64.	
	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	
Grant for the preparation of sites.....	2,000	...	...	...	...	...	...	...	...	...	
Establishments... ..	...	4,200	5,350	5,880	3,324	4,305	4,609	2,280	5,400	5,700	
Buildings..... ..	...	...	...	...	1,200	...	...	560	...	...	
					2,000	...	...				
Tool and Store-rooms.	...	...	...	...	...	...	...	...	250	...	
Coolies' quarters.....	...	...	...	...	...	...	...	200	500	...	
Felling.....	...	...	...	...	...	...	...	400	1,500	...	
Clearing.. ..	...	...	...	...	...	...	...	280	1,500	...	
Pitting.....	...	...	...	...	...	...	...	400	1,500	...	
Carriage of plants...	...	...	...	...	...	...	...	150	...	...	
Planting and Shading.	...	...	...	...	...	...	...	200	500	...	
Trenching..... ..	...	...	...	...	...	...	...	1,800	...	...	
Enclosing..... ..	...	...	...	...	756	...	...	...	5,850	...	
Road-making.....	...	...	...	...	...	...	...	...	2,025	...	
Tools.....	...	...	...	...	...	...	...	...	1,200	...	
Contingencies..... ..	...	...	...	...	196	...	...	399	1,200	...	
Total...	2,000	4,200	5,350	5,880	7,476	4,305	4,609	6,669	21,425	5,700	

OOTACAMUND,
7th July 1864.

A.

Actual expenditure on each Chinchona Plantation

Particulars.	Operations preparatory to receipt of plants.	Superintendent and Office Establishment.				Propagation and Nursery Departments.		
	1860-61.	1861-62.	1862-63.	1863-64.	1861-62.	1862-63.	1863-64.	
	RS.	RS.	RS.	RS.	RS. A. P.	RS.	RS.	
Establishment.....	114 2 3	4,347	5,343	6,437	2,024 11 6	3,329	3,410	
Buildings.....	.....	...	...	...	2,647 0 0	3,578	3,000	
Tool and Store-rooms.	.....	...	...	...	.....	...	...	
Coolies' quarters.....	.....	...	...	...	.....	...	...	
Felling.....	302 5 3	...	...	...	.....	...	...	
Clearing.....	.....	...	...	...	.....	...	...	
Pitting.....	.....	...	...	...	.....	...	...	
Carriage of plants ...	.....	...	...	...	.....	...	...	
Planting and shading.	.....	...	...	...	.....	...	...	
Trenching... ..	.....	...	...	...	.....	...	...	
Enclosing.....	.....	...	...	...	.....	...	...	
Road-making.....	300 0 0	...	...	...	.....	...	...	
Tools.....	271 0 0	...	...	...	.....	...	...	
Contingencies.....	67 0 0	...	...	...	.....	...	...	
Total...	1,054 7 6	4,347	5,343	6,437	4,671 11 6	6,907	6,440	

OOTACAMUND,
7th July 1864.

commencement of operations to 30th April 1864.

Neddivuttum Plantations.			Pykara Plantations.		Malah Koondah Plantations.	For the Plantations of 1864-65.	Total.
1861-62.	1862-63.	1863-64.	1862-63.	1863-64.	1863-64.	1864-65.	
RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
...	...	...	...	...	...	...	2,000
5,064	8,412	15,348	...	4,033	...	...	73,905
2,080	...	...	1,530	...	...	4,000	18,445
250	...	...	2,000	...	125	...	...
1,000	1,000	...	250	...	500	...	...
1,500	3,000	...	1,000	...	6,150	2,250	...
1,500	3,000	...	1,500	...	...	...	43,930
2,000	3,000	...	1,500	...	...	...	...
450	450	...	...	...	...	...	...
550	550	...	...	1,300	...	...	...
4,000	...	...	...	8,000	...	...	11,631
3,900	...	...	...	750	375	...	5,570
1,520	...	...	...	1,350	675	...	4,405
1,282	...	...	...	1,282	611	...	8,521
2,003	1,831	...	...	2,046	846	...	...
27,099	21,243	15,348	7,780	18,761	9,312	6,250	1,73,407

(Signed) W. G. McIVOR,
Supt. Govt. Chinchona Plantations.

from commencement of operations to 30th April 1864.

Dodabetta Plantations.			Neddivuttum Plantations.			Pykara Plantations.		Malah Koondah Plantations.	Total.
1861-62.	1862-63.	1863-64.	1861-62.	1862-63.	1863-64.	1862-63.	1863-64.	1863-64.	
RS.	RS.	RS.	RS. A. P.	RS.	RS.	RS.	RS.	RS.	RS. A. P.
1,481	2,274	2,605	2,910 0 0	6,195	5,874	...	1,608	...	47,981 13 9
865	...	...	1,560 0 0	...	1,000	1,683	...	350	21,188 0 0
...	...	230	...	350	500	275	...	...	...
...	250	500	...	1,750	1,000	1,100	550	...	...
448	750	500	1,780 7 3	1,500	2,200	1,500	2,000	2,400	...
400	750	400	...	1,500	2,200	1,125	2,000	1,125	...
848	750	1,010	1,680 7 3	858	2,000	...	1,000	...	42,637 7 2
245	200	140	540 1 9	900	750	...	65	...	...
355	450	560	640 1 3	900	898	...	65	...	...
...	...	1,200	...	1,972	1,780	...	...	...	...
...	2,800	...	...	1,550	900	...	679	...	5,929 0 0
600	700	2,070	1,100 0 0	1,000	2,000	...	1,500	502	9,772 0 0
394	304	600	700 0 0	400	860	...	1,500	...	5,029 0 0
124	460	500	340 0 0	915	850	...	400	100	3,756 0 0
5,760	9,688	10,315	11,351 1 11	19,790	22,812	5,683	11,367	4,477	1,36,343 4 11

(Signed) W. G. McIVOR,
Supt. Govt. Chinchona Plantations.

B.

Meteorological observations from 1st May 1863, to 30th April 1864, made on the Government Chinchona Plantations at Neddivuttum.

MONTH.	Mean monthly temperature.	Mean daily range.	Maximum observed during the month.	Rain-fall in inches.	Days without rain.	Days with rain.
1863. July	63°·5	12°·6	76°	15·46	5	26
August	64°·6	16°·3	74°	23·77	9	22
September	66°·5	15°·6	80°	5·59	9	21
October	66°·0	17°·3	82°	10·47	14	17
November	70°·0	23°·0	89°	0·50	26	4
December	80°·4	27°·0	92°	1·95	26	5
1864. January	65°·7	28°·0	85°	0·52	30	1
February	69°·6	28°·0	87°	—	29	0
March	72°·1	29°·4	90°	0·38	29	2
April	71°·4	22°·5	99°	2·80½	18	12
Annual	68°·8	21°·9	84°·5	61·44½	196	110

The readings in this table are high in consequence of the sun occasionally striking on the board upon which the Thermometers were placed.

Ootacamund,
7th July 1864.

(Signed) W. G. McIVOR,
Supt. Govt. Chinchona Plantations.

C.

Meteorological observations from 1st May 1863, to 30th April 1864, made at the Government Gardens, Ootacamund.

MONTH.	Monthly mean of dry bulb thermometer.	Monthly mean of wet bulb thermometer.	Due point of monthly means.	Maximum observed during the month.	Greatest daily range.	Rain-fall.	Days without rain.	Days with rain.
1863. May	62°·5	60°·8	59°	78°	23°	5·98	13	18
June	58°·7	58°·0	58	73	18	3·99	14	16
July	57°·8	56°·7	56	72	18	1·49	16	15
August	59°·1	58°·5	56	71	17	3·58	16	15
September	58°·9	57°·6	56	72	24	2·16	14	16
October	58°·1	57°·1	56	72	23	8·45	14	17*
November	56°·4	54°·8	53	70	22	1·86	22	8
December	56°·3	53°·2	51	71	26	2·38	24	7
1864. January	55°·0	51°·0	47	73	31	...	31	0
February	58°·0	52°·0	48	76	28	...	29	0
March	62°·0	55°·0	50	80	30	0·8	30	1
April	59°·0	57°·0	56	77	26	8·18	13	17
Annual	Mean 58°·5	Mean 53·9	Mean 53·8	Mean 73·7	Mean 23·8	Total 38·17	Total 236	Total 130

South-west monsoon commenced on the 31st of May 1863.

* On the 26th of October 1863, and two following days, rain most excessive and gauge overflowed, a calculation from a quarter of an hour's reading on the morning of the 26th, gave 4 inches, 56 cents., as the rain of the preceding night which was probably below the correct amount. This amount is omitted in the monthly total.

Ootacamund,
7th July 1864.

(Signed) W. G. McIVOR,
Supt. Govt. Chinchona Plantations.

No. 193.

ORDER THEREON, 9th February 1865, No. 273.

Miscellaneous.

1. The Governor in Council considers the foregoing report of the progress of the Chinchona plantations during the official year 1863-64, to be extremely satisfactory. The season was an unusually trying one, the drought being so long continued that it became necessary to resort to watering by the hand, yet the plants made good progress.

2. The propagation has been more successful than in previous years, the monthly average having been 15,326 plants, and the maximum, in February 1864, 32,408. The total number of plants produced up to the 31st May 1864 has been 416,909, of which 31,662 have been distributed to the public.

3. The extent actually planted out in the different Government plantations is stated to be 323 Acres.

4. The first plants were permanently planted out at Neddivuttum in August 1862, and have, in the twenty months which have since elapsed, "attained heights varying from six to nine feet, with thick stems, well furnished with lateral branches, and presenting as robust and healthy an appearance as could be wished." This growth is said to be about three inches in excess of the average of the same species (*C. Succirubra*) throughout the plantations.

5. The results of the year's analysis of the bark is also highly encouraging, the yield of rough alkaloids having been six per cent, while in the previous year it was only 4·3.

6. There can no longer be room for doubt as to the successful introduction of the Chinchona on the Neilgherries, and the extraordinary success which has attended its culture, whether regard be had to extensive propagation, rapid and healthy growth, or the rich production of alkaloids.

7. For these results the Government are indebted to Mr. McIvor, whose able and zealous exertions in this important enterprise merit the highest praise.

8. The total expenditure up to the 30th April 1864 has amounted to Rupees 1,36,343, under the following heads:—

	RS.
Buildings	21,188
Plantations	58,388
Tools	5,029
Establishment	47,982
Contingencies	3,756

9. The progress of the different plantations appears to be as follows:—

At Neddivuttum 220 Acres have been planted out, with roads, drains, &c., completed; 205 acres are in a forward state of preparation for planting, and the earth-work of the roads and bridges completed. The propagating house has been extended, and afford space for 20,000 cuttings.

At Pykara 8 Acres have been planted out; and 165 more or less prepared; the permanent buildings and cooly lines have been finished.

At Dodabetta 95 Acres have been planted; 60 Acres are in progress; 500 Acres have been enclosed with a trench, and 11,000 yards of road cut.

At the Koondahs (sanctioned only in December 1863) 75 Acres have been lopped and burned, and are in course of preparation for planting; 85 Acres have been felled and cooly lines and temporary buildings erected.

A range of hardening pits, affording shelter for 75,000 plants, has been added to the propagating houses, and there are thus ample means for producing from 20,000 to 30,000 plants monthly. Extensive nurseries have also been formed on the different plantations.

10. This is a very satisfactory state of affairs.

11. The failure of the seeds of *C. Pitayensis* is much to be regretted, and will be brought to the notice of the Home Government, that efforts may be made to procure a further supply.

18 *Proceedings of the Madras Government, Revenue Department,*
9th February 1865.

Paragraphs 9 to 13.
Do. 24 to 38.

12. The paragraphs marginally noted contain much valuable information as to the culture, &c., of the Chincona, and will be

separately printed uniformly with the Manual to which they will be added.

13. The Government have already issued orders for the preparation of a list of reserved lands, so that intending planters may have the means of readily ascertaining what lands are, and are not, available. The impression, which is said to prevail, that no more forest land will be sold, is altogether without foundation; the extreme difficulty of obtaining competent Surveyors and the necessity, which the Law imposes, of advertising all lots for three months, necessarily cause delay in the transfer of land; but the Government are not aware of applications having been refused, on the plea of the land being reserved, so frequently as to afford ground for the impression stated. The Collector will report how many cases of refusal on this account have occurred during the last year. In order to avoid delay the Government, it may be remarked, now allow lands to be sold prior to actual survey, on condition of the boundaries being carefully and permanently marked, and the purchase being subject to adjustment on the survey.

14. The Government do not deem it necessary here to discuss the subject of paragraphs 17 to 23 of Mr. McIvor's report. They will merely observe that Mr. McIvor's views are not those in general acceptance.

15. Mr. McIvor's account of the Botanical gardens is highly satisfactory. The Government consider it desirable that he should now prepare for publication a catalogue of the different trees, shrubs, &c., in the gardens.

16. In future reports the progress of the Tea plantation and nurseries of Australian trees should be specially noticed. The Government wish attention paid to the latter, and will continue to supply Mr. McIvor with seeds from Australia. The plants when grown can be sold to the public at a fair price, and furnished to the Forest Department for the Government Sholas. The commoner kinds of Australian trees, as the *Acacia Melanoxylon*, need not of course be raised by Mr. McIvor.

17. The Government note with satisfaction the testimony borne by Mr. McIvor to the services of Mr. Batcock, Lieutenant Nichol, Mr. Smith, and Overseers Burrows, Ramsay, and Wilkinson, and of his Office Assistants Narrainsawmy Naidoo and Mr. McNair.

(True Extract.)

(Signed) A. J. ARBUTHNOT,

Chief Secretary.

To W. G. McIvor, Esq.
To the Collector of Coimbatore. .
" Officiating Conservator of Forests.
" *Board of Revenue* .

Exd. S. T. Augustin.

I am in general with Mr. Innes. I don't think that
 a fall in the Redphenies Corribators would be the
 the only mode of improving the rain fall in Connaught
 would be to plant them at the same time however I am
 not disposed to admit the conclusion drawn by Mr. Innes
 that the Redphenies Forest should be left untouched
 in order to attract rain. The proportion of the surface covered
 with timber is too small to have any very marked effect on
 the rain fall. and the decay in L.W. Inneson is more
 than could be required for the cultivation of the country
 should you therefore approve the allocation of the Gov^{ts} land
 to the Inneson Forest

to men inclined to cultivate it either with Forest trees or Tea &
coffee. The substitution of the Noblest of Subtropical
trees of America for
Tropical wood as it will probably
extend over land now covered with
grass will do us harm, and the plants
will give more shelter to the present than pop. Fort St George
should therefore put on one side all objections based upon purely
meteorological considerations, &
as hardly applicable to the ~~present~~ being requested to give my opinion
state of things in on the views maintained by Mr. Mc Ivor in para
graphs 17 to 23 of his report on the Government Chinchor
Plantations and Botanical Gardens for 1863 & 1864
I proceed by an: relative to the effect of the Italy berry Forests on
the local rainfall and springs and upon the
wholly to follow from rainfall in Coimbatore, I will first observe that
such as. Mr. Mc Ivor's object in that portion of his report

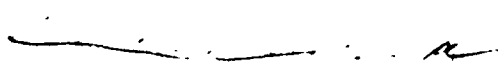
Mr. Mc Ivors object in that portion of his report, is to show that the reservation of the forests on the Kilgherry Hills in consequence of the supposed connection of vegetation with rain fall is not only unnecessary, but that positive advantages would follow their removal.

2. While admitting in para 18 the principal effect of trees in generating by evaporation a cooler atmosphere and so causing condensation of the vapour conveyed by warmer currents passing over them, he urges Ist That it is unnecessary to reserve the forests on the hills in order to secure condensation, because the temperature is such that the clearing of the forests would

is followed by no great diminution in the rainfall.
II That positive advantages would follow from
from water being set free to flow into the
streams, which is now on its passage downward
through the soil intercepted by the roots of trees,
absorbed by them, and discharged by evapora-
tion into the atmosphere through the foliage;
and (second) from the greater quantity of moist
vapour which would float over the hills to con-
densation in consequence of the clouds being no
longer subjected to the action of vegetation in
winging out from them every particle of mois-
ture.

3. I will first consider the second posi- ^{tion} ^{June 3 6 18}
tion which Mr. Mc Ivor takes up; in which he
first urges that positive advantages would
flow from the denudation of the forests in
the increased volume of water which, at present
intercepted by the roots of trees and absorbed
and evaporated, would then fall into the streams.

4 There can be no doubt that the im-
mediate effect of clearing away vegetation along
the course of a stream is to draw off more
rapidly water which was previously deposited
in the soil and in reserve, and thus for a
time increase its volume.

5. The ground in such situations has
more or less of a slope, and water falling
upon it takes at once  a
direction towards the stream. According

as it is more or less obstructed in its passage,
it reaches the stream more or less tardily. Where
there is no vegetation in the way and no
other obstruction, the rain falling on a slope
is only delayed in its passage to the stream
by the thirstings of the surface ground on which
it falls; when that is saturated the residue
flows off at once to the stream. Where there is
vegetation along the banks the roots of the
trees act as so many dams, and delay but
do not altogether prevent the passage of the
water through the soil to the stream. The ground
on the bank of the stream is thus kept satu-
rated with moisture. The stream does not
run so full during the continuance of rain
as it would were vegetation removed, but
from the frugal regularity with which the
reserves of moisture are doled out, runs
more equally under all conditions of the
atmosphere.

6 Mr. Mc Ivor has observed that a cer-
tain stream until lately protected by a thicket
has flowed with double the volume since the
clearing, and he argues from this and from
the known capacity of vegetation to absorb mois-
ture that the streams on the hillsides would
flow with greater volume were they unobstruc-
ted by vegetation. This phenomenon were
it continuous would certainly be contrary

to all experience. But I venture to think that it will prove only temporary.

7. I say contrary to all experience, because, having for several years paid great attention to this subject, and made numerous enquiries of those best able to form a judgment in the matter, I have never once heard it disputed that the removal of vegetation had a rapid effect in draining dry the local springs. This in 1848 and 1852 was certainly admitted to have followed clearing on the Shevaroy Hills. Several springs had disappeared shortly after the removal of the shade which had protected them from evaporation, and which perhaps by capillary attraction or simple obstruction had aided in keeping the surface ground in a constantly moist and saturated state.

8. In Tanjore it is proverbial that water can seldom now be obtained at double the depth at which it was obtainable 20 years ago - and the general belief is that the clearing which has been going on for many years in that District has gradually removed many obstructions that formerly existed to the passage of water and has drained the surface soil of that reserve of moisture which it formerly held in suspension, and which used to pass off gradually and be re-supplied by the regularly returning rains and freshes.

9. I recollect being told in 1849 by Colonel McCally then, and for some years previously, Commissary in Bangalore, that similar effects had been observed to follow clearing in the Mysore territory, and particularly so about Bangalore, where the natives to whom the connection between vegetation and the conservation of moisture had apparently not occurred, accounted for it by supposing that the stream of population constantly moving about the place, had gradually pressed the water down.

10. On the Mississippi it has been found that clearing the forests on its banks has for the present at least increased its volume of water. (Vide Ellet on the Mississippi). so much so that artificial banks have to be raised to prevent the flooding of valuable lands along the stream. The Mississippi is under different conditions however to those of any river in India. The Ganges, and the Arun, and its chief affluents have their sources in the rocky mountains which are covered with snow and from which they receive a regular and unfailing supply. Great clearing of forests have been for some years going on along the banks of the river, and a large amount of water which vegetation formerly absorbed, or dammed up in swamps, now finds its way into the main stream.

11. The difference in clearing in the South

of India consists in this, that while in the instance just given the river is filled from the snow clad Rocky mountains and the supply of moisture from condensation caused by the vegetation of the country is but secondary, and trees may there be viewed as but the absorbents and depositaries of moisture; here we are confidently in a great measure, if not entirely, dependant upon trees as the very sources of moisture as well as its depositaries, and it yet remains to be seen whether the effect of clearing along the Mississippi will not in the end be to diminish its volume, when the enormous reserves of moisture stored up for so many ages past in swamps and mangroves have had time to drain off.

12. That since Europe has been cleared of the dense forests which formerly covered it, it has become much drier, in other words that the moisture present in the soil and atmosphere is less than formerly, is an indisputed fact.

Gibbon in the IX Chapter of his Hist of the decline and fall of the Roman Empire observes. "The modern improvements sufficiently explain the causes of the diminution of the cold. These immense woods have been gradually cleared, which intercepted from the earth the rays of the sun. The mangroves have been drained, and in proportion as the soil has

13
been cultivated, the air has become more temperate.
13. The remarkable aridness of climate which in Palestine has followed the removal of the forests is thus noticed by Stanley in his work on that country: "And this brings on to the question which Eastern Travellers so often ask and are asked on their return, can these stony hills, these deserted valleys be indeed the land of promise, the land flowing with milk and honey?"

"As in Greece since the fall of the Plane trees which once shaded the bare landscape of Attica, so in Palestine, the gradual cessation of rain produced by the loss of vegetation, has exposed the country in a greater degree than in early times, to the evils of drought. This at least is the effect of the testimony of residents at Jerusalem within whose experience the Kedron has recently for the first time flowed with a copious torrent, evidently in consequence of the numerous enclosures of mulberry and olive groves made within the last few years by the Greek convent. There are proofs also of the same general change of climate which in Europe has been effected by the disappearance of the German forests. The constant allusions to winter snow in the ancient writers are not borne out by its rare occurrence in modern times. The forest of Hareth in the thicket woods of Ziph, in Judaea; the forest of Bethel, the forest of

"Sharon, the forests which gave its name
to Rishath fairim (the city of forests) have
"long disappeared."

14 In South Africa, the scarcity of rain,
the disappearance of springs formerly well
known, and the degeneracy of the vegetation
of the present day in comparison with that
of past times (as evidenced by the still existing
holes of figmastic trees long ago felled and
of a girth which is never now attained to)
are noticed by Moffatt's well known missionary
missionary who was for many years in that
country, as effects which have evidently
followed the reckless destruction of wood
by some of the native tribes. I regret that
I have not his work by me to quote from.

15 I said above that I thought the phe-
nomenon noticed by Mr. Mc Ivor of a more
copious flow of water since the felling
of the trees along the particular stream he
refers to, would not prove permanent.
I think the circumstance of the volume
of water that flowed through it during the
four dry months of the season follow-
ing the monsoon being greater than usual,
may be accounted for partly by the regular
continuance of wet weather during last year's
S. W. Monsoon, and partly by the drainage
or expenditure of the reserve of water

in the soil which invariably follows the
clearing of forests. 14

16. The aggregate inch-age shown by
occasional heavy rains may be as great
in any given number of days as that
of gentle rains spread equally over the
same period. But the effect upon the
soil is very different. In the former
case the rain necessarily runs off before
it can sink deep into the ground. In
the latter there is more possibility of com-
plete saturation taking place.

17. The rain on the Hills being gene-
rally soft and gentle, the ground becomes
well saturated by it; and as a vast amount
of moisture is in this way and by the
interception of vegetation kept suspend-
ed in the soil, it seems quite intelligible
that when set free it should take time
to exhaust itself; and meanwhile as the
volume of water flowing from this reserve
is added to that of the usual yearly supply,
the volume of the stream would for the
time be much increased.

18. While therefore the phenomenon
noticed by Mr. Mc Ivor can be thus reason-
ably accounted for, there seems little
ground for attributing it to a cause
which else where is generally acknowledged.

to be followed by permanent effects of the very opposite character; and I think it may be reasonably apprehended that Mr. Mc Ivor's plan would in its results prove to be a practical illustration of the fable of Killing the Goose for the golden egg.

19. Mr. Mc Ivor also urges that trees absorb a vast amount of the moisture in the soil and discharge it through their foliage into the air, where it is dissipated and carried away by the prevailing currents and so lost to the soil & the Springs.

* Discussed in
p. 20 & 26
of this memo.

20. An acre of trees 45 feet high he calculates would give off 14,000 gallons daily. During 150 days of dry weather he reckons that at least 1,500,000 gallons are thus thrown off per acre of forest land.

21. That the exhalations from vegetation are very large cannot be doubted, but the amount cannot with any safety be even approximately ascertained from the experiments made on a few plants.

22. The quotations given by Mr. Mc Ivor show that in the one case a sun-flower in a flower pot in which it was purposely planted when young, was watered through a small tube, which by the arrangements

made was with exception of another similar small tube the only means of communication the plant had with the outer air.

15

23. It was thus brought up artificially, and at the age at which it underwent the experiments was supplied artificially with food.

It was constantly weighed, and the amount of perspiration on a very warm dry day was found to be 1 pound 14 ounces. The perspiration of a dry warm night, without any sensible dew, was about 3 ounces.

A similar experiment with similar results was made with a cabbage.

24. These experiments show doubtless the amount of moisture which plants in an artificial state may be induced to consume and exhale. The experience of the poultry yard in this country equally shows that turkeys under human care may be made to consume a measure of bran and ^{3/8} minime of cholum per day, but no safe calculation could be drawn from such data, as to the exact amount of food required by plants or animals in their natural state, and free from the cramping influences so apparent in the foregoing experiments. Indeed it seems not improbable that the extreme inconvenience the plants were subjected to in being deprived of their free natural communications with the outer air, and supplied with moisture, not as actually required, but at the discretion of the experimenter may have necessitated the

25 It is besides an established fact that vegetation absorbs moisture through its leaves as well as its roots.

"So carefully indeed has nature provided against the chance of deficient moisture, that the leaves are endowed with the property both of absorbing aqueous vapour directly from the atmosphere and of lowering their temperature during the night by radiation, so as to cause a deposition of dew on their surface; in consequence of which during the driest seasons and in the warmest climate they frequently continue to convey this fluid to the plant, when it can no longer be obtained in sufficient quantity from the soil". (Turners Chemistry 5th Ed. page 932.)

26 Thus it appears that a great por-
tion of the moisture evolved by plants is
originally received through the atmos-
phere and is not drawn exclusively from
the soil, and it is ^{not} ascertained what pro-
portion of the moisture exhaled by Plants in
their natural state ^{is} originally received from
the atmosphere and what proportion is drawn
from the soil. Nor is it established
what proportion ^{the} moisture exhaled by
vegetation bears to the amount which it
condenses. So that no effective argument
in favor of the removal of our Forests can be
drawn from the undisputed fact of their copious
exhalations.

* Notices in
Papers 27 & 29

27. ~~As to the~~ ^{in regard to} ~~it~~ ^{that}, gives
ask whether if the forests of the Pulgherries
were cleared the Cornubators Rich would
benefit;

Dr. H. C. Inoué's argument is that as vegetation brings the maximum amount of moisture from the clouds, if the forests were removed, much of the vapour which reaches the hills from the western coast would escape condensation and pass over the hills to the Crimintoro District.

28. It is probably true that a great portion of the vapour would under these circumstances pass over Eastward, but at too great a height to be condensed before passing beyond the limits of the Coimbatore district.

29. The Cambridge district during the Northwest monsoon must receive its rain from the west and south west while the Highway Hills lie to the north west of it.

The planting of the Casimatore district

will probably from Canevara to the adjacent to
(cane 30 to 33) be the most effective remedy
for the continued drought in labour under
as it must from its situation be in a great
measure if not entirely independent of the
Trilgheries for its supply of rainfall. I
do not think therefore that either the re-
: servation or removal of Forest on the
Trilgheries would directly affect the rainfall
in Coimbatore

31. I will now consider the first Pars 30 to 33
point maintained by Dr. De Jor. He
observes in Pars 17 "The Trilgheries like
"other high mountain ranges generally and
"are covered by a cool stratum of air
"which condenses the moisture contained
"in the warm atmosphere in its passage
"from the sea", and he argues therefrom
that the forests on the hills are unnecessary
to secure condensation. as the warm

17

vapour charged clouds from the coast on reaching
the cool atmos, here of the hills must necessarily
yield up their vapour independently of
vegetation. He seems however to have overlooked
the circumstance that in their passage from
the sea and up the side of the hills the
clouds pass through a continuous succession
of atmospheres of increasing rarity, and
that the capacity of this rarefied air for
moisture or in other words its capacity to
hold moisture in suspension and its power
to resist the extraction of its moisture by
the process of condensation, are considerably
greater than that of the denser atmosphere
which on the coast was the vehicle of the
vapour

31. Precipitation is determined not merely
by the relative temperature of the vapour-
charged stratum to that with which it
comes in contact but by the relation
of temperature and density in the one,

to temperature and density in the other, and when
the vapour charges atmosphere there is much
rarefied, a far greater degree of cold is required
to extract the vapour from it, ~~than is possible~~
have supplied, ~~had it been~~ of the density of the lower strata;
and while (as Dr. De Lavoisier humbly admits
in para 18) there is no question about forest
plantations springing from the atmosphere
the maximum of condensation, on the
other hand it is by no means ascertained
and can at the best be merely matter of
conjecture that denuded of vegetation, the
Hills would present to the vapour charges,
but rarefied atmosphere a surface
sufficiently cold to extract from it even
a moderate amount of rainfall.

32. The quotations I have above given
I think favour the view that the removal
of the natural vegetation of a country
is followed as a consequence by the
drainage of the reserves of moisture
with which the soil is saturated.

Sho

155
The climate becomes drier; there is less evaporation
from the surface; it consequently becomes hotter,
and the atmosphere enveloping it, becoming
more heated by radiation from the bare and
heated surface, has a greater tendency to ascend.
Its vertical play will carry the clouds higher,
where caught by the prevailing currents they
will be dissipated & lost.

33. It cannot be doubted that similar
effects would follow the clearing of the
Scilly herries. Cold as the stratum of air is
at the elevation of the plateau, it must
be remembered that the low temperature
of the air is not generated, as Dr. De Lavoisier
seems to assume by the Hills but depends
entirely upon the rarefaction which ~~is~~ always
found in a high stratum of atmosphere,
and that it is still subject to be heated by
the masses of earth with which it is in
contact. As long as the temperature of the
earth is kept low the air in contact with
it will be kept at a low temperature. When
the temperature of the earth is raised that
of the atmosphere enveloping it will be

likewise raises. Now the effect of clearing the Scilgherries, if my conclusions are correct, will be to drain the soil and lay it bare, and increased heat of surface must follow, which could not fail seriously to affect the rain fall

34. To sum up, therefore. It is certain that trees exercise a very powerful influence in the production of rain fall

35. It is certain that the destruction of the Forests on the Scilgherries would cause a diminution in the amount of vapour rising from the clouds in the shape of rain fall, and would thus prejudicially affect the Rivers which have their sources on these hills

36. It is uncertain what the amount of that diminution would be. It is improbable that the annual amount of that diminution would be less than the amount of the water in the soil which from the falling of the Forests would

17
be annually set free to swell the streams unimpeded by interception & no longer subject to be absorbed and again dissipated by evaporation. It is improbable that any benefit would accrue to the Coimbatore District from the removal of the Forests on the Scilgherries as these forests do not directly affect its rain fall either way. On the other hand as Dr. Schimper truly observes "trees improve the soil on which they grow, render the temperature more equable, reduce the violence of storms, afford shelter and shade very grateful to man, their presence gives a pleasing effect to the eye, while their gaseous emanations are highly beneficial to animal life."

37. It may be added that trees when once removed are very difficult to replace. Their removal is the work of a day, while it takes years to grow them; it is difficult if not impossible for a Government

to undertake replanting, and the tardiness
of a return makes planting an unacceptable
investment to the private Capitalist. Hence
many years might pass away before a
remedy would even be projected for the
evils which would not improbably at once
follow the removal of our Forests

38. Should it be wise therefore on
arguments put forward on an almost
purely conjectural basis to run so
great a risk of losing present undoubted
advantages.

Edmund

Edmund
19 July 1864

Orders requested as to
the number of Copies to be
struck off, of the accompa-
nying Chinchona Report.
The report for the previous
year was simply transfe-
red to the Public Department
and embodied in the Admi-
nistration report. Mr. McMor-
wankin pamphlet form
300 Copies of paras 9 to 13 &
24 to 38 of the present report
for distribution. Perhaps
250 in this form and 100 full
copies may suffice. -

500

Reported to England
of 14th March 1865 A-16
Mex.

June 20/65

W. 4/5
9 of July
1865

The firm considers
the 'finishing' report
of the progress of
the Chinchona plan-
tations during the
official year 1863/4
to be extremely satis-
-factory - The season
was an unusually
trying one, the drought
being so long continued
that it became ne-
cessary to resort to
watering ^{by hand} the ~~plants~~
yet the plants have
made good progress.

The propagation
has been more suc-
cessful than in
previous years - The
monthly average

having been 15,326
plants and the
maximum - in Feb'y
1862 - 32408. The
total number of
plants produced
up to the 31st May
1862 has been 416,909
of which 31,662 have
been distributed to
the public.

The extent ac-
tually planted out
in the different
plantations is stated
to be 323 acres.

here The first plants
permanently planted
out at Keddinuthum
in August 1862, and
have, in the 20 months,
which have since elapsed,
"attained heights
varying from 6 to 9 ft.

with thick stems
well furnished
with lateral branches,
and presenting an
robust & healthy ap-
pearance as could
be wished. This ^{growth} is
said to be about
3 inches in excess
of the average of the
same species / C. Suc-
cumbra throughout
the plantations.

The results of
the year analysis
of the bark is also
highly encouraging,
the yield of rough
alkaloids having
been 6 per cent: while
in the previous
year it was only 4.3.

There can no
longer be room for
doubt as to the suc-
cessful introduction

of the Chirichona
on the Neelgherries
and the ^{Extraordinary} ~~success~~
success which has
attended its culture.
He then reported he
had by extensive
propagation - rapid
& healthy growth -
or the rich production
of alkaloids -

For these results
the Govt. are ~~much~~
indebted to Mr.
McLvor, whose
able & zealous
executions in this
important enter-
prise merit the
highest praises -

The total Ex-
penditure up to
the 30 April 1865
has amounted to
Rs. 130,343 - under

1/ the following heads -
Rs.
Buildings - 21,100 -
Plantations - 58,388
Tools - 5,029
Establishment - 47,982
Contingencies 3,756 -

The progress of
the different plan-
tations appears to
be as follows -

At Neddiwuttum
220 acres have been
planted out, ^{with} roads
drains &c completed -
and 205 acres are
in a forward state
of preparation for
planting & the earth
work of the roads &
bridges completed - The
propagating house has
been extended & afford
space for 20,000 cuttings.
At Pykara, 8 acres

have been planted
out and 165 more
or less prepared - the
permanent buildings
& coaly lines have
been finished -

At Doda betta, 95
Acres have been planted
60 ^{acres} are in progress,
500 acres have been
enclosed with a
trench and 11,000 yds
of road cut.

At the Hoon dahs
/Sanctum only in
Dec 1863/ 75 Acres
have been logged &
burned & are in
course of preparation
for planting - 85
acres have been felled
and coaly lines &
temporary buildings
erected -

25
A range of hardening
pits, a harding shelter
for 75,000 plants, has
been added to the
propagating houses
and there are thus
ample means for
producing from
20,000 to 30,000
plants monthly -
Extensive nurseries
have also been formed
on the different
plantations -

This is a very
satisfactory state
of affairs.

The failure of
the seeds of C. Pitayo
-ensis is much to
be regretted and will
be brought to the
notice of the Home

put, that efforts
may be made to
procure a further
supply -

The paragraphs men-
tioned are con-
tain much valuable
information as to
the culture & of
the Chinchorro &
will be separately
printed uniformly
with the Manual
to which they will be
added.

The Govt have
already ~~passed~~ ^{issued}
orders for the pre-
paration of a list
of reserved lands
so that intending
planters may have
the means of readily
ascertaining what

31

lands are ^{not} ~~are~~ ^{not} ~~are~~
available. The im-
pression, which is
said to prevail,
that no more forest
land will be sold
is altogether without
foundation - the
extreme difficulty
of obtaining compe-
tent surveyors &
the necessity, which
the Law imposes, of
advertising all lots
for 3 months, necessarily
causes delay in
the transfer of land,
but the Govt are not
aware of objections
having been so
~~formally~~ ^{formally} repeated, on
the plea of the land
being reserved, so
~~formally~~ ^{formally} & frequently
as to afford ground

for the impression
stated. The Com-
missioner's report has
many cases of
deposits on this ac-
count have occurred
during the last year.
In order to avoid
delay the put, it
may be remarked,
has all as lands
of the old prior to
actual survey,
on condition of
the boundaries
being carefully &
permanently marked
& the purchase being
subject to adjust-
ment after survey.

The put. To
not claim it be-
cause ^{here} necessary to the case

the subject of Kansas
17 to 23 of Mr. Mc-
Leary's report. The
McLeary's views are
not those in general
acceptation. At
the put. have never
entertained any
intention of stopping
all further selling
on the Neely's claim
~~in order to do so~~
with the idea of
thereby increasing
the cash value in
Columbia. The
reservations are
all for special
reasons, connected
with the tract
reserved. and
each case is care-
fully considered
on its own merits.

Mr. Mc Lennan's
account of the
Botanical gardens
is highly satisfactory.
The pub. can state it
desirable that he
should ^{also} prepare
for publication a
catalogue of the
different trees, shrubs
etc. in the gardens.

In future reports
the progress of the
plantation & nur-
series of Australian
trees should be specially
noticed. The pub. with
attention paid to the
latter, and will con-
tinue to supply Mr
Mc Lennan with seeds
from Australia. The
plants when grown can
be sold to the public at
a fair price and pro-
vided to the great benefit
for the pub. schools. The
common kinds of Aus-
tralian trees, as the acacia melaleuca, need not of course be
raised by Mr Mc Lennan.

The pub. state with satisfaction the testimony
borne by Mr Mc Lennan to the services of Mr Botcher, Clerk
Hickok, Mr Smith, & Messrs Burrows, Ramsay & Wilkinson
and of his office assistants Harriman & Ward of
Mr Mc Lennan.

" E. W. P. has been engaged - Mr. G. W. L. - 300 Campbell St. N.Y.
" S. H. P. has been engaged - Mr. G. W. L. - 300 Campbell St. N.Y.
" S. H. P. has been engaged - Mr. G. W. L. - 300 Campbell St. N.Y.
" S. H. P. has been engaged - Mr. G. W. L. - 300 Campbell St. N.Y.

1877.

Reported to Enrolment
of 16th March 1865 N. 15
Miss

Revenue 1865 Dep't.
Pro. of Govt for February

N. 273.

Pro. of the Madras Govt.
28th February 1865

Reviewing the Progress
Report of the Quinchona
plantations for 1863/64.

N. 192493.