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*Proceedings of the Madras Government, Revenue Department,
27th September 1865.*

Nb. 542. Read the following letter from the Superintendent, Government Chinchona Plantations, to W. HUDLESTON, Esq., Acting Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 16th August 1865, No. 59 :—

SIR,

1. I have the honor to forward herewith the Report on the Government Chinchona Plantations and Botanical Gardens for the official year 1864-65. Much important information having been gained during the year with reference to the cultivation of Chinchona, especially in the preparation of the young plants, rendering the operations of propagation and transplanting much more certain, simple, and economical.

2. I would, therefore, respectfully solicit the favor of being supplied with 300 copies of paragraphs 2 to 13 and 19 to 35 inclusive, for distribution to planters.

**REPORT ON THE GOVERNMENT CHINCHONA PLANTATIONS AND
BOTANICAL GARDENS ON THE NEILGHERRIES FOR 1864-65.**

Introductory Observations.

1. In submitting this Report it affords me much satisfaction to be able to state, that the past season has been favorable for planting operations, and that considerable progress has been made in the works connected with our plantations. The plants continue to flourish and maintain a luxuriant state of health. The maxi-

Increase of propagation.

Number of plants on 31st May 1865—5,58,105. this does not include 78,612 plants the number issued to the public from the commencement to 31st May 1865. Our oldest plants were planted out in August 1862, and have attained heights varying from 8 to 12 feet; the circumference of the stems, at 6 inches from the ground, varying from

Height and growth of plants.

Thickness of stems.

7 to 13 inches, the plants being well furnished with lateral branches, and present a most robust and healthy appearance. The Chinchona Succirubra, Peruviana, and

Condition of plants at Neddivuttum and Pykara.

Dodabetta plantations.

C. Officinalis and varieties grow as well upon grass as on forest land.

almost every exposure, hence they may be successfully cultivated over the whole pla-

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teau of the Neilgherries, excepting such land locked holloys as are subject to severe

Analysis of bark shew great increase in Alkaloids.

Bark submitted in 1862 yielded Quinine in too small a quantity to be determined; that submitted in 1863 gave 3.30 to 3.40 of purified alkaloids; while that submitted in 1864 gave 6 per cent.

3.30 to 3.40 of purified alkaloids, while that forwarded in May 1864 gave 6 per cent. of purified alkaloids. These are the results of the analysis by Mr. Howard;

Dr. deVry found 8.49 per cent. in one specimen of Red bark.

much as 8.49 per cent. of alkaloids, being fully five times the average quantity found in the barks of Commerce, this result has exceeded our most sanguine expectation,

Cultivation seems to increase the quantity and improve the quality of alkaloids.

loids, and also improves their quality at least in the *Chinchona Succirubra*, and we may assume that a like result will be produced in the other species of *Chinchona*. With these observations, I proceed to particulars which, for the sake of convenience, are arranged under the following heads:—

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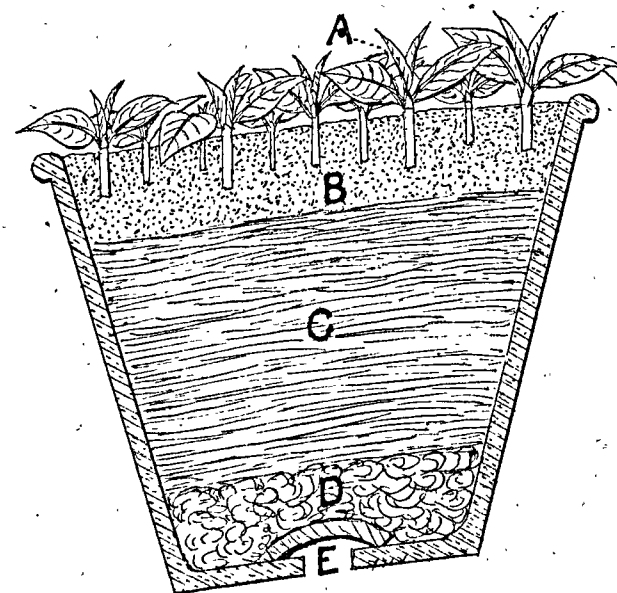
Appendix A—Accounts from the commencement of operations to the 30th April 1865.

Do. B— Meteorological observations at Neddivuttum.

Do. C— do. do. at Ootacamund.

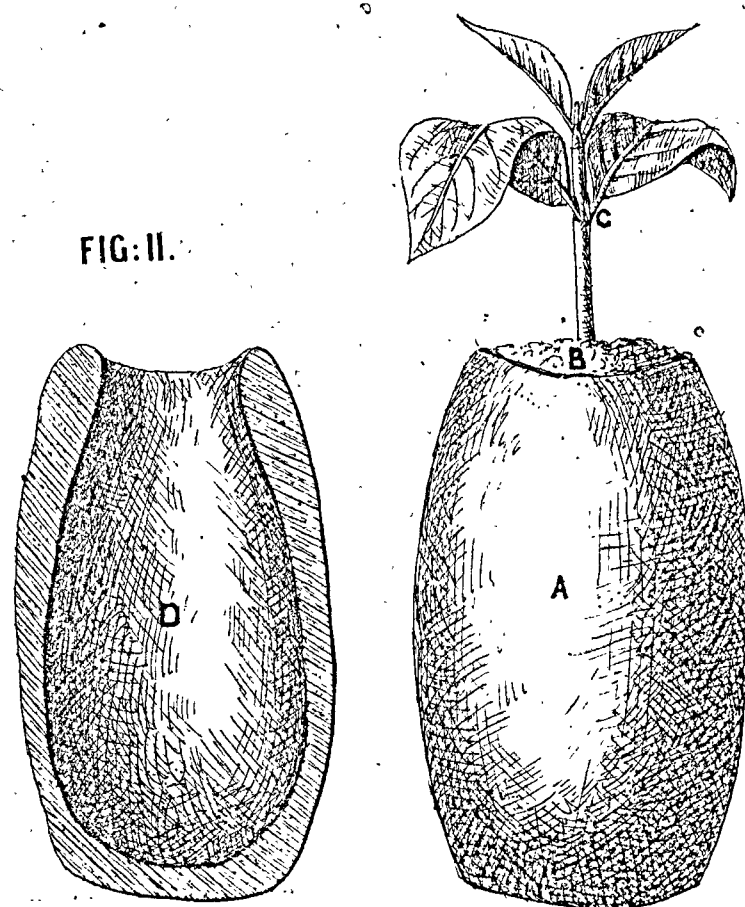
Propagation of the plants, alteration in system of. 2. Owing to the large number of plants produced, and consequently the employment of much labor in this operation, we have found it necessary, in order to economize and lessen the cost of propagation, to abandon the system of placing the cuttings on a piece of brick, as described in previous reports. The method now adopted is to fill the pots as formerly with prepared soil, but only to within an inch or three-fourths of an inch of the surface; this space is then filled up with pounded brick dust, into which the cuttings are inserted as at A in Figure I.; B representing the stratum of brick dust; C, the ordinary soil used and described in previous reports; D, moss to facilitate drainage; E, the potsherd or draining material. Under this treatment the cuttings are found to root more freely than by the method previously adopted, while a man can pot off in a day from four to five times the number of cuttings. This simple expedient, which may scarcely appear worth detailing, is of great importance in extensive propagating operations, as it reduces the cost to nearly one-fifth of that originally incurred, and at the same time economizing space in the propagating cases, as by the present system double the number of cuttings can be placed in a four inch pot.

FIG. I.



Rooted cuttings not transplanted from cutting pots until hardened when they are put singly into pots formed of cowdung and sand.

FIG. II.



3. The cuttings when rooted in the propagating cases are not as hitherto transplanted into larger pots, but the cutting pots removed into the hardening cases, and when hardened off, the plants are placed singly into pots two inches in diameter, and about $3\frac{1}{2}$ in depth, formed of a mixture of cowdung and sand as illustrated at Figure II.: A being the cowdung pot; B, the soil; C, the plant; D, a section. These pots are, prior to use, dried in the sun, by which they become hard and in every respect answer the purpose of an ordinary pot, when buried in the soil they become soft by the moisture, and in this condition are easily penetrated by the roots of the plants, but are still

sufficiently adhesive to permit of handling, without breaking, when removing or transplanting the plants.

The cowdung pots cheaper and better than the ordinary earthen pots, and admits in permanently planting out of being placed together with the plant into the ground.

ordinary pot, while they more effectually answer the purpose required in giving nourishment to the young plants, and in the operation of permanently planting out, admits of the pot with the plant being at once placed into the soil, thus avoiding the injury done to the roots in removing the plant from ordinary earthen pots.

Condition and growth of plants.

Growth of the plants planted by the Governor and Staff in August 1862.

4. These cowdung pots are made by hand, and a man will make from 400 to 500 per diem; they are thus produced at less than $\frac{1}{100}$ th part of the cost of an

5. The first Chinchona plants were permanently planted out on the 30th August 1862. The eleven plants of *C. Succirubra* planted by His Excellency Sir William Denison and Staff, made an

average growth of three feet from that time to 30th April 1863, the circumference of the stems, at six inches from the ground, varying from two to three and half inches; and from the 1st of May 1863 to 30th April 1864, these plants made an average perpendicular growth of two feet eleven inches, with the circumference of the stems varying from six to nine inches; and from the 1st May 1864 to 30th April 1865 these plants attained an average perpendicular growth of one foot six inches, with stems varying from 8 to 12 inches in circumference. The perpendicular growth of these individual plants in the official year 1863-64 exceeded the average growth of the same species throughout the plantation by about three inches. This year, however, these plants have not attained the average growth of those on the plantation, in consequence of the heavy storms which have prevailed, and the situation in which they are planted, being exposed to the full force of the western winds. On the first Denison Plantation the *C. Succirubra* was planted at 10 and 12 feet apart, and the branches of many of these plants are now touching each other, presenting the appearance of a luxuriant young forest. The bark has much increased

Bark much improved in thickness.

in thickness, while the markings characteristic of the finest Peruvian bark become more and more apparent; mosses and lichens having developed themselves upon the stems of the oldest plants. This, in combination with the healthy growth of the trees, now establishes, beyond all doubt, that the Chinchona bark can be grown on the Neilgherries to as great perfection as in the most favorable localities on the Andes. The *C. Succirubra*

Can be grown to great perfection on the Neilgherries.

still continues to grow most robust and to produce the thickest and the largest quantity of bark in a given period; this species is also very hardy, and would no doubt be most profitable to cultivate at elevations varying from 4,000 to 6,000 feet. One plant of this species has already produced perfect seeds, and as upwards of a thousand plants are now in bloom, we may shortly expect to be able to supply

abundance of seed of this valuable species, which stands pre-eminent in the quantity of alkaloids it produces, also in the thickness of its bark, and in its luxuriant and rapid growth; in short, it possesses in the highest degree, every quality necessary in a plant intended for profitable cultivation.

C. Succirubra the most profitable species to cultivate.

C. Officinalis and its varieties next in value.

in value, producing a bark nearly equal

And better suited for growth at high elevations and exposed situations.

6. The *C. Officinalis* (*Condamenea*) in cultivation promises to rank second in thickness to *C. Succirubra*, but the plant is of less luxuriant habit, although more hardy and better suited for cultivation in exposed situations and high elevations. This species, together with its varieties, *Crespilla* and *Bonplandiana*, should invariably be selected for cultivation at high altitudes, as they thrive best at elevations varying from 6,000 to 8,000 feet; some plants of the *C. Officinalis* are coming into bloom, and possibly may produce perfect seeds this season.

C. Calisaya rich in Quinine, but of slow growth.

7. The *C. Calisaya* has hitherto only been planted at elevations varying from 4,000 to 6,000 feet, and here the

plants thrive well, although the habit of this species is less vigorous than the "Red" or "Crown" barks, the stems scarcely increasing more than half as much as these species in thickness during the same period of growth, and consequently as a bark producing tree is less valuable. A few plants of the Calisaya, accidentally placed out at a high elevation (7,300 feet), seem to have adopted a much more luxuriant habit, than those planted at lower elevations, consequently a number of this species will be planted during this season at much higher elevations than hitherto.

Now in full flower on 1st Denison Plantation. Several plants of the C. Calisaya planted on the 1st Denison Plantation in November 1862, are now in full bloom, presenting a most beautiful appearance, while their fragrance fills the air for a considerable distance.

C. Lancifolia resembles Calisaya.

8. The C. Lancifolia, received from Java, much resembles the C. Calisaya in its habit and growth, but our experience with this species has been too short to admit of an opinion being formed of its ultimate value as a cultivated plant. The plant, no doubt, is the true C. Lancifolia of botanists, and is a most valuable species for the production of Quinine.

Propagation of Grey barks discontinued.

9. The propagation of the "Grey" barks, C. Micrantha, C. Peruviana, and C. Nitida, has been discontinued in consequence of the small quantity of Quinine produced by these species; although they yield a considerable quantity of Chincho-nine, yet the value of this being much inferior to Quinine, it has been considered undesirable further to extend their cultivation. Many of the older plants of these three species are now coming into bloom.

Many of these species now in bloom.

C. Pahudiana.

10. The C. Pahudiana could be grown to any extent in this locality, but in consequence of the uncertain value of the plant, it has not been propagated. A few of this species are also now in bloom.

Cultivation, modification in system of.

11. The treatment described in previous reports has been found adapted to the requirements of the plants, but in order to lessen the labor and risks from carelessness in transplanting, some modification in our former treatment has been found necessary. The plants being established in the hardening oases, are planted

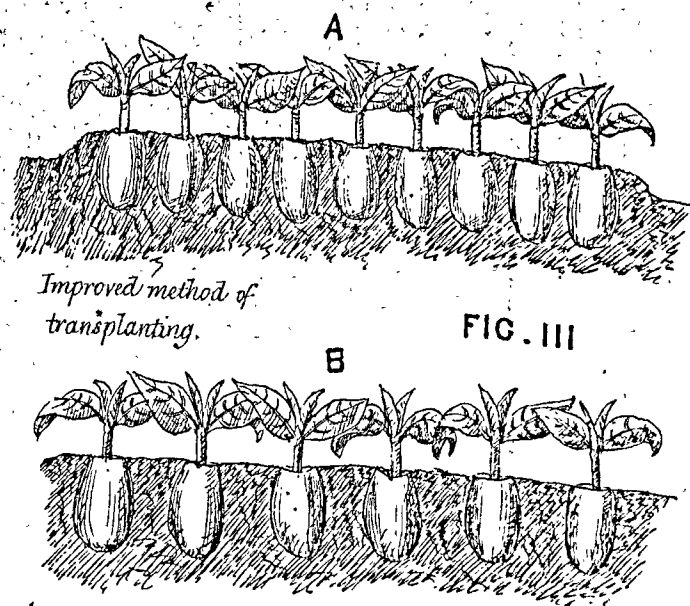


FIG. III

in the nursery beds as illustrated at Figure III. : A being a transverse section of a row of cowdung pots as placed in the beds, and filled in between with earth; B shewing a longitudinal section of the bed, the pots being placed at the distance of $2\frac{1}{2}$ inches apart, and the spaces between them filled up with earth to a level with the stem of the plants. In this

Method of transporting the plants.

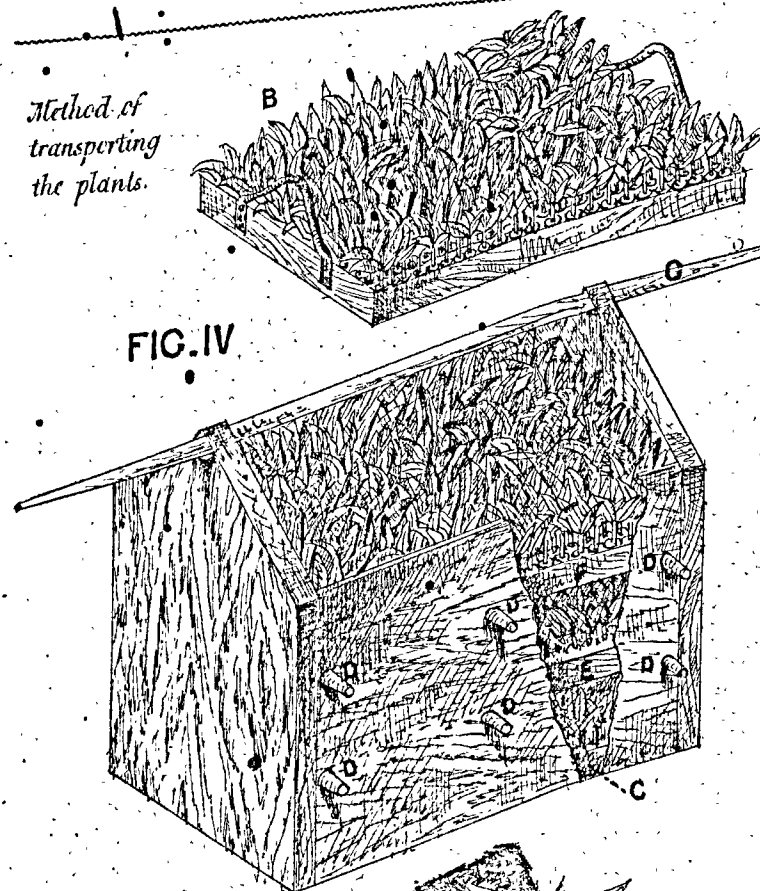
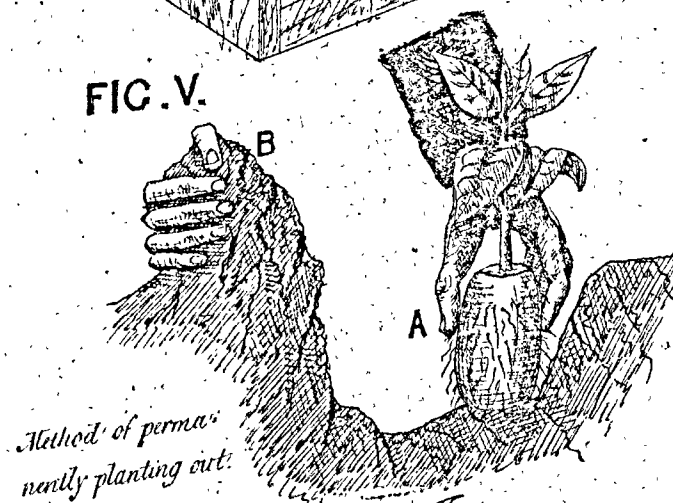


FIG. IV

FIG. V.



Method of permanently planting out.

FIG. VI.



Rough wood protection & shelter for young plants

way the plants can be removed and transplanted by untrained laborers without danger of damage to their roots. In removing the plants from the nurseries to be permanently planted out, they are raised from the nursery beds and arranged on a light dealwood tray, 2 feet by 3 feet as at Figure IV, B; this tray being filled, is lifted by the handles and placed in the bottom of a box as at C; another tray is filled in like manner, and three round sticks being run through holes in the sides of the box at D; the second tray E is placed on and supported by these sticks, and the third tray F treated in the same way. The box now being filled and containing about 540 plants, is lifted by the pole G and carried by two men to the planters where it is deposited, the same men returning with an empty box to be re-filled. The planters first draw out the pole and remove the upper tray F from the box, and proceed to plant out the plants as illustrated at Figure V, A, filling in the soil in the manner shewn at B; this completed, the plants are immediately shaded with split pieces of wood as at Figure VI, and the operation of planting is finished. When the plants have grown above the wood, they are protected from chafing by a grass rope being twisted round the

top as at H. This rough split wood, as a protection and shade for the young plants, has been found quite as efficient as the baskets described in paragraph 27 of last year's report, and requires less labor, as one man in this manner is able to shade from 50 to 60 plants per day. The distance at which the plants are now placed, when permanently planted out, are for the "Red," "Grey," and "Yellow" barks

7x7 feet. The "Crown" barks in very exposed situations 4x4 feet, in medium exposed places 6x6 feet, and in sheltered localities they are also placed 7x7.

Cultivation under the shade of living trees. Principal plantation entirely cleared of forest. Dodabetta plantation, also on some portions of the 2nd, the forests were only partially cleared, in order to test the effect of cultivating the plants under the shade of living trees, and the experience of upwards of two and a half years, although comparatively short, is still, I think, sufficient to establish beyond doubt that they cannot be successfully grown under living shade. The plants in such situations are weak, 'drawn,' and liable to damp off in continuous wet weather, and they suffer much more from gales of wind than in open and even exposed places, while the accidental falling of the forest trees, which occasionally takes place, destroys many of the young plants.

Are also injured by the falling of the forest trees during storms.

Suggests that the forest trees be removed. shade, and I would respectfully suggest that while the Chinchona plants are young, the forest trees be removed from about 30 acres, preserving 10 acres by way of experiment, as it will probably be 30 or 40 years before any return can be expected from plants grown under the shade of forest.

Cultivation results obtained in by private planters. Increase of private plantations. Chinchona bark as a staple product of the Neilgherries. Mr. Money, a gentleman from Bengal, having procured no less than 900 acres of land in the Deva Sholah and its neighbourhood to be devoted entirely to Chinchona cultivation.

Progress of plants in different Districts of India. 15. From Mahableshwar, Belgaum, Honore, and elsewhere in the Bombay Presidency, reports have been received of the plants making fair progress, while the plants supplied to Mr. Fitzgerald at Darjeeling are succeeding well; also in the North-Western Provinces considerable success has been attained. From Coorg, Nugur, and Wynad, reports have been received which seem to establish that the plants

grow freely, and promise to be cultivated with great success in these localities. The number of plants issued from our nurseries to the public in three years, exceeds 78,000, and portions of these have been distributed to every District in India considered suitable to their growth.

Felling forests for Chinchona cultivation, effect on springs and water supply. Streams continue to flow more copiously when forests are felled.

16. Farther observations seem to establish the impression detailed in paragraphs 17 to 22 of last year's report, that the felling of forests at the sources of springs, and along the banks of streams, instead of diminishing, (as generally believed) considerably increases the flow of water. The views on this subject, as the Government correctly observe, are not those in general acceptance, but the question is one of so great moment to India, where the water supply forms the wealth of the country, that the facts observed are worthy of careful investigation. The result of experience from the felling which has already taken place, unmistakeably establishes that, in these localities at least, streams flow far more copiously, and maintain their volume much more regularly, throughout the dry season when the forests are felled, and this has continued for four years. These are facts hitherto unaccounted for, and apparently little observed, although they appear to take place in every spot where felling has been carried on to any extent. The felling of forests is not supposed in any way to increase or diminish the rainfall, but to preserve and economize it, giving off the water to the streams by the slow and regular process of filtration, the land being deprived by felling, of the myriads of pumps in the shape of trees, which previously daily drew from the arteries and dissipated into the air an immense quantity of water.

Felling of forests not supposed to effect rainfall. rainfall, is a complex subject not easily subjected to practical test, but deductions drawn from the fact that young trees require for their existence more uniform moisture than old ones, it is fair to conclude that trees exercise no influence in attracting moisture, as all spots upon which forests are now found, must necessarily have been more uniformly moist prior to the forests being produced than after they became established.

18. In the extension of our operations it will be necessary to fell several other forests well calculated to test the effect of trees upon the flow of water in springs and streams, consequently instruments have been constructed to measure the flow of water in the streams issuing from these forests, for at least a year prior to the trees being felled. The flow of water from the same forests being registered by the same instrument for several years after felling, will establish the exact increase or decrease in the flow, and its variations throughout the seasons both in the unfelled and felled forests.

Cultivation, elevations and exposure best suited to.

Elevation and exposure best suited to the "Red Bark."

best at elevations varying from 5,000 to 6,200

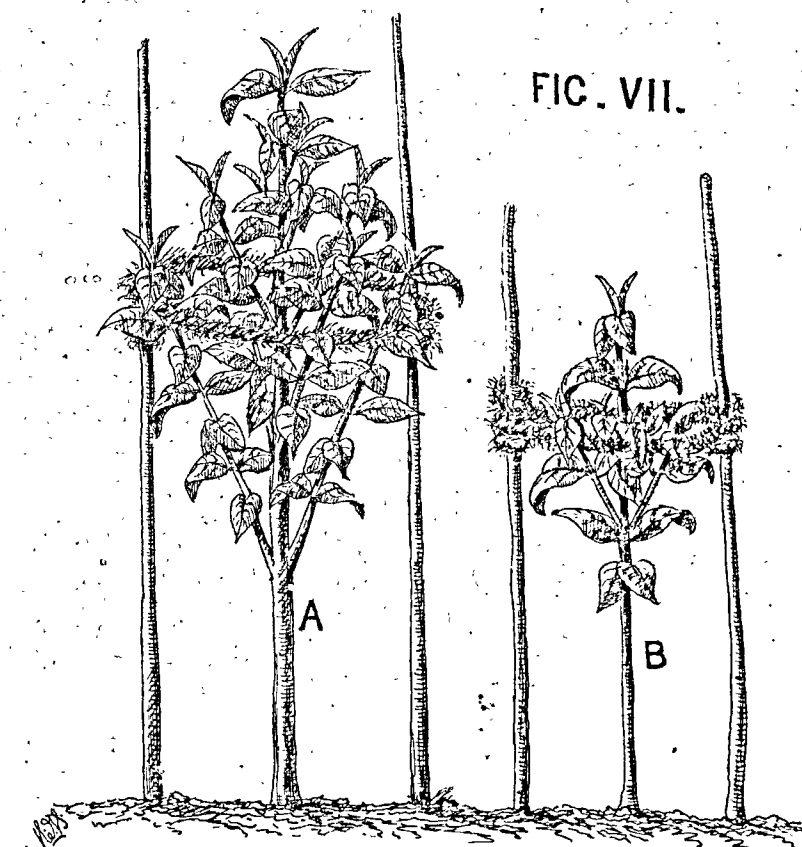
Effects of exposure on.

aspect, nothing could be more satisfactory than the growth of these plants, while on the lower portion of the 2nd Denison Plantation, which is very much exposed to the S. W. monsoon, and to the full effect of the rays of the afternoon sun, during the dry season, the growth of this species has been very unsatisfactory, the plants being stunted in consequence of the soil becoming parched and dried up during the months of February and March, while they are cut to pieces in the months of June and July by the violence of the winds. Various expedients have been adopted to counteract these disadvantages, and although none of them have proved quite effectual, they have been so far useful in protecting the plants as to merit description.

Means of protection.

19. The elevations found best suited to the growth of *C. Succirubra* or 'Red' bark is about 6,000 feet, the plant, however, will grow at considerably greater elevations as also down to 4,000 feet, but they have been found to thrive best at elevations varying from 5,000 to 6,200 on slopes facing the north, and well sheltered from the N. E. and S. W. monsoons. On the 1st Denison and Markham Plantations, which possess this

20. The plants when young are shaded and protected as described in paragraph 11, and when they attain the height of 1 foot or 18 inches, they are staked, and tied with grass ropes as at Figure VII, A and B, great care being taken to see that the grass rope does not touch the stem of the plant, as when this is the case, the movement of the plant with the winds cuts the bark through at the point of contact with the rope, and destroys the plant; this can be effectually avoided by drawing the rope up to encircle the leaves and small branches when present, so that the leaves or branches come between



the rope and the stem of the plant. This requires particular attention; because, if not attended to a whole plantation might be destroyed in one storm, it being much better that the plants be not tied at all, if not secured effectually.

21. The various species of "Crown" Bark, *C. Officinalis* (Condamenea), *Bonplandiana* (Uritusinga), and *Crespilla*, thrive best at elevations varying from 6,000 to 8,350 feet, the latter being the highest elevation at which the plants are grown here. These species or varieties, when well secured as described in the preceding paragraph, grow in any exposure, and even where exposed to the full force of the monsoons they are not much injured, although their leaves become shattered by the storms, fresh leaves however being immediately produced the plants are

Bears considerable exposure.

not materially damaged. These species will not grow in land-locked hollows subject to severe frosts, but otherwise can be grown in almost every soil on the plateau of the Neilgherries, apparently succeeding as well in grass land as in forest. Although the "Crown" Barks bear this amount of exposure, nevertheless like all the other species of *Chinchona* they thrive best in well sheltered situations with a N. or N. E. aspect, as these localities

But prefers sheltered positions.

maintain a more uniform moisture throughout the dry season, and this is highly beneficial to the growth of *Chinchona*.

"Yellow Bark."

22. The "Yellow" Bark, or *Chinchona Calisaya* and its varieties grow well at 5,000 to 6,000 feet, and also in the Wynaud at 3,000 feet, these are the only elevations at which we have grown the plants. This species although valuable for the production of quinine, does not promise to be a profitable plant under cultivation, in consequence of the thinness of its bark and slow growth, a few plants unintentionally placed out at a much higher elevation than formerly (7,300 feet) have assumed a more robust habit than those planted at a lower altitude.

"Pitayo Bark."

23. The "Pitayo" Bark, *C. Lancifolia*, has been planted out at an elevation of 7,600 feet, but owing to the few plants and the shortness of our experience with this species, it is impossible at present to state with any certainty the elevation best suited to the cultivation of the plant.

"Grey Bark."

24. The "Grey" Barks, *C. Peruviana*, *Nitida*, and *Micrantha*, have been found to grow well in the localities in which they were originally planted, at elevations varying from 4,500 up to 6,000 feet, flourishing best at the highest elevation and in sheltered positions facing the north. During the present year these plants have not been propagated in consequence of the small quantity of quinine they produce, they are nevertheless rich in chinchonine.

C. Pahudiana.

25. The *C. Pahudiana* continues to flourish both at an elevation of 5,000 and 7,400 feet, but this has also not been increased in consequence of the uncertain value of its bark. Another species nearly allied, if not identical with the *Pahudiana*, has recently been received from Java, but none of these have yet been permanently planted out.

Cultivation, soils best suited for

Soils best suited to the growth of Chinchona.

in this soil, but prefers a deep brown mould; this species is also found to grow well in the laterite soils so common on the plateau of the Neilgherries. The "Yellow" and "Grey" Barks prefer the same soil as the C. Succirubra, while the C. Lancifolia and Pahudiana indicate a preference for a dry and gravelly soil.

Cultivation, effects of storms and wet weather upon

Plants when established are not liable to be blown down.

and thus the plants are secure against being blown down even in the heaviest storms. In exposed situations, however, the stems are occasionally broken off, while the foliage of the larger leaved species are much tattered, and have sometimes been blown away entirely; however, as the plants attain age, the leaves become smaller and are less affected by the wind. The greatest injury the plants receive is from the branches striking against each other, and damaging the bark.

28. The continuous rain during the last monsoon proved less injurious to our plants than the preceding one, the plants of younger growth having suffered most, only five plants of the "Grey" Barks having died during the monsoon, while twenty-five were lost from the effects of the previous monsoon. The "Grey" Barks suffer most from the effects of heavy and continuous rain, while the leaves of all the species assume a yellow tint, indicating the presence of a superabundance of moisture, but this has only proved fatal to a few plants of the "Grey" Barks. All the species luxuriate and make most vigorous growth in the seasons alternated with showers and sunshine, and even continue to grow well for two months after the rain has ceased, thus establishing that they bear a considerable amount of drought without injury.

Gathering the bark, farther observations on the treatment for this purpose.

Removing strips of bark most successful.

instantly covered with moss; and secondly, from allowing lichens to be mixed with the moss used for this purpose. This season the treatment of the plants on this system has been most successful, in consequence of the stems being covered with moss the instant the strips of bark were removed, care being taken to select such moss as was entirely free from an admixture with lichens, it being found that the presence of these among the moss, generated a fungus, which penetrated into, and

26. The C. Succirubra or the "Red" Barks thrive in a dark Crown deep vegetable mould, resting upon an open sub-soil. The C. Crespilla in peaty land, the C. Officinalis also grows freely

27. The different species of Chinchona are found to establish themselves securely in the ground, in consequence of their throwing out a dense moss of fibrous root, much like the Rhododendron:

29. Farther experience in removing strips of bark indicate this to be the most profitable system. The causes of failure in our first experiments having arisen, first, from the stems not being

injured the wood of the plants, preventing the formation of new bark. It is, therefore,

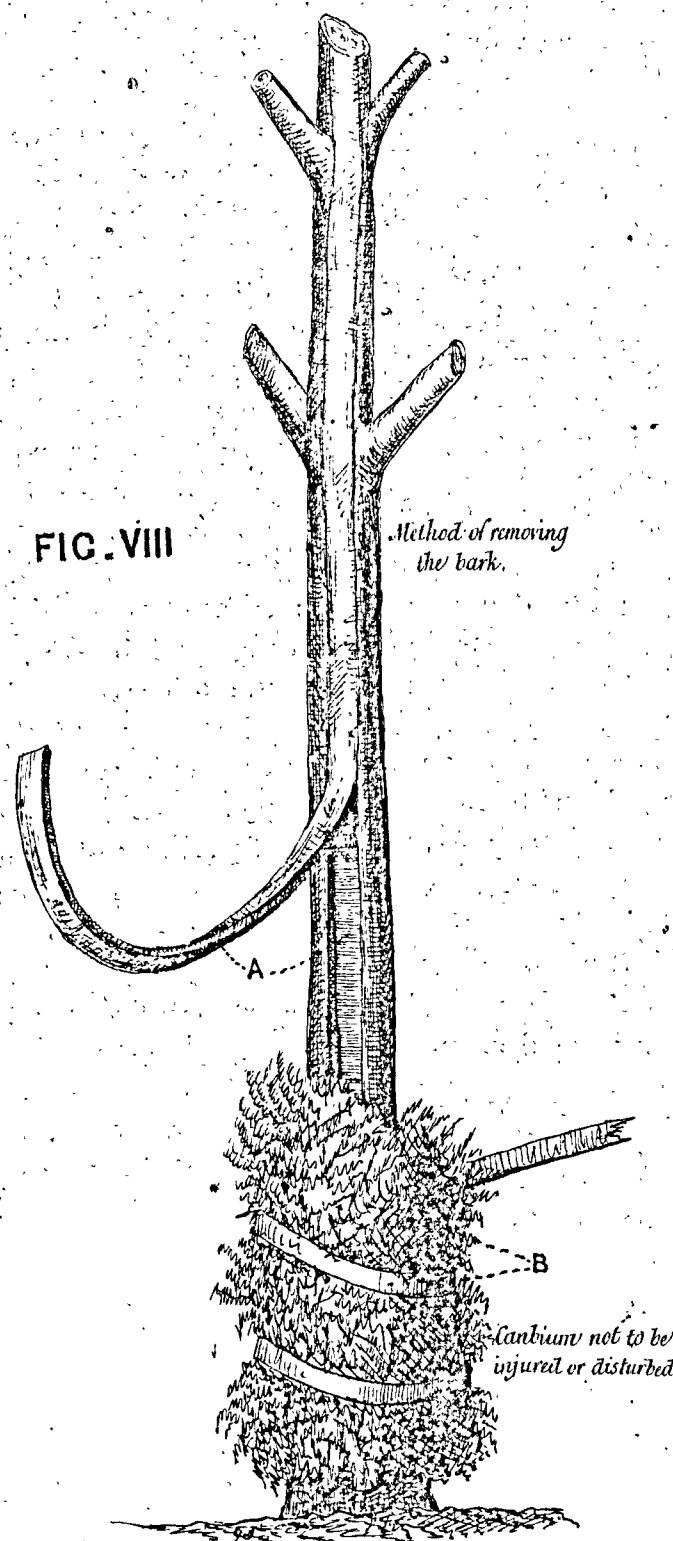
Description of moss to be used for covering.

Lichens to be carefully rejected.

of the utmost importance to select the best green moss, a uniform bright green in its texture indicating that lichens are not present, as the whole of the tribe of lichens can easily be distinguished by the

casual observer from moss which is always of a green color, soft and velvet like in appearance, while the lichens are invariably of a grey, yellow or brown color, scaly and harsh in appearance and to the touch.

30. Figure VIII. illustrates the stem of a plant with a strip of bark removed as at A; B, shewing the manner in which the moss is laid on and secured around the stem. In removing the strip of bark, two parallel cuts should be made down the stem, at the distance apart of the intended width of the strip of bark as at C this done the bark is raised from the sides of the cut, and drawn off beginning from the bottom, care being taken not to press or injure the sappy matter ("cambium") left upon the stem of the tree. This cambium or sappy matter immediately granulates on the removal of the bark, and being covered forms a new bark, which



maintains the circulation undisturbed. This is rather a precarious operation, and one which must be performed by intelligent men; but the results obtained by this system of treatment will no doubt double the annual yield of bark, because the

Quality of renewed bark.

Application of moss to thicken Chinchona bark.

renewed bark of one season's growth is quite as thick as ordinary bark of two or even three years' growth. The application of moss has also the advantage of greatly increasing the weight and thickness of the bark, and from the observations which have been made, would indicate an increase in the alkaloids, that is, a pound of bark covered with moss produces more alkaloids than the same quantity of bark not so protected. This very important question will be, to a certain extent, established by the analysis of the barks submitted to Mr. Howard in May last; but whether there is an increase in the yield of alkaloids or not, the effect of mossing the stems is to give a great increase in the yield of bark, and consequently in the value of the produce, the result of analysis already received establishing beyond doubt that the application

Effects on Alkaloids and weight of bark.

of moss in no way decreases the yield of alkaloids. Dr. deVry* having obtained from Neilgherry bark, treated in this manner, the enormous product of 8.409 per cent of alkaloids, and in a state of greater purity than usually found in Chinchona bark. The idea of artificially applying moss to the bark of our Chinchona plants, originated from the fact that the best Chinchona bark of commerce is invariably overgrown with moss. Hence, deterioration, which they apparently undergo when the bark is long exposed to the full action of light.

Considerations prior to reaping our first harvest of bark.

31. The period being rapidly advancing when we must begin to harvest our bark, it becomes a matter of serious consideration to devise the best means of preparing it, and if possible extracting the alkaloid on the spot, in order to save the cost of carriage. Connected with this subject I would much like the benefit of a personal consultation with Mr. Markham, especially as this gentleman has obtained much valuable information by experience in South America, and his intercourse with scientific men in Europe on the best methods of extracting the alkaloids. Moreover, an inspection of our plantations would enable Mr. Markham to draw a correct conclusion as to the state and health of the plants here, compared with those on the Andes.

* The Chinchona Bark of British India, by Dr. J. E. deVry, page 5.

"The leaves of *C. Succirubra*, *C. Micrantha*, and *C. Pahudiana* contain traces of alkaloids; but I could not find quinine amongst them. The results of experiments on No. 7, Red Bark, thickened by moss, deserve the greatest attention, for although Mr. Howard had already ascertained that Mr. McIvor's experiment of thickening the bark by covering it with moss had been really successful, I was quite struck by the enormous amount of 8.4 per cent. of alkaloids in so young a bark. The other peculiarity of this bark was that I never obtained Chinchona Alkaloids so easily pure as from it; hence, I hope that the experiment will be repeated by Mr. McIvor on a large scale, not only with *C. Succirubra*, but also with the other species, and particularly with *C. Calisaya*."

32. In South America the bark is gathered at random, and without reference to the period of its growth, or the best seasons for obtaining the alkaloids. The results of our observations are so limited that it is impossible to draw from them reliable practical deductions. I would, however, notice that our barks have increased in the produce of their alkaloid at the rate of about 2 per cent. per annum. As it cannot be supposed that the barks can continue to increase in this ratio, a period must occur at which the maximum quantity of alkaloids are contained in the bark, and after this there will in all probability be a period of deteriorations, should this be the case

Yield of Alkaloids yearly increasing. • must shortly attain the maximum when it should be gathered.

it is of vital importance for us to ascertain, and reap our harvest of bark at that period of growth when the bark contains the greatest amount of alkaloid. This refers principally to the removal of the bark from the stems of the trees, as the operation of lopping and barking the branches may have to be proceeded with for the sake of convenience, and to give light and air to the plants prior to the bark having attained its maximum quantity of alkaloid.

33. Mr. Howard's analysis of the bark submitted in May last will give much information on this subject, for if our last sample of bark gives an increase over that submitted in May 1864, it will be undesirable for us to harvest our bark until this yearly increase has ceased or at least become unimportant.

34. All the species have been found to throw out shoots from the stools when prepared, as described and illustrated at paragraph 21, Plate VI., in the Manual on Chinchona cultivation, dated March 1863. This will necessarily have to be practised when the plants are placed close together, and it becomes necessary to remove each alternate tree to give light and air to the plantation.

35. The quotations at foot will, I trust, be sufficient to establish that no injury can accrue from the application of moss to the stems of our plants, and with the permission of Government I will at once moss from 7,000 to 10,000 of our largest plants, preparatory to removing the bark.

Recommends from 7,000 to 10,000 plants to be covered with moss.

36. The analysis by Mr. Howard* of the samples of bark collected in February 1864, shews an increase in the quantity of purified alkaloid of 3.60 per

Effect of cultivation on the quality and produce of alkaloids.

Results of analysis of bark thus treated.

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cent. on the result obtained in 1863, while the result of Dr. deVry's analysis* of

Specimens examined.	Alkaloids in 100 parts.	Quinine.	Chinchonine and Chinchonadine.	Chinchonine and Chinchonadine.	Quinovic acid.	Analytical data.
3. C. Succirubra.						
a. Bark of the stem ...	2.657	1.486	1.171	.....	0.398	41.7 grm. of bark of the stem produced 1.108 grm. of Alkaloids, and 0.166 grm. Quinovic acid of the Alkaloids 0.62 grm. were dissolved by Ether.
b. Bark of the root ...	7.514	3.443	4.071	.....	0.533	21.2 grm. bark of the root produced 1.593 grm. Alkaloids, and 0.113 grm. Quinovic acid, of the Alkaloids 0.73 grm. were dissolved by Ether.
c. Stem-wood	.....	.....	.....	.....	0.212	25.0 grm. dry stem-wood produced 0.053 grm. Quinovic acid.
d. Root-wood	.....	.....	.....	.....	0.867	18.8 grm. dry root-wood produced 0.163 grm. Quinovic acid.
4. C. Succirubra.						
a. Leaves ...	0.017	.....	.....	.....	1.300	32.4 grm. dry leaves produced 0.436 grm. Quinovic acid, 76.7 grm. dry leaves produced only 0.013 grm. of very impure Alkaloids containing not a trace of Quinine.
5. C. Succirubra						
Bracts ...	.....	.....	.....	.....	0.870	15.3 grm. dry bracts produced 0.133 grm. Quinovic acid.
6. C. Succirubra					x	2.045 grm. dried juice was proved to contain not a trace of Alkaloids, but Quinovic acid was readily detected.
Juice dried in the sun.	.....	.....	.....	.....	0.530	14.9 grm. dry bark produced 1.253 very slightly colored Alkaloids, and 0.08 grm. Quinovic acid, of the Alkaloids 0.412 grm. were dissolved by Ether.
7. C. Succirubra.	8.409	2.765	5.644	.....	0.640	14.5 grm. dry bark produced 0.274 grm. Alkaloids, and 0.093 grm. Quinovic acid, of the Alkaloids 0.177 grm. were dissolved by Ether.
8. C. Calisaya.	1.890	1.220	.....	0.670	x	3.25 grm. dry bark of the root produced 0.103 grm. Alkaloids partially soluble in Ether.
a. Bark of the stem ...	3.100	x	.....	y	0.230	8.7 grm. dry bark produced 0.133 grm. Alkaloids, and 0.02 grm. Quinovic acid, of the Alkaloids 0.063 grm. were dissolved by Ether.
b. Bark of the root ...	1.520	0.724	.....	0.796	x	11.1 grm. bark produced 0.05 grm. Alkaloids, for the greatest part soluble in Ether.
9. C. Calisaya.	0.450	x	y	.....	0.450	11.2 grm. bark produced 0.174 grm. Alkaloids, and 0.051 grm. Quinovic acid. The Alkaloids were partially soluble in Ether.
Bark of the stem ...	1.553	x	y	.....	0.150	32 grm. leaves produced 0.048 grm. Quinovic acid, and 0.004 grm. very impure Alkaloids.
10. C. Pahudiana.	0.010	.....	.....	.....	0.113	28.3 grm. bark produced 0.79 grm. Alkaloids, and 0.032 grm. Quinovic acid, of the Alkaloids 0.346 grm. were dissolved by Ether.
a. Bark of the stem ...	2.791	.....	.....	.....	0.678	18 grm. bark produced 0.75 grm. Alkaloids, and 0.122 grm. Quinovic acid, of the Alkaloids 0.15 grm. were dissolved by Ether.
b. Bark of the root...	4.166	x			1.276	28.4 grm. leaves produced 0.36 grm. Quinovic acid, 209 grm. leaves produced only 0.008 grm. very impure Alkaloid.
13. C. Micrantha.	traces.					
Leaves ...						

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bark from the same plantation, collected in November 1863, gives a result nearly the same as that obtained by Mr. Howard, with one very important exception, namely, that of sample No. 7, which yielded an increase of 5.591 per cent. or a total of 8.409; this bark having been covered with moss for nearly twelve months prior to the bark being removed. A peculiar feature in the mossed bark noticed both by Mr. Howard and Dr. deVry, was the existence of the alkaloid in abundance, and in a state of greater purity than in the ordinary samples from South America.

And purity than in ordinary samples of American Bark.

* "Report of an analysis of the third remittance of Bark from India."

"From J. E. HOWARD, Esq., to the Under Secretary of State for India, June 15th, 1864.

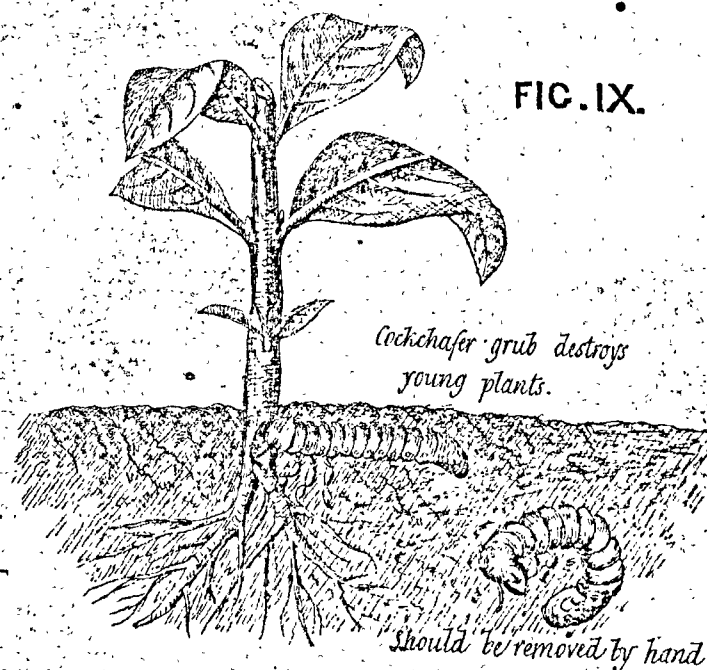
"SIR,—I have the honor to report that I received on the 20th May, the specimens mentioned by Mr. McIvor in his despatch of 17th March last, and that the same were all in good condition. I have since devoted most careful attention to ascertain by experiment the probable market value especially of the first two samples of the bark sent. It will not be necessary for me to detail the various means by which I succeeded in convincing myself, not only of the existence of the alkaloids, but of their being extant in such a state of purity as is certainly not found in the ordinary samples of Red Bark imported from South America. The result of my examination tended to shew distinctly that cultivation has improved the produce of at least this species of Chinchona.

"I must remark that the commercial value of specimens of bark intended for the manufacture of Sulphate of Quinine can never be ascertained by the mere knowledge of the percentage of alkaloid soluble in Ether, since it is necessary that this should be shewn to exist in such a state as to crystallize with acids into the required compounds.

"In the case of No. 1, the bark from the thickest part of the lower branches of C. Succirubra, two years and five months old, this examination was most satisfactory, confirming that which I stated in my first Report as to the facility with which the alkaloids were obtained in a state of purity, although the amount of red coloring matter in the bark is very great. The amount of purified alkaloids I estimate at 6 per cent., consisting of Quinine 3.14, Chinchonadine 2.06, Chinchonine 0.80. This large product of alkaloids might probably be still further increased by surrounding the stem with moss, in the manner which Mr. McIvor has so happily suggested, since Dr. deVry found 8.409 per cent. of alkaloids in a stem which had been so treated. It seems to me, from the trial, that the East India Bark, the produce of C. Succirubra, will rival in price the Bolivian Calisaya, which is by no means the case with the bark of the branches of the C. Succirubra as grown in South America. It is important to remark, that the very high price of between 8s. and 9s. which has quite recently been paid for Red Bark in this market, applies only to those prices of bark from the trunk of the tree which possess from their age a peculiarly bright red appearance; I have forwarded a small vial with commercial Sulphate of Quinine obtained from this No. 1, as also Sulphate of Chinchonadine separated from the above. I have only to remark further on this bark that its appearance bespeaks its good quality, and that there can be no doubt the season chosen (24th of February) is most favorable to its being well secured."

37. While cultivation has thus improved the quality of the alkaloid in rendering it easily purified, it has increased the quantity at least five-fold, the alkaloid, as a rule, not being found to exceed 1 per cent., in so young barks from South America. These remarks refer principally to the "Red" and "Crown" Barks, which have readily assumed the habit of domestic plants, being stimulated to vigorous growth by cultivation and the application of manure, while the barks are easily thickened by the artificial application of moss without in any way retarding the growth or effecting the health of the plants.

Insects injurious to Chinchonas.



And plants examined.

How to destroy perfect insect.

of March and the beginning of April, as it flies abroad in the evenings immediately on the commencement of the first spring showers. Bright fires being lighted here and there on the land about half-past six in the evening, and a good flame maintained until about 8 o'clock, myriads of these insects dash into the flame and are destroyed.

Leaves of plants injured by a caterpillar like that of the Oleander moth.

allied to the Oleander moth, but apparently a distinct species, this caterpillar which

39. The leaves of the *C. Succirubra* have, during the past year, been attacked by the caterpillar of a Hawk moth, nearly

38. Our young plants on being transplanted are apt to be destroyed by the grub of the cockchafer (*Melolontha vulgaris*) gnawing away the bark at the crown of the root immediately under the soil, as illustrated at Figure IX., these grubs can only be removed by hand-picking. When once they have attacked a piece of land their presence is soon detected by the plants assuming a yellow appearance; on this taking place the roots

of every plant should be examined and the grubs destroyed. In localities liable to suffer from attacks of these grubs the perfect insect is easily destroyed in the end

is illustrated in Figure X, at B, attacks and devours the leaves with great rapidity. In order to save the plants from their ravages considerable labor has been entailed in removing and destroying these insects. The perfect insect is shewn at A, and the chrysalis at C. Our cuttings in the propagating cases, as also the plants in the houses, are liable to injury from the attacks of the green and white fly, these are easily destroyed by tobacco fumigation. The other enemies which attack the Chinchona, in common with all other plants, are the mealy, and scaly bugs; these like the grubs of the cockchafer can only be removed by the hand, and when once they make their appearance should never be allowed to spread.

Mealy and scaly bugs.

New varieties of Chinchona introduced, remarks on

C. Lanceolata.

with Mr. Howard's figure and description of this species, but in general appearance and habit of growth, seems to be identical with the *C. Pahudiana*, and in consequence cannot be entered in our list, until further information has been received on the subject, because of the inconvenience likely to arise from the distribution of species incorrectly named, and of uncertain value. Two varieties of the *C. Calisaya* have also been added to our stock, namely, *Calisaya* var. *frutex*, and *Calisaya* var. *vera*, the seeds of these varieties were imported by Mr. Markham, and are very valuable as quinine producing plants.

C. Calisaya, var. *frutex*, var. *vera*.

Pitayo Bark seeds to be re-collected.

Pitayo Barks, which failed last year a fresh; a supply of these seeds may therefore be shortly expected, and it is to be hoped they will arrive in good condition and germinate freely, as the addition of this species and its varieties completes our collection of quinine yielding Chinchonas.

42. Mr. Batcock, the Deputy Superintendent, has given every satisfaction in carrying out the work entrusted to his charge, also in superintending the payment of establishments, &c., and to whose attainments in drawing I am indebted for the illustrations in this Report. Lieutenant Nichol, Assistant Superintendent Neddivuttum Plantations, has shewn considerable energy and activity, and is attaining a better knowledge of the arrangement of labor, and conducting operations. Mr. Charles Dawson, Assistant Superintendent Wood Plantation, Pykara, has given every satisfaction, and is well worthy of imitation in the neat and tidy condition in which he keeps the plantations, and in the conciliatory spirit exhibited in the management of his laborers. I have also every reason to be satisfied with the manner

tment,

by a brick tion of about rsery is at ncalypti and he ridges on nurseries the nchona culti- this Report.

Plantations have been at place of This exten- 0 Acres of res pitted. on Planta- tions, and s. On the er than fill- have been y part of it be more

lantation isfactory exposed tions the very re- selected. ge Jails tion of ing the mately drying ls have it of a e bark, walls, oring of mpleted. s, and the d for the artisans



TRANSF. BY A. BARREN - LITHOGRAPHED BY J. DUMPHY, CHICAGO, SEPT. 1860.

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in which Mr. Smith, the Assistant Superintendent of the Dodabetta Plantations, has carried out the operations entrusted to his charge. Overseers Burrows, Hudson, and Demsey have been attentive and careful in conducting their respective works. In the Office Establishment, Narrainsamy Naidoo and Mr. McNair continue to give every satisfaction in the performance of their duties as Pay Clerk and Accountant.

Labor difficult to be procured.

43. The difficulties previously experienced in procuring and maintaining a sufficient number of trained laborers still continues to be severely felt, and as this difficulty seems yearly to increase, I fear a rise in our present rates of pay will be necessary. For the past year, and on the Neddivuttum Plantations from the commencement, our laborers have had a slight indulgence in addition to their pay, by being supplied with grain at rates rather under those prevailing in the market. This advantage being given to the laborers by all Coffee planters.

Progress of operations.

44. In addition to the range of hardening cases built in 1863 for the accommodation of 75,000 plants, our rapidly increasing stock has rendered it necessary to construct a temporary hardening house 100 feet in length by 18 wide, giving accommodation for 130,000 plants. This house has been found very useful in protecting our plants during the dry winter months. Our propagating appliances now afford accommodation for 135,000 cuttings, and hardening space for 250,000 plants. The total number of plants produced to 30th April 1865 was 645,717, of this number 78,612 have been issued to the public, the number of plants propagated during the official year being 254,471, of which 47,489 have been sold or supplied to the public. On the 31st July 1865, the number and distribution of our plants stood as follows:—

Increase and distribution of plants.

Number of plants permanently planted out in the plantations	205,678
Do. of plants in the open air nurseries	217,000
Do. of rooted plants in the propagating and hardening houses	284,919
Estimated number of cuttings in the propagating cases	100,000

Total number of rooted plants and cuttings ... 807,597

Open air Nurseries.

45. Extensive open air nurseries have been formed on the different plantations for the reception of the plants propagated this season. The old nurseries contained on the 1st May 1865 134,000 well established plants, a portion of these have since been permanently planted out, and the nurseries re-stocked with young plants from the hardening houses. The nursery on the Dodabetta Plantations has been enlarged to receive 150,000 plants. On the Neddivuttum Plantations 250,000; on the Wood Plantation at Pykara 150,000; and on the Melkondah Plantation 30,000. This arrangement has been made in order to secure a large stock of well established plants, they being found to transplant much better than plants direct from the

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hardening houses. The open air nursery at Ootacamund, enclosed by a brick wall, has also been extended, and now affords space for the reception of about 350,000 plants. This nursery is at Nursery at Ootacamund at present used for rearing Encalyptii and other trees for planting the ridges on our plantations, and the Lawrence Asylum sites. In extending these nurseries the beds have been formed in the manner described in the Manual on Chinchona cultivation, and the plants recently planted as described at paragraph 11 of this Report.

46. On the Neddivuttum Plantations

On the Neddivuttum Plantations 60 additional Acres planted, making 284 Acres under cultivation.

sixty-four additional Acres have been planted, making the total at that place of 284 Acres under cultivation. This extension has been on the Markham and second Denison Plantations. Here 20 Acres of additional forest have also been felled during the season, and about 50 Acres pitted. The roads, drains, and water-courses through the Markham and Kilgraston Plantations have been finished, together with the trenches enclosing these Plantations, and a considerable portion enclosed by a high fence to exclude wild animals. On the first Denison Plantation no planting operations have taken place, farther than filling up a few spaces near the roads, here, however, additional surface drains have been formed, and pathways cut intersecting the plantation, and rendering every part of it easily accessible from the main roads. In this plantation nothing can be more satisfactory than the growth and condition of the plants.

47. On the second Denison Plantation

Second Denison Plantation much exposed to west winds.

the plants have not made such satisfactory growth, in consequence of being exposed to the full force of the winds. On the Markham and Kilgraston Plantations the plants have made very satisfactory growth, these plantations promising in every respect to be fully as well suited to the growth of Chinchonas as any site yet selected.

Jail in course of construction.

On the Markham Plantation a large Jail is in course of erection for the reception of 270 prisoners to assist in working the plantations. This building is constructed with the intention of being ultimately formed into a bark store, and drying

To be ultimately used as a Bark Store.

house, consequently the main walls have been raised high, so as to admit of a flooring being introduced. The upper main rooms to be used for storing the bark, the lower floor being furnished with flues will form the drying rooms. The walls, roof, and outside plastering of this building have been finished. The plastering of the interior, the sleeping benches, air drains, and out-offices have still to be completed. The two main rooms are intended to accommodate 225 native prisoners, and the eight verandah rooms 50 Chinese convicts, the other rooms being intended for the use of the Police. On this plantation lines for Koorumbers and the native artisans employed on the buildings have been constructed.

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On the Wood Plantation 63 Acres planted, making 71 under cultivation. 48. On the Wood Plantation at Pykara 63 Acres of land have been planted during the season, which, together with the 8 Acres planted in 1863-64 gives a total at that place of 71 Acres under cultivation, a farther extent of 40 Acres has been cleared, and is now in course of preparation for planting. In addition to this, the avenue leading past the water falls has been re-planted. The roads widened, and edged with grass or box, a few arbours erected, and the main water channel from the Pykara river for the supply of the plantation reveted and well secured.

Dodabetta Plantations, 57 Acres planted, making 152 under cultivation. 49. On the Dodabetta Plantations the work has also progressed satisfactorily, 57 Acres having been planted out during the season, making the extent under cultivation on these two plantations 152 Acres. On the second Plantation several new roads have been formed, others widened and edged with grass or box, all the planted land drained, and about 70 additional Acres pitted, or in course of preparation for planting. On this plantation a Jail has been erected for the accommodation of 100 prisoners, the main room to contain 70 native prisoners, and eight of the verandah rooms to accommodate 30 Chinese prisoners, the other rooms being for the Police. This building is completed and ready for occupation, some of the out-offices including the latrines have not yet been finished, but will probably be so in the course of a month. This Jail is also constructed so as ultimately to be converted into a bark store.

Mélkondah Plantation. 50. In forming the new plantation on the Koondahs, great difficulty still continues to be experienced in pushing forward operations in consequence of the want of roads. Here, however, an extent of 193 Acres has been felled, of this 150 Acres have been lopped and burned, 75 Acres pitted. The roads on the plantation in a forward state, and when this portion is drained will be ready for the reception of the plants. The Superintendent's house has been built, a line of road traced and used as a bridle-path connecting the plantation with Ootacamund, a distance of 29 miles. The opening out of this line of road for cart traffic will probably cost between 30,000 and 40,000 Rupees, but it would render available this hitherto untouched, although the finest tract of land on the Neilgherries, for Tea and Chinchona cultivation. I would respectfully suggest that the opening of this road be undertaken by the Department of Public Works, as it will be of immense advantage not only for the Government Plantation, but for private planters who wish to open in this direction. The Bowany river being unbridged, prevents communication between the Koondahs and the Neilgherries during the monsoon. On the Mélkondah plantation a Jail is also in course of construction, this building is intended to accommodate 95 native prisoners, and 30 Chinese convicts. Only 5,000 plants have been placed in the nurseries on this plantation.

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Botanical Gardens, improvements in. 51. In the Botanical Gardens considerable improvements have lately been effected, between the upper and lower gardens an Italian parterre has been introduced with three basins for fountains, the eastern half of this parterre being finished, is planted with choice flowers and has become very attractive. A new Orchid and Fern house is in course of construction, which will prove of great advantage in enabling us to cultivate these very interesting tribes of plants. The house being furnished with a cascade and fountain, and placed in a well protected position in the garden, offers every advantage for growing these plants; small parterres and terraces filled with flowering plants have also been added in the upper portion of the garden.

Labelling plants. 52. Arrangements have been made for labelling the plants in the gardens with their botanical names, classes, and orders, &c., the labelling being carried out simultaneously with the preparation of a catalogue of the plants. This list of plants is contemplated to be something more than a mere catalogue, as we possess many plants of interest, and especially the economic plants may be accompanied by a short notice of their habit of growth, soil, cultivation, &c.

Plants introduced. 53. This season has added many valuable plants to our collection, and to His Excellency Sir William Denison we are indebted for supplies of fine seeds of the valuable timber trees of Australia, among these may be particularly mentioned, as introduced in large quantities, the various species of Eucalyptii, as also the very valuable Arancarias Cookii, and Bidwillii, and the much prized Myall or violet scented Acacia; likewise Phormium tenax or New Zealand flax, the New Holland Nymphaas, and several species of Tropadlum. To General McCleverty we are indebted for spores of several pretty New Zealand ferns which have germinated freely, especially the sweet scented Doodia; this gentleman has also supplied seeds of Edwardsia Microphylla, a handsome Australian shrub. To Dr. Cleghorn we are indebted for seeds of various Himalayan trees, among these was a species of Cherry apparently nearly allied to the British species, and as this plant succeeds admirably, will prove invaluable as a stock on which to graft the hybrid varieties. Dr. Cleghorn also supplied seeds of the best variety of the Bengal "Bael." From the Mauritius Botanic Garden a Wardian case has been received in exchange for ferns and Chinchonas, containing two valuable species of Guava, the Chinese Litchi, the Camphor tree, and many other useful plants. To Major Michael we are indebted for a small collection of seeds of New Zealand trees and shrubs, which have grown freely and containing many new and valuable species. To Captain Beddome, Acting Conservator of Forests, we are indebted for spores of many new and rare ferns; also to Colonel Scott for good seeds of the Arbutus imedo.

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Distribution of Garden plants and seeds.

54. The following table exhibits the distribution of Garden plants, seeds, &c., for 1864-65.

Months.	Fruit trees and shrubs.	Timber trees.	Shrubs and flowers.	Collections of seeds.	Amount.
1864.					RS. A. P.
May	53	252	399	10	360 2 0
June... ..	4	260	266	27	280 7 0
July... ..	...	100	48	37	241 8 0
August	164	2	199	27	289 2 0
September... ..	...	12	119	29	175 5 0
October	6	22	174	15	151 14 0
November... ..	...	8	149	9	79 3 0
December... ..	16	...	64	3	50 14 0
	243	656	1,418	157	1,628 7 0
1865.					
January	...	...	56	13	41 10 0
February... ..	26	...	2	8	148 6 0
March	43	44	141	20	135 12 0
April	4	76	274	27	283 6 0
Total distribution..	316	776	1,894	225	2,237 9 0

Tea plantation.

Tea plantation, 7 acres planted.

Additional land prepared to be planted with Chinchona.

No. 162, limiting the Tea plantation to five acres, consequently no further operations beyond weeding, &c., have been in progress on this plantation and the unplanted pits will be filled up with Chinchona plants. The Tea plants have made fine growth, and will no doubt continue to do so, as the situation is well protected from the S. W. monsoon, the soil deep and of good quality. The Tea seeds received from Dr. Jameson in March last, have not grown well, having apparently suffered much on the journey, their germinating powers was in a great degree destroyed.

Tea seeds received from Dr. Jameson arrived in bad condition.

Lawrence Asylum sites.

Timber trees planted.

globulus, (blue gum) and Eucalyptus giganteus (stringy bark); about 6,000 other trees more of an ornamental nature, such as Willows and Cypress have also been planted along the avenues and bordering the belts and clumps of Eucalyptii.

55. In the Tea plantation sanctioned in G. O., dated 23rd December 1863, No. 2,362, seven acres have been planted with about 9,000 plants of the Chinese and Assam varieties of Tea, this extent having been planted and about 12,000 additional pits made prior to the receipt of the G. O., dated 29th January 1864, consequently no further operations have been made on this plantation and the unplanted pits will be filled up with Chinchona plants. The Tea plants have made fine growth, and will no doubt continue to do so, as the situation is well protected from the S. W. monsoon, the soil deep and of good quality. The Tea seeds received from Dr. Jameson in March last, have not grown well, having apparently suffered much on the journey, their germinating powers was in a great degree destroyed.

56. At the new Lawrence Asylum sites 10,300 Eucalyptus trees have been planted in clumps and belts so as to afford shelter to the buildings, the species used being principally the Eucalyptus globulus, (blue gum) and Eucalyptus giganteus (stringy bark); about 6,000 other trees more of an ornamental nature, such as Willows and Cypress have also been planted along the avenues and bordering the belts and clumps of Eucalyptii.

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No. 543. ORDER THEREON, 27th September 1865, No. 2,325.

Miscellaneous.

1. The results of the year's operations detailed in the above Report may be briefly epitomised as follows.
2. The average monthly increase in the number of plants by propagation was 21,200, and the total number of plants on 1st May 1865, was 5,58,105, exclusive of 78,612 plants issued to the public.
3. The oldest plants, which were planted out in August 1862, are now from 8 to 12 feet in height, and from 7 to 13 inches in girth, at 6 inches from the ground, "well furnished with lateral branches, and present a most robust and healthy appearance."
4. The analysis of the barks has exhibited a further increase in the yield of alkaloids. Mr. Howard having obtained 6 per cent. of purified alkaloids, while Dr. deVry found in one specimen as much as 8.49 per cent. of alkaloids, being fully five times the average quantity found in the barks of commerce.
5. In the oldest plantations the branches of the plants 10 and 12 feet apart are now touching each other, the bark has much increased in thickness. The characteristic markings of the finest Peruvian bark are becoming more and more apparent, lichens and mosses being freely developed. The plants are flowering freely, and perfect seeds have already been obtained; in short there is no room to doubt that the Chinchona can be grown on the Neilgherries to as great perfection as in the most favorable localities in which it has been found, and the "Crown" bark species is found to do well in almost every soil on the plateau of the hills, in grass land as well as in forest, so long as land-locked hollows are avoided in which it suffers from frost.
6. Additional hardening houses and nurseries have been provided.
7. At Neddiwuttum 64 more acres have been planted, and a total area of 284 acres is there under cultivation. About 50 more acres have been pitted, and 20 acres of forest felled.
8. A building to be used temporarily as a Jail for 270 Convict laborers, and ultimately as a bark store and drying house, is under construction.
9. At Pykara 63 more acres have been planted, making a total of 71 acres under cultivation, and a further extent of 40 acres is under preparation.
10. At Doddabett 57 more acres have been planted, making a total of 152 acres cultivated, and 70 more acres are under preparation.
11. A building to be temporarily occupied by 100 Convict laborers, and ultimately converted into a bark store, has been completed.
12. On the Koondahs 193 acres are in different stages of preparation. A Superintendent's house has been built, and much road work done.
13. A building to be temporarily used as a Jail for Convict laborers is under construction, and about 5,000 plants have been placed in the nurseries.
14. Thus altogether an additional area of 184 acres has been planted during the season, and a further area of 373 acres is under preparation.

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15. The total extent planted is 507 acres, viz.:-

	Acres.
Neddiwuttum	284
Pykara	71
Doddabett	152
	<u>507</u>

16. The total cost of the operations up to 30th April 1865 was Rupees 2,12,602, thus distributed—

	Rs.
Establishment	81,872
Buildings	40,988
Plantations	62,459.
Roads	12,474
Tools	8,178
Sundry contingencies... ..	6,631

2,12,602

17. The Government consider that the progress in the operations has been very satisfactory, and they congratulate Mr. McIvor on the important success that has attended his labors in this national undertaking.

18. He will act as he thinks best in regard to the removal of the forest trees referred to in paragraph 13.

19. The subject of paragraph 31 will be submitted for the consideration of the Secretary of State. The Government fully appreciate the importance of obtaining Mr. Markham's opinion and advice as to the best method of harvesting and preparing the bark.

20. Mr. McIvor has full permission to carry out the experiment proposed in paragraph 35, for extended mowing.

21. The subject of completing the road to the Koondahs from Ootacamund, will be considered in the Department Public Works.

22. The Government are glad to note the favorable terms in which Mr. McIvor notices the services of his Assistants.

23. As requested 300 copies of paragraphs 2 to 13, and 19 to 35 inclusive, of the Report will be struck off separately, printed uniformly with the Manual to which they will be added.

24. The account of the Botanical gardens is very satisfactory, and the Government are glad to learn that a Catalogue *raisonné* of its contents is under preparation.

25. In the Tea plantation, which is intended to be a source for supplying seed to planters, seven acres have been planted with about 9,000 plants of the China and Assam varieties, and the plants have done well.

26. At the sites for the new Lawrence Asylums 10,300 Eucalyptus trees (Blue gum and stringy bark) have been planted out for shelter in masses, bordered by some 6,000 trees of more ornamental kind.

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27. The Government have to thank Mr. McIvor for the zeal and energy to which they are indebted for the valuable results recorded in the above Report.

28. His proposal to fix the future price for Chinchona plants at one Anna each when 5,000 and upwards are taken, and two Annas each for any number under 5,000, is approved and sanctioned.

(True Extract.)

(Signed) W. HUDLESTON,

Acting Secretary to Government.

To the Superintendent Government Chinchona Plantations.

„ the Board of Revenue.

„ the Collector of Coimbatore.

„ the Conservator of Forests.

„ the Department Public Works.

Ed. T. O'Connor.

*Proceedings of the Madras Government, Revenue Department,
31st October 1865.*

Read the following letters:—

No. 586A. From the Superintendent Government Chinchona Plantations, to the Acting Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 25th September 1865, No. 79.

With reference to my letter No. 59, dated 16th August 1865, submitting the Report on the Government Chinchona Plantations and Botanical Gardens for 1864-65, I have the honor to inform you that in consequence of the result of Mr. Howard's analysis of the bark forwarded in May last, I beg to withdraw paragraphs 29 and 30 of the Report above alluded to, as the views set forth in these paragraphs now appear immature, and will require further consideration, and more experience prior to their being laid before the public.

No. 586B. From the Superintendent Government Chinchona Plantations, to the Private Secretary to His Excellency the Governor, Ootacamund, dated Ootacamund, 3rd October 1865, No. 81.

I have the honor to enclose a copy of a detailed analysis by J. E. Howard, Esq., of Neilgherry Chinchona barks submitted in June last, and request the favor of your being so good as to submit the same to His Excellency the Governor, in order that it may be printed as an Appendix to my Report for 1864-65 on the Government Chinchona Plantations and Botanical Gardens.

Analysis of Chinchona Bark and Leaves. (Received June 21st, 1865.)

From the Superintendent of the Government Chinchona Plantations, Ootacamund, to the Secretary to Government, Revenue Department, dated Ootacamund, 3rd May 1865.

1. I have the honor to forward, by banghy, a box containing a further supply of Chinchona Bark, as per Memorandum annexed, for transmission to the Right Honorable the Secretary of State for India, in order that it may be submitted to Mr. Howard for analysis and report.

2. The bark now forwarded was removed from the plants in the early part of April last, or as the sap begins to rise, as at this season the bark separates freely from the wood.

3. Specimens Nos. 2 and 3 are renewed barks; these attain extraordinary thickness in a short period of growth; and if they contain a proportionate quantity of alkaloids, this system of treating the plants appears to offer greater advantages than the other methods proposed.

4. I may observe, that further observation seems to establish that this system of removing strips of bark from the stems of the plants can be practised without injury, provided the wound is instantly covered with damp moss; inattention to covering the wounds having produced the bad effects detailed in my letter of the 17th March 1864.

MEMORANDUM.

Chinchona Succirubra.

No. 1. Bark of three years and five months' growth, thickened by the application of moss.

No. 2. Renewed bark of one year and five months' growth, being re-produced on the same portion of a stem which produced the bark given to Doctor de Vry in November 1863, and from which that gentleman obtained 8.409 per cent. of alkaloid.

No. 3. Renewed bark of one year's growth, and gathered from portions of the stem which yielded No. 1 bark, submitted to Mr. Howard in the spring of 1864.

No. 4. Bark of two years and five months' growth, not thickened by the application of moss.

Chinchona Calisaya.

No. 5. Bark of two years and five months' growth.

Chinchona Condamenia.

No. 6. Bark of one year and seven months' growth.

Chinchona Micrantha.

No. 7. Bark of two years and five months' growth, thickened by the application of moss.

No. 8. Ditto of same growth, but not thickened by the application of moss.

(Signed) W. G. McIVOR,

Superintendent of the Government Chinchona Plantations.

Report of an Analysis of the Fourth Remittance of Bark from India.

From J. E. HOWARD, Esq., F.L.S., to the Under Secretary of State for India,
dated August 1st, 1865.

I have the honor to report that I received, and have during the past month devoted much careful attention to the analysis of eight specimens of Bark, referred to in a letter from Madras, dated 3rd May 1865.

The whole of the samples were in excellent condition, shewing the care and skill bestowed on their cultivation. They contrasted most favorably with specimens from South America, of bark used at the present moment in the extraction of quinine.

The mode of analysis I have followed, in the present instance, is that which is employed to ascertain the *commercial value*, which rests almost entirely with the *crystallizable sulphates*, with perhaps some slight loss of the residuary product. The results will compare well with those given in Delondre's *Quinologie*.

No. 1 gave of crystallized sulphate, per 100 parts ... 6.00
of alkaloid soluble in extra light ether ... 0.94
of alkaloid insoluble in the above (therefore Chinchonine) ... 1.06

Memo.—The sulphate refined into white sulphate of quinine in appearance, but this did not stand the test used for commercial sulphate of quinine.

No. 2 gave of crystallized sulphate ... 5.00
of alkaloid sol. in E. L. ether ... 0.90
of alkaloid insol. in E. L. E. (Chinchonine) ... 1.80

Memo.—Refined as above.

No. 3 gave of cryst. sulphate ... 2.72
of alkaloids, sol. in *alcohol*. ... 7.00

Memo.—As I could only submit to examination 165 grains of the bark, the above result must be taken with reserve.

No. 4 gave of cryst. sulphate ... 2.43
of alkaloid sol. in E. L. E. ... 2.03
of alkaloid insol. in E. L. E. (Chinc.) ... 0.60

Memo.—This specimen gave a product not refining quite so well as No. 1.

No. 5 gave of cryst. sulphate ... 0.70
of alkaloid sol. in E. L. E. ... 0.10
of do. do. but crystallized by evaporation. ... 0.26
of do. insol. in E. L. E. (Chinc.) ... a trace.

Memo.—This sulphate did not stand the ether test.

No. 6 gave of cryst. sulphate ... 0.90
of alkaloid sol. in E. L. E. ... 0.60
of do. insol. (Chinc.) ... a trace.

Memo.—The tests shewed Quinine and Chinchonidine.

No. 7 gave of cryst. sulphate ... 5.82
of alkaloid sol. in E. L. E. (Aricine) ... 0.29
of alkaloid insol. in E. L. E. (Chinc.) ... 0.39

Memo.—This sulphate is that of *commercial* Quinidine, and contains probably no Quinine.

No. 8 gave of cryst. sulphate ... 1.26
of alkaloid sol. in E. L. E. ... 0.60
of alkaloid insol. in E. L. E. (Chinc.) ... a trace.

Memo.—The product similar to that of No. 7.

I beg to direct special attention to the remark, that the fine white crystallized *Sulphate of Quinine* (apparently) made from the bark of *C. Succirubra* will not stand the test which is employed to distinguish the pure article in commerce. The cause of this I stated in my first Report, viz., that "the crystallizations obtained are mixed with some Sulphate of Chinchonidine, which is commercially (but not medicinally) a disadvantage, and one which always attends the products of Red Bark." It is, of course, possible to separate the Chinchonidine, but then this must very seriously diminish the per-centage of six per cent. I obtained from this gross product little more than four per cent. refined in the first instance (though more subsequently), and of this I ascertained about 10 per cent. as Chinchonidine. This difficulty must be looked steadily in the face, and I would suggest that it may be obviated, either by a change being wrought in the opinion of the medical world as to the value of Chinchonidine as a medicine, or by the plant being encouraged to produce Quinine instead of Chinchonidine.

The first might be, very probably, the result of a commission of inquiry composed of competent medical practitioners. I may mention that the late Dr. Royle entered zealously, at my suggestion, into the question, and satisfied himself by experiment as to the value of Chinchonidine, but I am not aware that he left any written record of the result he attained. My own experiments confirm this view of the question, and I have shewn* that this alkaloid (which must not be confounded with Chinchonine) must have constituted (in whole or in part) the ther-

* "Illustration of Nueva Quinologia sub. voc. Chatnuarjuera."

peutic agent in the cure of the Countess of Chinchon, as also that it was the alkaloid successfully employed at Philadelphia. The second alternative may seem visionary at first sight, but when we consider the results at which Mr. McIvor has arrived, and further the circumstances under which Chinchonidine is produced, this view of the case may be altered.

In No. 7, we have an illustration of what careful cultivation will do, as the plant, *C. micrantha*, which (with its congeners the Grey Barks) produces largely and chiefly Chinchonine in its native climate of Huanuco,* now produces a very small portion of Chinchonine, and a large quantity of the allied alkaloid Quinidine. This is, then, a hopeful change, if time should confirm the observation.

Then Chinchonidine seems almost always to accompany Quinine in greater or less abundance. It does so in the *Calisaya* of Bolivia, in the *Lancifolia* barks of new Granada, and in various barks of Ecuador and Peru, and markedly in the best of the barks of Loxa. It is highly probable that a very slight circumstance in the growth may determine the production of one or other alkaloid. Dr. Hera- path has shewn, in a communication to the Royal Society "Researches on the Chinchona Alkaloids,"† that the Quinine and Chinchonidine salts agree closely among themselves, and differ widely from the Quinidine and Chinchonine compounds.

I may further remark, that the *Chinchona Succirubra* is a tree which varies greatly in its products in its native forests, and that the *Chinchona Micrantha*, in Bolivia, approaches to the character of a *Calisaya*, as I have noticed under that head; its bark has a different appearance from that of Huanuco, and again this now sent home varies widely from either of the above. I noticed in examination, the peculiar yellow coloring matter common, it seems, to all the forms of the plant, as I have before noticed.

The *Calisaya* bark sent this time by Mr. McIvor is, I fear, an illustration of the possibility of change in the wrong direction, as it contains far too large a per-centage of Chinchonidine in proportion to the Quinine. The appearance of the bark indicates a not very vigorous growth, or at all events it differs from that it assumes in its native locality. It would never be recognized as the bark of *Chinchona Calisaya*.

The bark of No. 6 is recognized by an experienced dealer as "thin rusty crown, worth 1s. 3d. to 1s. 4d. per lb.‡ It is, I presume, the bark of the variety *Bonplandiana*, i. e., the *colorada del Rey*, as brought home by Cross; it is remarked as more red than is customary with rusty crown.

As the quantity of bark in No. 1 and No. 4 was not exhausted in my experi-ments, I have returned 1,000 grains of each of these, thinking that it would be a satisfaction to the Government to engage Dr. de Vry, whose chemical skill and experience are so well known, in further researches on the subject.

*A peculiar climate, of which I have recorded Mr. Pritchett's description under head *C. micrantha*.

† Dated 19th June 1857.

‡ From Messrs. Jenkin and Phillips to Mr. J. E. Howard.—"51, Lime Street, 21st July 1865.—

"The sample of bark you left with us appears to be thin rusty crown, worth 1s. 3d.—1s. 4d. per lb.
"We thank you for the sight of it."

No. 586c. ORDER THEREON, 31st October 1865, No. 2,666A.

Miscellaneous.

Ordered that the above letters be printed as Ap- pendices to Mr. McIvor's letter No. 59, dated 16th August 1865, submitting his Report on the Government Chin- chona Plantations for 1864-65, recorded in G. O. dated 27th September 1865, No. 2,325.

(True Extract.)

(Signed) W. HUDLESTON,
Acting Secretary to Government.

To the Superintendent Government Chinchon 5,58,105.
,, the Board of Revenue.
,, the Collector of Coimbatore.
,, the Conservator of Forests.
,, the Department Public Works.

Exd. T. O'Connor.

No. 542. Read the following letter from the Superintendent, Government Chinchona Plantations, to W. HUDLESTON, Esq., Acting Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 16th August 1865, No. 59:—

SIR,

1. I have the honor to forward herewith the Report on the Government Chinchona Plantations and Botanical Gardens for the official year 1864-65. Much important information having been gained during the year with reference to the cultivation of Chinchona, especially in the preparation of the young plants, rendering the operations of propagation and transplanting much more certain, simple, and economical.

2. I would, therefore, respectfully solicit the favor of being supplied with 300 copies of paragraphs 2 to 13 and 19 to 35 inclusive, for distribution to planters.

**REPORT ON THE GOVERNMENT CHINCHONA PLANTATIONS AND
BOTANICAL GARDENS ON THE NEILGHERRIES FOR 1864-65.**

Introductory Observations.

1. In submitting this Report it affords me much satisfaction to be able to state, that the past season has been favorable for planting operations, and that considerable progress has been made in the works connected with our plantations. The plants continue to flourish and maintain a luxuriant state of health. The maxi-

Increase of propagation.

Number of plants on 31st May 1865—5,58,105. The maximum monthly increase by propagation has reached as high as 31,984 plants, the average monthly propagation throughout the year being 21,200 against 15,326 the result of last year. The total number of plants on the 1st May 1865 was 5,58,105; this does not include 78,612 plants the number issued to the public from the commencement to 31st May 1865. Our oldest

Height and growth of plants.

Thickness of stems.

7 to 13 inches, the plants being well furnished with lateral branches, and present a most robust and healthy appearance. The Chinchona Succirubra, Peruviana, and

Condition of plants at Neddivuttum and Pykara.

Dodabetta plantations.

C. Officinalis and varieties grow as well upon grass as on forest land.

Micrantha, continue to thrive on the Neddivuttum and Pykara Plantations, at elevations varying from 4,000 to 6,000 feet, while Chinchona Officinalis, Bonplandiana, and Crespilla continue to grow more sturdy and vigorous on the Dodabetta Plantations, at elevations varying from 7,000 to 8,350 feet. These latter species grow equally well upon grass as upon forest land, and bear almost every exposure, hence they may be successfully cultivated over the whole pla-

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teau of the Neilgherries, excepting such land locked hollows as are subject to severe frosts. The results of last year's analysis of the barks has exhibited a farther increase in the yield of alkaloids, which is both interesting and encouraging. The first sample of bark submitted in 1862 yielded Quinine, but the quantity was not determined. The bark forwarded in 1863 yielded 4.3 per cent. of rough, and 3.30 to 3.40 of purified alkaloids, while that forwarded in May 1864 gave 6 per cent. of purified alkaloids. These are the results of the analysis by Mr. Howard; while the analysis by Dr. deVry gives still more favorable results, that gentleman having found in Specimen No. 7 as much as 8.49 per cent. of alkaloids, being fully five times the average quantity found in the barks of Commerce, this result has exceeded our most sanguine expectation, and together with the observations of Mr. Howard establishes that cultivation does greatly favor the increase of alkaloids, and also improves their quality at least in the Chinchona Succirubra, and we may assume that a like result will be produced in the other species of Chinchona. With these observations, I proceed to particulars which, for the sake of convenience, are arranged under the following heads:—

HEADS OF REPORT.

1. Propagation of the plants, alteration in system of ...	Paras. 2 to 4
2. Condition and growth of the plants ...	5 to 10
3. Cultivation, modification in system of ...	11
4. Do. under the shade of living trees...	12 & 13
5. Do. results obtained by private planters	14 & 15
6. Do. felling forests for, effect on springs and water supply ...	16 to 18
7. Do. elevation and exposure best suited to the different species ...	19 to 25
8. Do. soils best suited to do. do...	26
9. Do. effect of storms and wet weather on	27 & 28
10. Gathering the bark, farther observations on treatment for this purpose ...	29 to 35
11. Alkaloids, effect of cultivation on the produce and quality of ...	36 & 37
12. Insects injurious to the plants...	38 & 39
13. Chinchona, new varieties introduced of remarks on ...	40 & 41
14. Establishments ...	42 & 43
15. Progress of operations...	44 to 50

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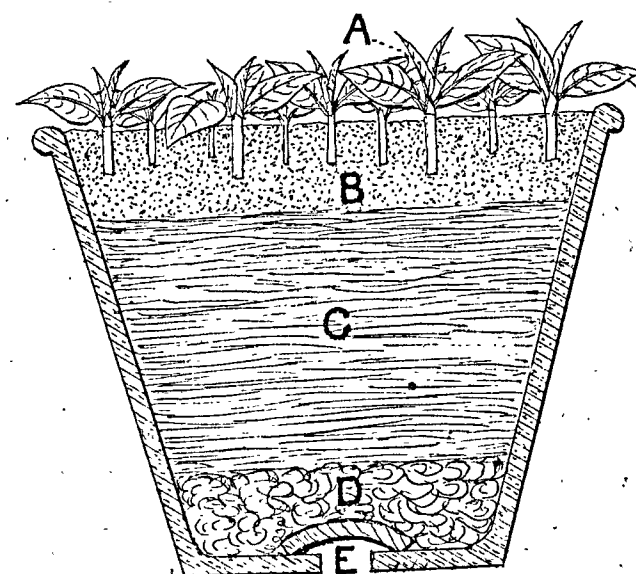
16. Botanical Gardens ...	51 to 54
17. Tea Plantation...	55
18. Lawrence Asylum Planting operations.	56
19. Concluding Remarks ...	57 to 60

Appendix A—Accounts from the commencement of operations to the 30th April 1865.

Do. B— Meteorological observations at Neddivuttum.
Do. C— do. do. at Ootacamund.

Propagation of the plants, alteration in system of. 2. Owing to the large number of plants produced, and consequently the

FIG. I.



employment of much labor in this operation, we have found it necessary, in order to economize and lessen the cost of propagation, to abandon the system of placing the cuttings on a piece of brick, as described in previous reports. The method now adopted is to fill the pots as formerly with prepared soil, but only to within an inch or three-fourths of an inch of the sur-

Cuttings now planted in brick dust.

face; this space is then filled up with pounded brick dust, into which the cuttings are inserted as at A in Figure I.; B representing the stratum of brick dust; C, the ordinary soil used and described in previous reports; D, moss to facilitate drainage; E, the potsherd or draining material. Under

When thus treated root more freely.

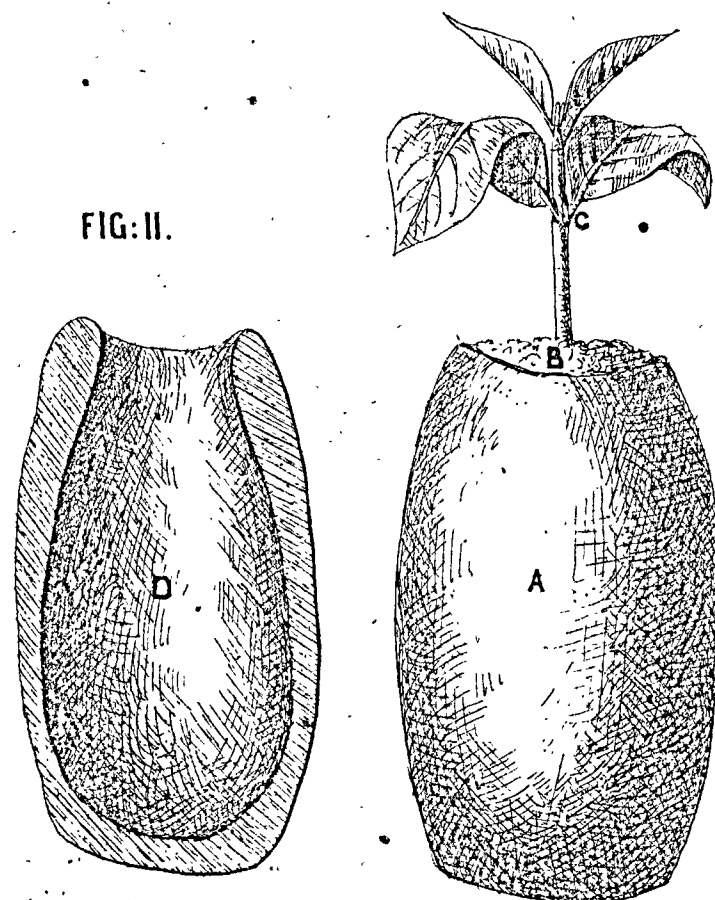
this treatment the cuttings are found to root more freely than by the method previously adopted, while a man can pot off in a day from four to five times the number of cuttings. This simple expedient, which may scarcely appear worth detailing, is of great importance in extensive propagating operations, as it reduces the cost to nearly one-fifth of that originally incurred, and at the same time economizing space in the propagating cases, as

This system much reduces the cost of propagation.

of cuttings can be placed in a four inch pot.

Rooted cuttings not transplanted from cutting pots until hardened when they are put singly into pots formed of cowdung and sand.

FIG: II.



3. The cuttings when rooted in the propagating cases are not as hitherto transplanted into larger pots, but the cutting pots removed into the hardening cases, and when hardened off, the plants are placed singly into pots two inches in diameter, and about $3\frac{1}{2}$ in depth, formed of a mixture of cowdung and sand as illustrated at Figure II.: A being the cowdung pot; B, the soil; C, the plant; D, a section. These pots are, prior to use, dried in the sun, by which they become hard and in every respect answer the purpose of an ordinary pot, when buried in the soil they become soft by the moisture, and in this condition are easily penetrated by the roots of the plants, but are still

sufficiently adhesive to permit of handling, without breaking, when removing or transplanting the plants.

The cowdung pots cheaper and better than the ordinary earthen pots, and admits in permanently planting out of being placed together with the plant into the ground.

ordinary pot, while they more effectually answer the purpose required in giving nourishment to the young plants, and in the operation of permanently planting out, admits of the pot with the plant being at once placed into the soil, thus avoiding the injury done to the roots in removing the plant from ordinary earthen pots.

Condition and growth of plants.

Growth of the plants planted by the Governor and Staff in August 1862.

4. These cowdung pots are made by hand, and a man will make from 400 to 500 per diem; they are thus produced at less than $\frac{1}{10}$ th part of the cost of an ordinary pot, while they more effectually answer the purpose required in giving nourishment to the young plants, and in the operation of permanently planting out, admits of the pot with the plant being at once placed into the soil, thus avoiding the injury done to the roots in removing the plant from ordinary earthen pots.

5. The first Chinchona plants were permanently planted out on the 30th August 1862. The eleven plants of *C. Succirubra* planted by His Excellency Sir William Denison and Staff, made an

average growth of three feet from that time to 30th April 1863, the circumference of the stems, at six inches from the ground, varying from two to three and half inches; and from the 1st of May 1863 to 30th April 1864, these plants made an average perpendicular growth of two feet eleven inches, with the circumference of the stems varying from six to nine inches; and from the 1st May 1864 to 30th April 1865 these plants attained an average perpendicular growth of one foot six inches, with stems varying from 8 to 12 inches in circumference. The perpendicular growth of these individual plants in the official year 1863-64 exceeded the average growth of the same species throughout the plantation by about three inches. This year, however, these plants have not attained the average growth of those on the plantation, in consequence of the heavy storms which have prevailed, and the situation in which they are planted, being exposed to the full force of the western winds. On the first Denison Plantation the *C. Succirubra* was planted at 10 and 12 feet apart, and the branches of many of these plants are now touching each other, presenting the appearance of a luxuriant young forest. The bark has much increased

Bark much improved in thickness.

in thickness, while the markings characteristic of the finest Peruvian bark become more and more apparent; mosses and lichens having developed themselves upon the stems of the oldest plants. This, in combination with the healthy growth of the trees, now establishes, beyond all doubt, that the Chinchona bark can be grown on the Neilgherries to as great

Can be grown to great perfection on the Neilgherries.

perfection as in the most favorable localities on the Andes. The *C. Succirubra* still continues to grow most robust and to produce the thickest and the largest quantity of bark in a given period; this species is also very hardy, and would no doubt be most profitable to cultivate at elevations varying from 4,000 to 6,000 feet. One plant of this species has already produced perfect seeds, and as upwards of a thousand plants are now in bloom, we may shortly expect to be able to supply

abundance of seed of this valuable species, which stands pre-eminent in the quantity of alkaloids it produces, also in the

thickness of its bark, and in its luxuriant and rapid growth; in short, it possesses in the highest degree, every quality necessary in a plant intended for profitable cultivation.

C. Officinalis and its varieties next in value.

in cultivation promises to rank second in thickness to *C. Succirubra*, but the plant is of less luxuriant habit, although more hardy and better suited for cultivation in exposed situations and high elevations. This species, together with its varieties, *Crespilla* and *Bonplandiana*, should invariably be selected for cultivation at high altitudes, as they thrive best at elevations varying from 6,000 to 8,000 feet; some plants of the *C. Officinalis* are coming into bloom, and possibly may produce perfect seeds this season.

And better suited for growth at high elevations and exposed situations.

7. The *C. Calisaya* has hitherto only been planted at elevations varying from 4,000 to 6,000 feet, and here the

C. Calisaya rich in Quinine, but of slow growth.

plants thrive well, although the habit of this species is less vigorous than the "Red" or "Crown" barks, the stems scarcely increasing more than half as much as these species in thickness during the same period of growth, and consequently as a bark producing tree is less valuable. A few plants of the Calisaya, accidentally placed out at a high elevation (7,300 feet), seem to have adopted a much more luxuriant habit, than those planted at lower elevations, consequently a number of this species will be planted during this season at much higher elevations than hitherto. Several plants of the C. Calisaya planted on the 1st Denison Plantation in November 1862, are now in full bloom, presenting a most beautiful appearance, while their fragrance fills the air for a considerable distance.

Seems to grow best at high elevations.
C. Lancifolia resembles Calisaya.
8. "The C. Lancifolia, received from Java, much resembles the C. Calisaya in its habit and growth, but our experience with this species has been too short to admit of an opinion being formed of its ultimate value as a cultivated plant. The plant, no doubt, is the true C. Lancifolia of botanists, and is a most valuable species for the production of Quinine.

Propagation of Grey barks discontinued.
9. The propagation of the "Grey" barks, C. Micrantha, C. Peruviana, and C. Nitida, has been discontinued in consequence of the small quantity of Quinine produced by these species; although they yield a considerable quantity of Chincho-nine, yet the value of this being much inferior to Quinine, it has been considered undesirable further to extend their cultivation. Many of the older plants of these three species are now coming into bloom.

Many of these species now in bloom.
C. Pahudiana.
10. The C. Pahudiana could be grown to any extent in this locality, but in consequence of the uncertain value of the plant, it has not been propagated. A few of this species are also now in bloom.

Cultivation, modification in system of.
11. The treatment described in previous reports has been found adapted to the requirements of the plants, but in order to lessen the labor and risks from carelessness in transplanting, some modification in our former treatment has been found necessary. The plants being established in the hardening cases, are planted

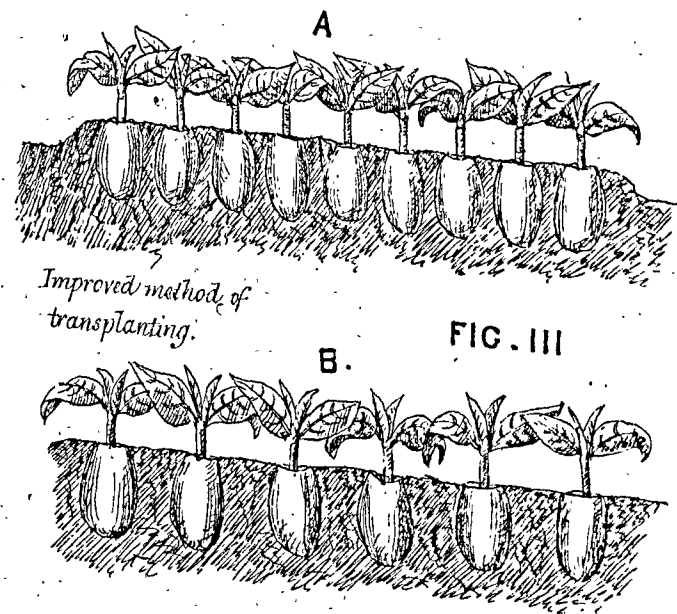


FIG. III

in the nursery beds as illustrated at Figure III: A being a transverse section of a row of cowdung pots as placed in the beds, and filled in between with earth; B shewing a longitudinal section of the bed, the pots being placed at the distance of 2 1/2 inches apart, and the spaces between them filled up with earth to a level with the stem of the plants. In this

Method of
transporting
the plants.

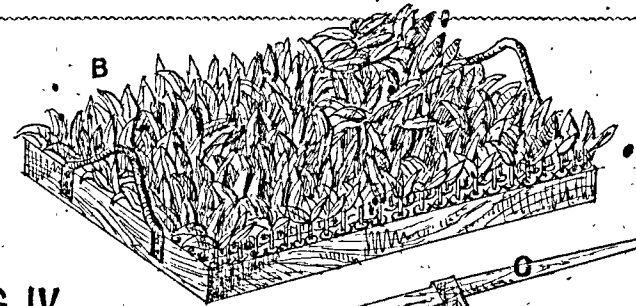


FIG. IV

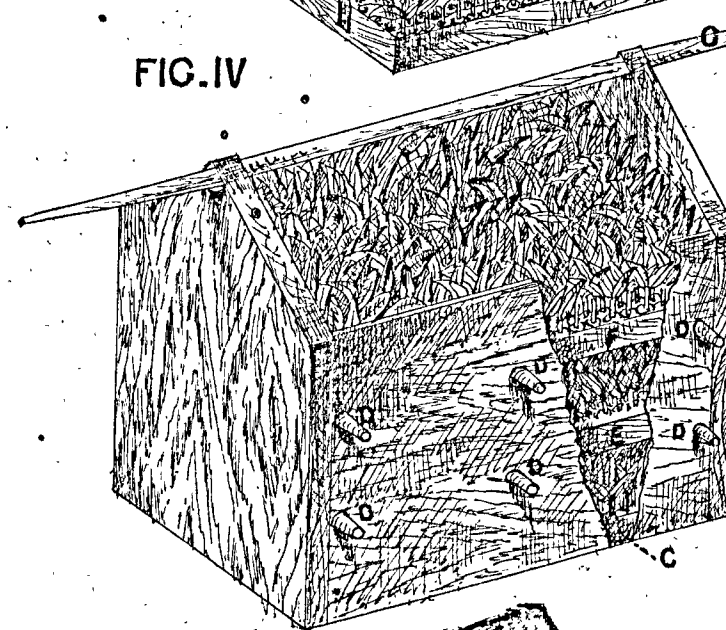


FIG. V.

Method of perma-
nently planting out.

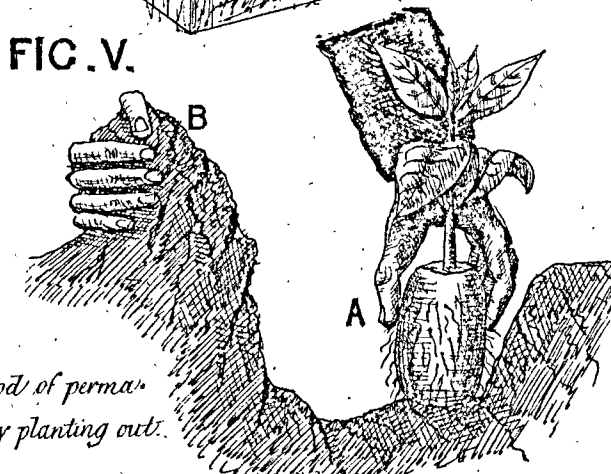


FIG. VI.

Rough wood
protection & shelter
for young plants.



way the plants can be removed and transplanted by untrained laborers without danger of damage to their roots. In removing the plants from the nurseries to be permanently planted out, they are raised from the nursery beds and arranged on a light dealwood tray, 2 feet by 3 feet as at Figure IV, B; this tray being filled, is lifted by the handles and placed in the bottom of a box as at C; another tray is filled in like manner, and three round sticks being run through holes in the sides of the box at D; the second tray E is placed on and supported by these sticks, and the third tray F treated in the same way. The box now being filled and containing about 540 plants, is lifted by the pole G and carried by two men to the planters where it is deposited, the same men returning with an empty box to be re-filled. The planters first draw out the pole and remove the upper tray F from the box, and proceed to plant out the plants as illustrated at Figure V, A, filling in the soil in the manner shewn at B; this completed, the plants are immediately shaded with split pieces of wood as at Figure VI, and the operation of planting is finished. When the plants have grown above the wood, they are protected from chafing by a grass rope being twisted round the

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top as at H. This rough split wood, as a protection and shade for the young plants, has been found quite as efficient as the baskets described in paragraph 27 of last year's report, and requires less labor, as one man in this manner is able to shade from 50 to 60 plants per day. The distance at which the plants are now placed, when permanently planted out, are for the "Red," "Grey," and "Yellow" barks 7x7 feet. The "Crown" barks in very exposed situations 4x4 feet, in medium exposed places 6x6 feet, and in sheltered localities they are also placed 7x7.

Cultivation under the shade of living trees.
Principal plantation entirely cleared of forest.

12. On our principal plantations the land was entirely cleared of forest prior to planting, but on the 1st Doda-betta plantation, also on some portions of the 2nd, the forests were only partially cleared, in order to test the effect of cultivating the plants under the shade of living trees, and the experience of upwards of two and a half years, although comparatively short, is still, I think, sufficient to establish beyond doubt that they cannot be successfully grown under living shade. The plants in such situations are weak, 'drawn,' and liable to damp off in continuous wet weather, and they suffer much more from gales of wind than in open and even exposed places, while the accidental falling of the forest trees, which occasionally takes place, destroys many of the young plants.

Are also injured by the falling of the forest trees during storms.

Suggests that the forest trees be removed.

13. Altogether about 40 acres of Chinchona have been planted under living shade, and I would respectfully suggest that while the Chinchona plants are young, the forest trees be removed from about 30 acres, preserving 10 acres by way of experiment, as it will probably be 30 or 40 years before any return can be expected from plants grown under the shade of forest.

Cultivation results obtained in by private planters.

14. Notwithstanding the scarcity of labor on these Hills, and the great difficulty and expense of getting work performed, Chinchona cultivation continues to be eagerly entered into by private planters, some being on a very large scale, which bids fair shortly to establish Chinchona bark as a staple product of the Neilgherries. Mr. Moncy, a gentleman from Bengal, having procured no less than 900 acres of land in the Deva Sholah and its neighbourhood to be devoted entirely to Chinchona cultivation.

Progress of plants in different Districts of India.

15. From Mahableshwar, Belgaum, Honore, and elsewhere in the Bombay Presidency, reports have been received of the plants making fair progress, while the plants supplied to Mr. Fitzgerald at Darjeeling are succeeding well; also in the North-Western Provinces considerable success has been attained. From Coorg, Nugur, and Wynad, reports have been received which seem to establish that the plants

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grow freely, and promise to be cultivated with great success in these localities.

78,000 plants issued to the public.

The number of plants issued from our nurseries to the public in three years, exceeds 78,000, and portions of these have been distributed to every District in India considered suitable to their growth.

Felling forests for Chinchona cultivation, effect on springs and water supply.
Streams continue to flow more copiously when forests are felled.

16. Farther observations seem to establish the impression detailed in paragraphs 17 to 22 of last year's report, that the felling of forests at the sources of springs, and along the banks of streams, instead of diminishing, (as generally believed) considerably increases the flow of water. The views on this subject, as the Government correctly observe, are not those in general acceptance, but the question is one of so great moment to India, where the water supply forms the wealth of the country, that the facts observed are worthy of careful investigation. The result of experience from the felling which has already taken place, unmistakeably establishes that, in these localities at least, streams flow far more copiously, and maintain their volume much more regularly, throughout the dry season when the forests are felled, and this has continued for four years. These are facts hitherto unaccounted for, and apparently little observed, although they appear to take place in every spot where felling has been carried on to any extent. The felling of forests is not supposed in any way to increase or diminish the rainfall, but to preserve and economize it, giving off the water to the streams by the slow and regular process of filtration, the land being deprived by felling, of the myriads of pumps in the shape of trees, which previously daily drew from the arteries and dissipated into the air an immense quantity of water.

Felling of forests not supposed to effect rainfall.

17. The effect of forests in attracting clouds and moisture, or increasing rainfall, is a complex subject not easily subjected to practical test, but deductions drawn from the fact that young trees require for their existence more uniform moisture than old ones, it is fair to conclude that trees exercise no influence in attracting moisture, as all spots upon which forests are now found, must necessarily have been more uniformly moist prior to the forests being produced than after they became established.

Because young trees require more uniform moisture than old ones.

18. In the extension of our operations it will be necessary to fell several other forests well calculated to test the effect of trees upon the flow of water in springs and streams, consequently instruments have been constructed to measure the flow of water in the streams issuing from these forests, for at least a year prior to the trees being felled. The flow of water from the same forests being registered by the same instrument for several years after felling, will establish the exact increase or decrease in the flow, and its variations throughout the seasons both in the unfelled and felled forests.

Instruments constructed to measure flow in streams and springs.

Cultivation, elevations and exposure best suited to.

Elevation and exposure best suited to the "Red Bark."

best at elevations varying from 5,000 to 6,200

Effects of exposure on.

aspect, nothing could be more satisfactory than the growth of *C. Succirubra* or "Red Bark" is about 6,000 feet, the plant, however, will grow at considerably greater elevations as also down to 4,000 feet, but they have been found to thrive on slopes facing the north, and well sheltered from the N. E. and S. W. monsoons. On the 1st Denison and Markham Plantations, which possess this aspect, nothing could be more satisfactory than the growth of these plants, while on the lower portion of the 2nd Denison Plantation, which is very much exposed to the S. W. monsoon, and to the full effect of the rays of the afternoon sun, during the dry season, the growth of this species has been very unsatisfactory, the plants being stunted in consequence of the soil becoming parched and dried up during the months of February and March, while they are cut to pieces in the months of June and July by the violence of the winds. Various expedients have been adopted to counteract these disadvantages, and although none of them have proved quite effectual, they have been so far useful in protecting the plants as to merit description.

Means of protection.

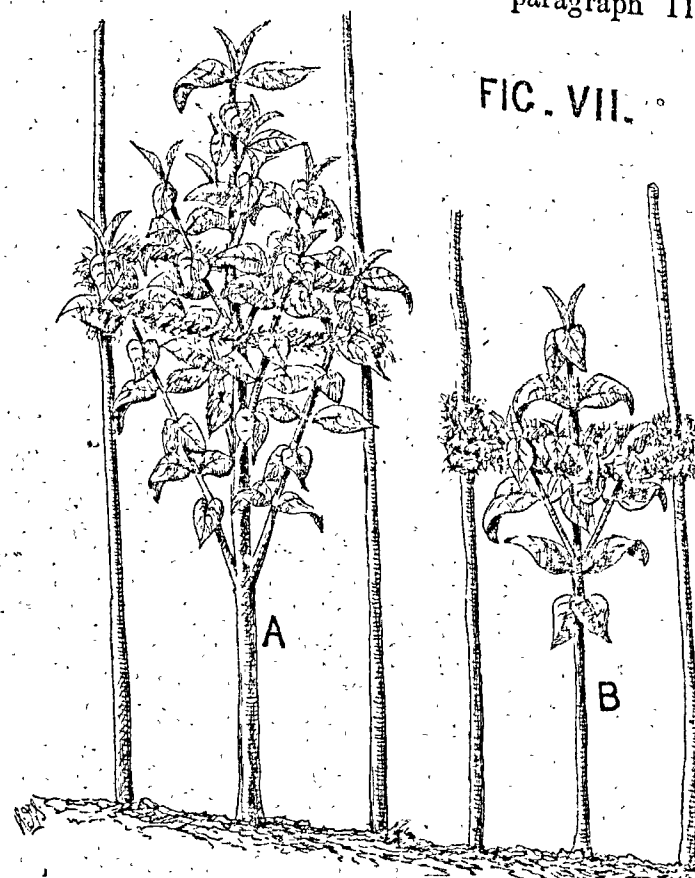


FIG. VII.

20. The plants when young are shaded and protected as described in paragraph 11, and when they attain the height of 1 foot or 18 inches, they are staked, and tied with grass ropes as at Figure VII, A and B, great care being taken to see that the grass rope does not touch the stem of the plant, as when this is the case, the movement of the plant with the winds cuts the bark through at the point of contact with the rope, and destroys the plant; this can be effectually avoided by drawing the rope up to encircle the leaves and small branches when present, so that the leaves or

branches come between the rope and the stem of the plant. This requires particular attention; because, if not attended to a whole plantation might be destroyed in one storm, it being much better that the plants be not tied at all, if not secured effectually.

21. The various species of "Crown" Bark, *C. Officinalis* (Condamena), *Bonplandiana* (Uritusinga), and *Crespilla*, thrive best at elevations varying from 6,000 to 8,350 feet, the latter being the highest elevation at which the plants are grown here. These species or varieties, when well secured as described in the preceding paragraph, grow in any exposure, and even where exposed to the full force of the monsoons they are not much injured, although their leaves become shattered by the storms, fresh leaves however being immediately produced the plants are not materially damaged. These species will not grow in land-locked hollows subject to severe frosts, but otherwise can be grown in almost every soil on the plateau of the Neilgherries, apparently succeeding as well in grass land as in forest. Although the "Crown" Barks bear this amount of exposure, nevertheless like all the other species of *Chinchona* they thrive best in well sheltered situations with a N. or N. E. aspect, as these localities maintain a more uniform moisture throughout the dry season, and this is highly beneficial to the growth of *Chinchona*.

Bears considerable exposure.

But prefers sheltered positions.

"Yellow Bark."

22. The "Yellow" Bark, or *Chinchona Calisaya* and its varieties grow well at 5,000 to 6,000 feet, and also in the Wynaud at 3,000 feet, these are the only elevations at which we have grown the plants. This species although valuable for the production of quinine, does not promise to be a profitable plant under cultivation, in consequence of the thinness of its bark and slow growth, a few plants unintentionally placed out at a much higher elevation than formerly (7,300 feet) have assumed a more robust habit than those planted at a lower altitude.

"Pitayo Bark."

23. The "Pitayo" Bark, *C. Lancifolia*, has been planted out at an elevation of 7,600 feet, but owing to the few plants and the shortness of our experience with this species, it is impossible at present to state with any certainty the elevation best suited to the cultivation of the plant.

"Grey Bark."

24. The "Grey" Barks; *C. Peruviana*, *Nitida*, and *Micrantha*, have been found to grow well in the localities in which they were originally planted, at elevations varying from 4,500 up to 6,000 feet, flourishing best at the highest elevation and in sheltered positions facing the north. During the present year these plants have not been propagated in consequence of the small quantity of quinine they produce, they are nevertheless rich in chinchonine.

C. Pahudiana.

25. The *C. Pahudiana* continues to flourish both at an elevation of 5,000 and 7,400 feet, but this has also not been increased in consequence of the uncertain value of its bark. Another species nearly allied, if not identical with the *Pahudiana*, has recently been received from Java, but none of these have yet been permanently planted out.

Cultivation, soils best suited for

Soils best suited to the growth of Chinchona.

26. The *C. Succirubra* or the "Red" Barks thrive in a dark Crown deep vegetable mould, resting upon an open sub-soil. The *C. Crespilla* in peaty land, the *C. Officinalis* also grows freely in this soil, but prefers a deep brown mould; this species is also found to grow well in the laterite soils so common on the plateau of the Neilgherries. The "Yellow" and "Grey" Barks prefer the same soil as the *C. Succirubra*, while the *C. Lancifolia* and *Pahudiana* indicate a preference for a dry and gravelly soil.

Cultivation, effects of storms and wet weather upon

Plants when established are not liable to be blown down.

27. The different species of Chinchona are found to establish themselves securely in the ground, in consequence of their throwing out a dense moss of fibrous root, much like the *Rhododendron*: and thus the plants are secure against being blown down even in the heaviest storms. In exposed situations, however, the stems are occasionally broken off, while the foliage of the larger leaved species are much tattered, and have sometimes been blown away entirely; however, as the plants attain age, the leaves become smaller and are less affected by the wind. The greatest injury the plants receive is from the branches striking against each other, and damaging the bark.

28. The continuous rain during the last monsoon proved less injurious to our plants than the preceding one, the plants of younger growth having suffered most, only five plants of the "Grey" Barks having died during the monsoon, while twenty-five were lost from the effects of the previous monsoon. The "Grey" Barks suffer most from the effects of heavy and continuous rain, while the leaves of all the species assume a yellow tint, indicating the presence of a superabundance of moisture, but this has only proved fatal to a few plants of the "Grey" Barks. All the species luxuriate and make most vigorous growth in the seasons alternated with showers and sunshine, and even continue to grow well for two months after the rain has ceased, thus establishing that they bear a considerable amount of drought without injury.

Gathering the bark, farther observations on the treatment for this purpose.

Removing strips of bark most successful.

29. Farther experience in removing strips of bark indicate this to be the most profitable system. The causes of failure in our first experiments having arisen, first, from the stems not being instantly covered with moss; and secondly, from allowing lichens to be mixed with the moss used for this purpose. This season the treatment of the plants on this system has been most successful, in consequence of the stems being covered with moss the instant the strips of bark were removed, care being taken to select such moss as was entirely free from an admixture with lichens, it being found that the presence of these among the moss, generated a fungus, which penetrated into, and

injured the wood of the plants, preventing the formation of new bark. It is, therefore,

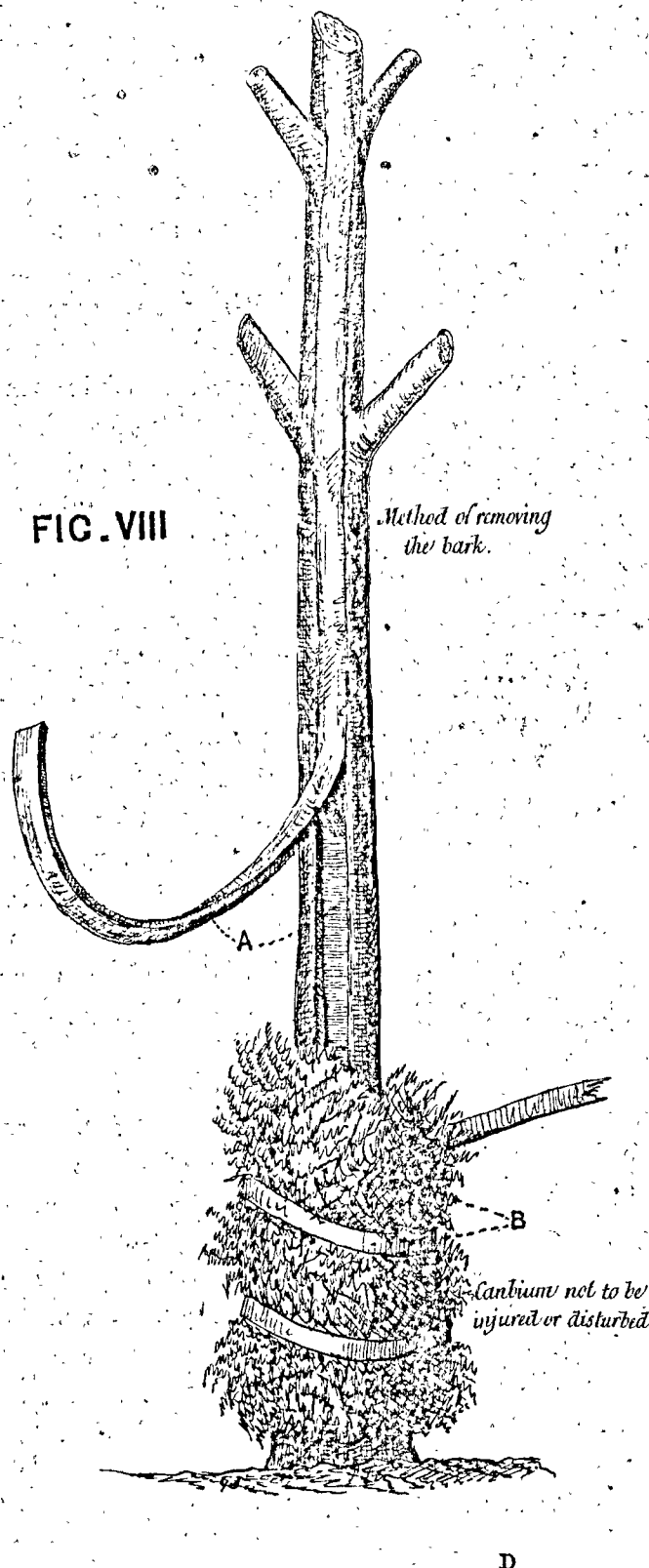
Description of moss to be used for covering.

Lichens to be carefully rejected.

of the utmost importance to select the best green moss, a uniform bright green in its texture indicating that lichens are not present, as the whole of the tribe of lichens can easily be distinguished by the

casual observer from moss which is always of a green color, soft and velvet like in appearance, while the lichens are invariably of a grey, yellow or brown color, scaly and harsh in appearance and to the touch.

30. Figure VIII. illustrates the stem of a plant with a strip of bark removed as at A; B, shewing the manner in which the moss is laid on and secured around the stem. In removing the strip of bark, two parallel cuts should be made down the stem, at the distance apart of the intended width of the strip of bark as at C this done the bark is raised from the sides of the cut, and drawn off beginning from the bottom, care being taken not to press or injure the sappy matter ("cambium") left upon the stem of the tree. This cambium or sappy matter immediately granulates on the removal of the bark, and being covered forms a new bark, which



maintains the circulation undisturbed. This is rather a precarious operation, and one which must be performed by intelligent men; but the results obtained by this system of treatment will no doubt double the annual yield of bark, because the renewed bark of one season's growth is quite as thick as ordinary bark of two or even three years' growth. The application of moss has also the advantage of greatly increasing the weight and thickness of the bark, and from the observations which have been made, would indicate an increase in the alkaloids, that is, a pound of bark covered with moss produces more alkaloids than the same quantity of bark not so protected. This very important question will be, to a certain extent, established by the analysis of the barks submitted to Mr. Howard in May last; but whether there is an increase in the yield of alkaloids or not, the effect of mossing the stems is to give a great increase in the yield of bark, and consequently in the value of the produce, the result of analysis already received establishing beyond doubt that the application of moss in no way decreases the yield of alkaloids. Dr. deVry* having obtained from Neilgherry bark, treated in this manner, the enormous product of 8.409 per cent of alkaloids, and in a state of greater purity than usually found in Chinchona bark. The idea of artificially applying moss to the bark of our Chinchona plants, originated from the fact that the best Chinchona bark of commerce is invariably overgrown with moss. Hence, the supposition that moss preserved the alkaloids from the process of oxidation or deterioration, which they apparently undergo when the bark is long exposed to the full action of light.

Effects on Alkaloids and weight of bark.

31. The period being rapidly advancing when we must begin to harvest our bark, it becomes a matter of serious consideration to devise the best means of preparing it, and if possible extracting the alkaloid on the spot, in order to save the cost of carriage. Connected with this subject I would much like the benefit of a personal consultation with Mr. Markham, especially as this gentleman has obtained much valuable information by experience in South America, and his intercourse with scientific men in Europe on the best methods of extracting the alkaloids. Moreover, an inspection of our plantations would enable Mr. Markham to draw a correct conclusion as to the state and health of the plants here, compared with those on the Andes.

* The Chinchona Bark of British India, by Dr. J. E. deVry, page 5.

"The leaves of *C. Succirubra*, *C. Micrantha*, and *C. Pahudiana* contain traces of alkaloids; but I could not find quinine amongst them. The results of experiments on No. 7, Red Bark, thickened by moss, deserve the greatest attention, for although Mr. Howard had already ascertained that Mr. McIvor's experiment of thickening the bark by covering it with moss had been really successful, I was quite struck by the enormous amount of 8.4 per cent. of alkaloids in so young a bark. The other peculiarity of this bark was that I never obtained Chinchona Alkaloids so easily pure as from it; hence, I hope that the experiment will be repeated by Mr. McIvor on a large scale, not only with *C. Succirubra*, but also with the other species, and particularly with *C. Calisaya*."

32. In South America the bark is gathered at random, and without reference to the period of its growth, or the best seasons for obtaining the alkaloids. The results of our observations are so limited that it is impossible to draw from them reliable practical deductions. I would, however, notice that our barks have increased in the produce of their alkaloid at the rate of about 2 per cent. per annum. As it cannot be supposed that the barks can continue to increase in this ratio, a period must occur at which the maximum quantity of alkaloids are contained in the bark, and after this there will in all probability be a period of deteriorations, should this be the case it is of vital importance for us to ascertain, and reap our harvest of bark at that period of growth when the bark contains the greatest amount of alkaloid. This refers principally to the removal of the bark from the stems of the trees, as the operation of lopping and barking the branches may have to be proceeded with for the sake of convenience, and to give light and air to the plants prior to the bark having attained its maximum quantity of alkaloid.

Yield of Alkaloids yearly increasing.

33. Mr. Howard's analysis of the bark submitted in May last will give much information on this subject, for if our last sample of bark gives an increase over that submitted in May 1864, it will be undesirable for us to harvest our bark until this yearly increase has ceased or at least become unimportant.

34. All the species have been found to throw out shoots from the stools when prepared, as described and illustrated at paragraph 21, Plate VI., in the Manual on Chinchona cultivation, dated March 1863. This will necessarily have to be practised when the plants are placed close together, and it becomes necessary to remove each alternate tree to give light and air to the plantation.

35. The quotations at foot will, I trust, be sufficient to establish that no injury can accrue from the application of moss to the stems of our plants, and with the permission of Government I will at once moss from 7,000 to 10,000 of our largest plants, preparatory to removing the bark.

Effect of cultivation on the quality and produce of alkaloids.
Results of analysis of bark thus treated.

36. The analysis by Mr. Howard* of the samples of bark collected in February 1864, shews an increase in the quantity of purified alkaloid of 3.60 per

cent. on the result obtained in 1863, while the result of Dr. deVry's analysis* of

Specimens examined.	Alkaloids in 100 parts.	Quinine.	Chinchonine and Chinchonadine.	Chinchonine and Quinidine.	Quinovic acid.	Analytical data.
3. C. Succirubra.						
a. Bark of the stem ...	2.657	1.486	1.171	.....	0.398	41.7 grm. of bark of the stem produced 1.108 grm. of Alkaloids, and 0.166 grm. Quinovic acid of the Alkaloids 0.62 grm. were dissolved by Ether.
b. Bark of the root ...	7.514	3.443	4.071	.....	0.533	21.2 grm. bark of the root produced 1.593 grm. Alkaloids, and 0.113 grm. Quinovic acid, of the Alkaloids 0.73 grm. were dissolved by Ether.
c. Stem-wood ...	.....	.....	.....	.....	0.212	25.0 grm. dry stem-wood produced 0.053 grm. Quinovic acid.
d. Root-wood ...	.....	.....	.....	.....	0.867	18.8 grm. dry root-wood produced 0.163 grm. Quinovic acid.
4. C. Succirubra.						
Leaves ...	0.017	.....	.....	.....	1.300	32.4 grm. dry leaves produced 0.436 grm. Quinovic acid, 76.7 grm. dry leaves produced only 0.013 grm. of very impure Alkaloids containing not a trace of Quinine.
5. C. Succirubra						
Bracts ...	.....	.....	.....	.....	0.870	15.3 grm. dry bracts produced 0.133 grm. Quinovic acid.
6. C. Succirubra						
Juice dried in the sun.	.....	.....	.....	.....	x	2.045 grm. dried juice was proved to contain not a trace of Alkaloids, but Quinovic acid was readily detected.
7. C. Succirubra.						
Bark of the stem ...	8.409	2.765	5.644	.....	0.530	14.9 grm. dry bark produced 1.253 very slightly colored Alkaloids, and 0.08 grm. Quinovic acid, of the Alkaloids 0.412 grm. were dissolved by Ether.
8. C. Calisaya.						
a. Bark of the stem ...	1.800	1.220	.....	0.670	0.640	14.5 grm. dry bark produced 0.274 grm. Alkaloids, and 0.093 grm. Quinovic acid, of the Alkaloids 0.177 grm. were dissolved by Ether.
b. Bark of the root ...	3.100	x	.....	y	x	3.25 grm. dry bark of the root produced 3.103 grm. Alkaloids partially soluble in Ether.
9. C. Calisaya.						
Bark of the stem ...	1.520	0.724	.....	0.796	0.230	8.7 grm. dry bark produced 0.133 grm. Alkaloids, and 0.02 grm. Quinovic acid, of the Alkaloids 0.063 grm. were dissolved by Ether.
10. C. Pahudiana.						
a. Bark of the stem ...	0.450	x	y	.....	x	11.1 grm. bark produced 0.05 grm. Alkaloids, for the greatest part soluble in Ether.
b. Bark of the root ...	1.553	x	y	.....	0.450	11.2 grm. bark produced 0.174 grm. Alkaloids, and 0.051 grm. Quinovic acid. The Alkaloids were partially soluble in Ether.
11. C. Pahudiana.						
Leaves ...	0.010	.....	.....	.....	0.150	32 grm. leaves produced 0.048 grm. Quinovic acid, and 0.004 grm. very impure Alkaloids.
12. C. Micrantha.						
a. Bark of the stem ...	2.791	.....	.....	.....	0.113	28.3 grm. bark produced 0.79 grm. Alkaloids, and 0.032 grm. Quinovic acid, of the Alkaloids, 0.346 grm. were dissolved by Ether.
b. Bark of the root ...	4.166	x	.....	.....	0.678	18 grm. bark produced 0.75 grm. Alkaloids, and 0.122 grm. Quinovic acid, of the Alkaloids 0.15 grm. were dissolved by Ether.
13. C. Micrantha.						
Leaves ...	traces.	.....	.....	.....	1.276	28.4 grm. leaves produced 0.36 grm. Quinovic acid, 209 grm. leaves produced only 0.008 grm. very impure Alkaloid.

bark from the same plantation, collected in November 1863, gives a result nearly the same as that obtained by Mr. Howard, with one very important exception, namely, that of sample No. 7, which

yielded an increase of 5.591 per cent. or a total of 8.409; this bark having been covered with moss for nearly twelve months prior to the bark being removed. A peculiar feature in the mossed bark noticed both by Mr. Howard and Dr. deVry, was the existence of the alkaloid in

And purity than in ordinary samples of American Bark. abundance, and in a state of greater purity than in the ordinary samples from South America.

* "Report of an analysis of the third remittance of Bark from India."

"From J. E. HOWARD, Esq., to the Under Secretary of State for India, June 15th, 1864.

"SIR,—I have the honor to report that I received on the 20th May, the specimens mentioned by Mr. McIvor in his despatch of 17th March last, and that the same were all in good condition. I have since devoted most careful attention to ascertain by experiment the probable market value especially of the first two samples of the bark sent. It will not be necessary for me to detail the various means by which I succeeded in convincing myself, not only of the existence of the alkaloids, but of their being extant in such a state of purity as is certainly not found in the ordinary samples of Red Bark imported from South America. The result of my examination tended to shew distinctly that cultivation has improved the produce of at least this species of Chinchona.

"I must remark that the commercial value of specimens of bark intended for the manufacture of Sulphate of Quinine can never be ascertained by the mere knowledge of the per-centage of alkaloid soluble in Ether, since it is necessary that this should be shewn to exist in such a state as to crystallize with acids into the required compounds.

"In the case of No. 1, the bark from the thickest part of the lower branches of C. Succirubra, two years and five months old, this examination was most satisfactory, confirming that which I stated in my first Report as to the facility with which the alkaloids were obtained in a state of purity, although the amount of red coloring matter in the bark is very great. The amount of purified alkaloids I estimate at 6 per cent., consisting of Quinine 3.14, Chinchonadine 2.06, Chinchonine 0.80. This large product of alkaloids might probably be still further increased by surrounding the stem with moss, in the manner which Mr. McIvor has so happily suggested, since Dr. deVry found 8.409 per cent. of alkaloids in a stem which had been so treated. It seems to me, from the trial, that the East India Bark, the produce of C. Succirubra, will rival in price the Bolivian Calisaya, which is by no means the case with the bark of the branches of the C. Succirubra as grown in South America. It is important to remark, that the very high price of between 8s. and 9s. which has quite recently been paid for Red Bark in this market, applies only to those prices of bark from the trunk of the tree which possess from their age a peculiarly bright red appearance; I have forwarded a small vial with commercial Sulphate of Quinine obtained from this No. 1, as also Sulphate of Chinchonadine separated from the above. I have only to remark further on this bark that its appearance bespeaks its good quality, and that there can be no doubt the season chosen (24th of February) is most favorable to its being well secured."

37. While cultivation has thus improved the quality of the alkaloid in rendering it easily purified, it has increased the quantity at least five-fold, the alkaloid, as a rule, not being found principally to the "Red" and "Crown" Barks, which have readily assumed the habit of domestic plants, being stimulated to vigorous growth by cultivation and the application of manure, while the barks are easily thickened by the artificial application of moss without in any way retarding the growth or effecting the health of the plants.

Insects injurious to Chinchonas.

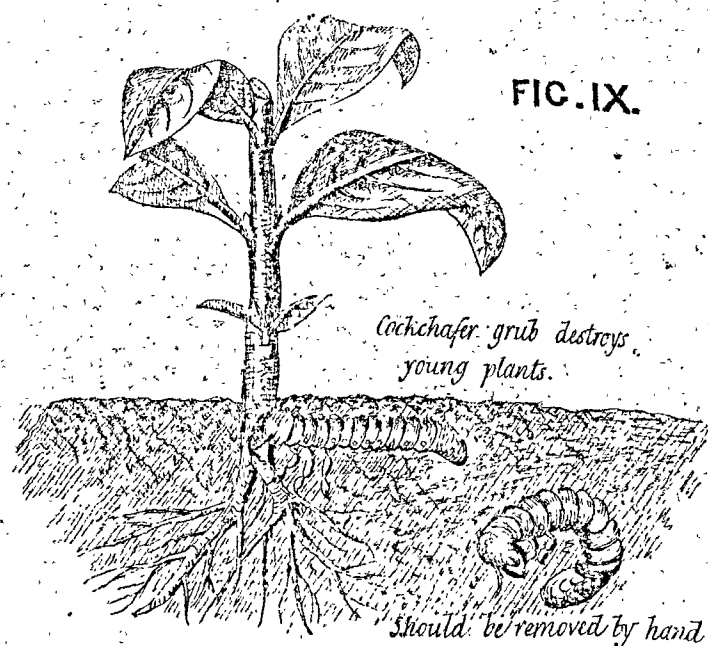


FIG. IX.

And plants examined.

How to destroy perfect insect.

of March and the beginning of April, as it flies abroad in the evenings immediately on the commencement of the first spring showers. Bright fires being lighted here and there on the land about half-past six in the evening, and a good flame maintained until about 8 o'clock, myriads of these insects dash into the flame and are destroyed.

Leaves of plants injured by a caterpillar like that of the Oleander moth.

39. The leaves of the *C. Succirubra* have, during the past year, been attacked by the caterpillar of a Hawk moth, nearly allied to the Oleander moth, but apparently a distinct species, this caterpillar which



is illustrated in Figure X, at B, attacks and devours the leaves with great rapidity. In order to save the plants from their ravages considerable labor has been entailed in removing and destroying these insects. The perfect insect is shewn at A, and the chrysalis at C. Our cuttings in the

Green and white fly attacks cuttings.

attacks of the green and white fly, these are easily destroyed by tobacco fumigation. The other enemies which attack the Chinchona, in common with all other plants, are the mealy, and scaly bugs; these like the grubs of the cockchafer can only be removed by the hand, and when once they make their appearance should never be allowed to spread.

Mealy and scaly bugs.

New varieties of Chinchona introduced, remarks on

C. Lanceolata.

with Mr. Howard's figure and description of this species, but in general appearance and habit of growth, seems to be identical with the C. Pahudiana, and in consequence cannot be entered in our list, until further information has been received on the subject, because of the inconvenience likely to arise from the distribution of species incorrectly named, and of uncertain value. Two varieties of the C. Calisaya have also been added to our stock,

C. Calisaya, var. frutex, var. vera.

namely, Calisaya var. frutex, and Calisaya var. vera, the seeds of these varieties were imported by Mr. Markham, and are very valuable as quinine producing plants.

Pitayo Bark seeds to be re-collected.

41. Arrangements have been made with Mr. Cross to re-collect seeds of the Pitayo Barks, which failed last year a fresh; a supply of these seeds may therefore be shortly expected, and it is to be hoped they will arrive in good condition and germinate freely, as the addition of this species and its varieties completes our collection of quinine yielding Chinchonas.

Establishments.

42. Mr. Batcock, the Deputy Superintendent, has given every satisfaction in carrying out the work entrusted to his charge, also in superintending the payment of establishments, &c., and to whose attainments in drawing I am indebted for the illustrations in this Report. Lieutenant Nichol, Assistant Superintendent at Neddivuttum Plantations, has shewn considerable energy and activity, and is attaining a better knowledge of the arrangement of labor, and conducting operations. Mr. Charles Dawson, Assistant Superintendent Wood Plantation, Pykara, has given every satisfaction, and is well worthy of imitation in the neat and tidy condition in which he keeps the plantations, and in the conciliatory spirit exhibited in the management of his laborers. I have also every reason to be satisfied with the manner

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in which Mr. Smith, the Assistant Superintendent of the Dodabetta Plantations, has carried out the operations entrusted to his charge. Overseers Burrows, Hudson, and Demsey have been attentive and careful in conducting their respective works. In the Office Establishment, Narrainsawmy Naidoo and Mr. McNair continue to give every satisfaction in the performance of their duties as Pay Clerk and Accountant.

Labor difficult to be procured.

43. The difficulties previously experienced in procuring and maintaining a sufficient number of trained laborers still

continues to be severely felt, and as this difficulty seems yearly to increase, I fear a rise in our present rates of pay will be necessary. For the past year, and on the Neddivuttum Plantations from the commencement, our laborers have had a slight indulgence in addition to their pay, by being supplied with grain at rates rather under those prevailing in the market. This advantage being given to the laborers by all Coffee planters.

Progress of operations.

44. In addition to the range of hardening cases built in 1863 for the accommodation of 75,000 plants, our rapidly increasing stock has rendered it

necessary to construct a temporary hardening house 100 feet in length by 18 wide, giving accommodation for 130,000 plants. This house has been found very useful in protecting our plants during the dry winter months. Our propagating appliances now afford accommodation for 135,000 cuttings, and hardening space for 250,000 plants. The total number of plants produced to 30th April 1865 was 645,717; of this number 78,612 have been issued to the public, the number of plants propagated during the official year being 254,471, of which 47,489 have been sold

Increase and distribution of plants.

or supplied to the public. On the 31st July 1865, the number and distribution of our plants stood as follows:—

Number of plants permanently planted out in the plantations	205,678
Do. of plants in the open air nurseries	217,000
Do. of rooted plants in the propagating and hardening houses	284,919
Estimated number of cuttings in the propagating cases	100,000
Total number of rooted plants and cuttings	807,597

Open air Nurseries.

45. Extensive open air nurseries

have been formed on the different plantations for the reception of the plants propagated this season. The old nurseries contained on the 1st May 1865 134,000 well established plants, a portion of these have since been permanently planted out, and the nurseries re-stocked with young plants from the hardening houses. The nursery on the Dodabetta Plantations has been enlarged to receive 150,000 plants. On the Neddivuttum Plantations 250,000; on the Wood Plantation at Pykara 150,000; and on the Melkondah Plantation 30,000. This arrangement has been made in order to secure a large stock of well established plants, they being found to transplant much better than plants direct from the

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hardening houses. The open air nursery at Ootacamund, enclosed by a brick wall, has also been extended, and now affords space for the reception of about 350,000 plants. This nursery is at present used for rearing Encalyptii and other trees for planting the ridges on our plantations, and the Lawrence Asylum sites. In extending these nurseries the beds have been formed in the manner described in the Manual on Chinchona cultivation, and the plants recently planted as described at paragraph 11 of this Report.

On the Neddivuttum Plantations 60 additional Acres planted, making 284 Acres under cultivation.

46. On the Neddivuttum Plantations sixty-four additional Acres have been planted, making the total at that place of 284 Acres under cultivation. This extension has been on the Markham and second Denison Plantations. Here 20 Acres of additional forest have also been felled during the season, and about 50 Acres pitted. The roads, drains, and water-courses through the Markham and Kilgraston Plantations have been finished, together with the trenches enclosing these Plantations, and a considerable portion enclosed by a high fence to exclude wild animals. On the first Denison Plantation no planting operations have taken place, farther than filling up a few spaces near the roads, here, however, additional surface drains have been formed, and pathways cut intersecting the plantation, and rendering every part of it easily accessible from the main roads. In this plantation nothing can be more satisfactory than the growth and condition of the plants.

Second Denison Plantation much exposed to west winds.

47. On the second Denison Plantation the plants have not made such satisfactory growth, in consequence of being exposed to the full force of the winds. On the Markham and Kilgraston Plantations the plants have made very satisfactory growth, these plantations promising in every respect to be fully as well suited to the growth of Chinchonas as any site yet selected.

Jail in course of construction.

On the Markham Plantation a large Jail is in course of erection for the reception of 270 prisoners to assist in working the plantations. This building is constructed with the intention of being ultimately formed into a bark store, and drying house, consequently the main walls have been raised high, so as to admit of a flooring being introduced. The upper main rooms to be used for storing the bark, the lower floor being furnished with flues will form the drying rooms. The walls, roof, and outside plastering of this building have been finished. The plastering of the interior, the sleeping benches, air drains, and out-offices have still to be completed. The two main rooms are intended to accommodate 225 native prisoners, and the eight verandah rooms 50 Chinese convicts, the other rooms being intended for the use of the Police. On this plantation lines for Koorumbers and the native artisans employed on the buildings have been constructed.

To be ultimately used as a Bark Store.

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On the Wood Plantation 63 Acres planted, making 71 under cultivation. 48. On the Wood Plantation at Pykara 63 Acres of land have been planted during the season, which, together with the 8 Acres planted in 1863-64 gives a total at that place of 71 Acres under cultivation, a farther extent of 40 Acres has been cleared, and is now in course of preparation for planting. In addition to this, the avenue leading past the water falls has been re-planted. The roads widened, and edged with grass or box, a few arbours erected, and the main water channel from the Pykara river for the supply of the plantation revetted and well secured.

Dodabetta Plantations, 57 Acres planted, making 152 under cultivation.

49. On the Dodabetta Plantations the work has also progressed satisfactorily, 57 Acres having been planted out during the season, making the extent under cultivation on these two plantations 152 Acres. On the second Plantation several new roads have been formed, others widened and edged with grass or box, all the planted land drained, and about 70 additional Acres pitted, or in course of preparation for planting. On this plantation a Jail has been erected for the accommodation of 100 prisoners, the main room to contain 70 native prisoners, and eight of the verandah rooms to accommodate 30 Chinese prisoners, the other rooms being for the Police. This building is completed and ready for occupation, some of the out-offices including the latrines have not yet been finished, but will probably be so in the course of a month. This Jail is also constructed so as ultimately to be converted into a bark store.

Melkondah Plantation.]

50. In forming the new plantation on the Koondahs, great difficulty still continues to be experienced in pushing forward operations in consequence of the want of roads. Here, however, an extent of 193 Acres has been felled, of this 150 Acres have been lopped and burned, 75 Acres pitted. The roads on the plantation in a forward state, and when this portion is drained will be ready for the reception of the plants. The Superintendent's house has been built, a line of road traced and used as a bridle-path connecting the plantation with Ootacamund, a distance of 29 miles. The opening out of this line of road for cart traffic will probably cost between 30,000 and 40,000 Rupees, but it would render available this hitherto untouched, although the finest tract of land on the Neilgherries, for Tea and Chinchona cultivation. I would respectfully suggest that the opening of this road be undertaken by the Department of Public Works, as it will be of immense advantage not only for the Government Plantation, but for private planters who wish to open in this direction. The Bowany river being unbridged, prevents communication between the Koondahs and the Neilgherries during the monsoon. On the Melkondah plantation a Jail is also in course of construction, this building is intended to accommodate 95 native prisoners, and 30 Chinese convicts. Only 5,000 plants have been placed in the nurseries on this plantation.

Jail in course of construction.

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51. In the Botanical Gardens considerable improvements have lately been effected, between the upper and lower gardens an Italian parterre has been introduced with three basins for fountains, the eastern half of this parterre being finished, is planted with choice flowers and has become very attractive. A new Orchid and Fern house is in course of construction, which will prove of great advantage in enabling us to cultivate these very interesting tribes of plants. The house being furnished with a cascade and fountain, and placed in a well protected position in the garden, offers every advantage for growing these plants; small parterres and terraces filled with flowering plants have also been added in the upper portion of the garden.

Labelling plants.

52. Arrangements have been made for labelling the plants in the gardens with their botanical names, classes, and orders, &c., the labelling being carried out simultaneously with the preparation of a catalogue of the plants. This list of plants is contemplated to be something more than a mere catalogue, as we possess many plants of interest, and especially the economic plants may be accompanied by a short notice of their habit of growth, soil, cultivation, &c.

Plants introduced.

53. This season has added many valuable plants to our collection, and to His Excellency Sir William Denison we are indebted for supplies of fine seeds of the valuable timber trees of Australia, among these may be particularly mentioned, as introduced in large quantities, the various species of Eucalyptii, as also the very valuable Arancarias Cookii, and Bidwillii, and the much prized Myall or violet scented Acacia; likewise Phormium tenax or New Zealand flax, the New Holland Nymphaas, and several species of Tropadlum. To General McCleverty we are indebted for spores of several pretty New Zealand ferns which have germinated freely, especially the sweet scented Doodia; this gentleman has also supplied seeds of Edwardsia Microphylla, a handsome Australian shrub. To Dr. Cleghorn we are indebted for seeds of various Himalayan trees, among these was a species of Cherry apparently nearly allied to the British species, and as this plant succeeds admirably, will prove invaluable as a stock on which to graft the hybrid varieties. Dr. Cleghorn also supplied seeds of the best variety of the Bengal "Bael." From the Mauritius Botanic Garden a Wardian case has been received in exchange for ferns and Chinchonas, containing two valuable species of Guava, the Chinese Litchi, the Camphor tree, and many other useful plants. To Major Michael we are indebted for a small collection of seeds of New Zealand trees and shrubs, which have grown freely and containing many new and valuable species. To Captain Beddome, Acting Conservator of Forests, we are indebted for spores of many new and rare ferns; also to Colonel Scott for good seeds of the Arbutus imedo.

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ribution of Garden plants and seeds.

54. The following table exhibits the distribution of Garden plants, seeds, &c., for 1864-65.

Months.	Fruit trees and shrubs.	Timber trees.	Shrubs and flowers.	Collections of seeds.	Amount.
1864.					RS. A. P.
May	53	252	399	10	360 2 0
June... ..	4	260	266	27	280 7 0
July... ..	...	100	48	37	241 8 0
August	164	2	199	27	289 2 0
September... ..	...	12	119	29	175 5 0
October	6	22	174	15	151 14 0
November... ..	...	8	149	9	79 3 0
December... ..	16	...	64	3	50 14 0
	243	656	1,418	157	1,628 7 0
1865.					
January	...	...	56	13	41 10 0
February... ..	26	...	2	8	148 6 0
March	43	44	144	20	135 12 0
April	4	76	274	27	283 6 0
Total distribution.	316	776	1,894	225	2,237 9 0

Tea plantation.

Tea plantation, 7 acres planted.

Additional land prepared to be planted with Chinchona.

No. 162, limiting the Tea plantation to five acres, consequently no further operations beyond weeding, &c., have been in progress on this plantation and the unplanted pits will be filled up with Chinchona plants. The Tea plants have made fine growth, and will no doubt continue to do so, as the situation is well protected from the S. W. monsoon, the soil deep and of good quality. The Tea seeds received from Dr. Jameson in March last, have not grown well, having apparently suffered much on the journey, their germinating powers was in a great degree destroyed.

Tea seeds received from Dr. Jameson arrived in bad condition.

Lawrence Asylum sites.

Timber trees planted.

globulus, (blue gum) and Eucalyptus giganteus (stringy bark); about 6,000 other trees more of an ornamental nature, such as Willows and Cypress have also been planted along the avenues and bordering the belts and clumps of Eucalyptii.

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Concluding remarks.

57. Our Chinchona plants being now produced at about one-fourth the cost originally incurred, I would most respectfully submit, for the consideration of Government, that the time has arrived when a reduction must be made in the prices charged to the public. The plants could be disposed of when 5,000 and upwards are taken by one party at the rate of Anna 1 each, and Annas 2 each for any number under 5,000. This difference is not more than will be necessary to compensate for the comparatively additional labor and expenses in sending out small numbers of plants, as also to give encouragement to cultivation on a large scale; the above rates will, I calculate, cover the actual cost of production, including a reasonable per-centage on the cost of our propagating houses.

58. The majority of European gentlemen at present engaged in cultivation on these Hills, from want of experience, have been unsuccessful in propagation, as also in transplanting these delicate plants, although qualified to carry on the cultivation successfully when the plants are established or delivered to them in such a condition as to be easily transplanted; our recent improvements in the preparation of the young plants will enable us to deliver them in such a condition as they cannot be well injured in transplanting. This, together with the price being reduced to its lowest rate, will, I submit, give a great stimulus to Chinchona cultivation on the Neilgherries, which must ultimately be productive of benefit to the Government, while it will secure the main object for which the plants were introduced, namely, an abundant and regular supply of Quinine.

59. From the above details it will be observed that during the year our operations have made satisfactory progress, still the scarcity of labor continues to be severely felt, rendering it impossible to perform the different operations in their proper seasons, this great drawback which has continued from the commencement of this undertaking, will, I trust, be overcome so soon as we are supplied with the 500 convicts sanctioned by Government for the working of our plantations; accommodation for these convicts will shortly be completed on all the plantations; the Jail on the Dodabetta Plantations, as before noticed, is now finished.

60. In conclusion, I beg to tender my grateful acknowledgments to His Excellency Sir William Denison and the Government of Madras for the very liberal manner in which they have met every suggestion tending to facilitate the progress of this undertaking; to Mr. Markham of the India House my best thanks are due, for much valuable information; also to Mr. Howard and Dr. deVry, for the very important information these gentlemen have furnished on the formation of alkaloids in our Neilgherry barks.

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A.

Sanctioned Estimate cost of each Chinchona Plantation from commencement of operations to 30th April 1865.

Particulars.	Operations preparatory to receipt of plants.	Superintendent and Office Establish- ment.				Nursery Department.				Dodabetta Plantations.				Neddivuttum Plantations.				Pykara Plantation.			Malakoondah Plantations.		Total.	
	1860-61.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1862-63.	1863-64.	1864-65.	1863-64.	1864-65.		
	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	
Grant for the preparation of sites	2,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2,000	
Establishments including salaries, &c.	...	4,200	5,350	5,880	8,180	3,324	4,305	4,609	3,948	2,280	5,400	5,700	7,248	5,064	8,412	15,348	12,360	...	4,033	6,564	...	5,600	1,17,805	
Buildings	...	...	...	...	...	1,200	...	...	800	560	...	...	600	2,080	...	...	750	1,530	...	...	...	750	12,270	
Tool and Store-rooms	...	...	...	...	...	2,000	...	...	...	...	250	...	250	250	...	...	400	2,000	...	...	350	125	150	2,025
Coolies' quarters... ..	...	...	...	...	...	...	...	...	...	200	500	...	250	1,000	1,000	...	300	250	...	200	500	250	4,950	
Felling	...	...	...	...	...	...	...	...	...	400	1,500	...	...	1,000	3,000	...	900	1,000	...	900	6,150	900	17,300	
Clearing	...	...	...	...	...	...	...	...	...	280	1,500	...	550	1,500	3,000	...	900	1,500	...	900	...	900	11,030	
Pitting	...	...	...	...	...	...	...	...	...	400	1,500	...	550	1,500	3,000	...	900	1,500	...	900	...	900	10,150	
Carriage of plants	...	...	...	...	...	...	...	...	...	150	...	...	150	2,000	3,000	...	900	...	...	350	...	50	2,000	
Planting and shading	...	...	...	...	...	...	...	...	...	200	500	...	150	450	450	...	400	...	...	250	...	...	3,900	
Trenching	...	...	...	...	...	...	...	...	...	1,800	...	...	200	550	550	...	350	...	1,300	...	...	1,250	17,900	
Enclosing	...	...	...	...	...	...	...	...	...	...	5,850	...	500	4,000	...	...	1,100	...	8,000	1,250	...	1,250	12,481	
Road making	...	...	...	...	...	756	...	...	...	...	2,025	...	550	3,900	...	...	...	...	750	...	375	300	7,320	
Tools	...	...	...	...	...	...	...	...	...	...	1,200	...	...	1,520	...	...	550	...	1,350	200	675	1,500	7,305	
Contingencies	...	...	...	...	...	...	...	...	...	399	1,200	...	800	1,282	...	...	900	...	1,282	500	641	700	10,521	
	...	...	...	...	...	196	...	...	300	...	...	...	500	2,003	1,831	...	600	...	2,046	350	846	250	...	
Total.....	2,000	4,200	5,350	5,880	8,180	7,476	4,305	4,609	5,048	6,669	21,425	5,700	12,448	27,099	21,243	15,348	20,410	7,780	18,761	12,714	9,912	13,500	2,39,457	

A.

Actual expenditure on each Chinchona Plantation from commencement of operations to 30th April 1865.

Particulars.	Operations preparatory to receipt of plants.	Superintendent and Office Establish- ment.				Propagation and Nursery Department.				Dodabetta Plantations.				Neddivuttum Plantations.				Pykara Plantations.			Malakoondah Plantations.		Total.	
	1860-61.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1861-62.	1862-63.	1863-64.	1864-65.	1862-63.	1863-64.	1864-65.	1863-64.	1864-65.		
	RS. A. P.	RS.	RS.	RS.	RS.	RS. A. P.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS. A. P.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.		RS. A. P.
Establishment including salaries, &c. ...	114 2 3	4,347	5,343	6,437	7,971	2,024 11 6	3,329	3,440	3,478	1,481	2,274	2,605	7,083	2,910 0 0	6,195	5,874	12,507	1,683	1,608	1,880	...	971	81,871 13 9	
Buildings ...	...	...	...	...	...	2,647 0 0	3,578	3,000	1,500	865	...	2,605	7,250	1,560 0 0	...	1,000	8,550	...	...	...	350	500	32,483 0 0	
Tool and Store-rooms. ...	...	...	...	...	...	...	...	...	...	...	...	230	...	...	...	500	450	275	...	...	...	300	2,555 0 0	
Coolies' quarters ...	...	...	...	...	...	...	...	...	...	...	...	500	...	...	350	500	500	1,100	550	250	...	250	6,150 0 0	
Felling ...	...	...	...	...	...	...	...	...	...	...	...	500	...	...	...	1,750	1,000	500	1,100	550	250	...	250	6,150 0 0
Clearing ...	302 5 3	...	...	...	...	...	...	...	...	...	...	500	...	...	...	1,500	2,200	800	1,560	2,000	750	2,400	851	16,431 12 6
Pitting ...	...	...	...	...	...	...	...	...	...	...	...	400	...	...	...	1,500	2,200	500	1,125	2,000	750	1,125	500	11,900 0 0
Carriage of plants.	...	...	...	...	...	...	...	...	...	...	...	400	...	...	...	1,500	2,200	700	...	1,000	600	...	738	10,684 7 3
Planting and shading.	...	...	...	...	...	...	...	...	...	...	...	848	...	...	...	858	2,000	362	...	65	350	...	...	3,802 1 9
Trenching ...	...	...	...	...	...	...	...	...	...	...	...	245	...	...	...	900	750	500	...	65	300	...	...	5,368 1 8
Enclosing ...	...	...	...	...	...	...	...	...	...	...	...	355	...	...	...	900	898	500	...	...	1,000	...	...	7,687 0 0
Road making ...	300 0 0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1,972	1,780	1,135	...	...	...	...	...	6,586 0 0
Tools ...	271 0 0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1,554	900	327	...	1,500	504	502	875	12,474 0 0
Contingencies.	67 0 0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	400	868	650	...	1,500	1,000	...	1,000	8,178 0 0
Total.....	1,054 7 6	4,347	5,343	6,437	8,021	4,671 11 6	6,907	6,440	5,428	5,760	9,688	10,315	20,339	11,251 1 11	19,790	22,812	28,181	5,683	11,367	7,880	4,477	6,410	2,12,602 4 11	

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B.

Meteorological observations made on the Government Chinchona Plantations at Neddiwuttum
from 1st May 1864 to 30th April 1865.

Months.	Dry Bulb Therm.	Wet Bulb Therm.	Max. Therm.	Min. Therm.	Terrestrial Radiating Therm.	Rainfall.		Days with rain.	Days without rain.
						Inches.	Cents.		
May. ...	68	...	...	...	...	3	80	6	25
June. ...	59	...	...	...	...	23	98½	13	17
July. ...	58	57	63	51	59	65	29	8	23
August. ...	58	57	66	54	58	9	96½	9	22
September. ...	59	57	68	55	58	11	18½	12	18
October. ...	61	60	71	56	59	4	51	4	27
November. ...	60	55	70	54	59	1	30½	6	24
December. ...	61	55	75	53	59	...	3	...	31
January. ...	59	51	77	50	60	...	31	...	31
February. ...	61	55	74	54	63	...	29	1	27
March. ...	66	57	80	56	66	...	79½	3	28
April. ...	66	59	82	58	65	5	80½	1	29

GOVERNMENT GARDENS,
OOTACAMUND,
16th August 1865.

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

C.

Meteorological observations made at the Botanical Gardens Ootacamund from 1st May 1864
to 30th April 1865.

Months.	Dry Bulb Therm.	Wet Bulb Therm.	Max. in Shade.	Min. in Shade.	Solar radiation.	Terrestrial radiation.	Rainfall.		Days with rain.	Days without rain.
							Inches.	Cents.		
May. ...	59	58	...	...	...	...	6	38½	18	13
June. ...	59	58	...	...	...	...	5	23	21	9
July. ...	55	54	...	...	...	...	8	66	26	5
August. ...	56	54	64	50	...	...	6	16	20	11
September. ...	56	54	65	46	...	...	3	92	12	18
October. ...	56	52	67	49	...	...	3	55	10	21
November. ...	56	52	68	47	...	...	2	64	13	17
December. ...	56	49	71	46	...	...	...	86	6	25
January. ...	57	48	71	42	...	...	...	47	3	28
February. ...	58	51	73	45	111	83	...	9	2	26
March. ...	61	51	75	49	115	86	...	13	2	29
April. ...	62	55	74	53	115	84	5	6	16	14

GOVERNMENT GARDENS,
OOTACAMUND,
16th August 1865.

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

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No. 543. ORDER THEREON, 27th September 1865, No. 2,325.

Miscellaneous.

1. The results of the year's operations detailed in the above Report may be briefly epitomised as follows.

2. The average monthly increase in the number of plants by propagation was 21,200, and the total number of plants on 1st May 1865, was 5,58,105, exclusive of 78,612 plants issued to the public.

3. The oldest plants, which were planted out in August 1862, are now from 8 to 12 feet in height, and from 7 to 13 inches in girth, at 6 inches from the ground, "well furnished with lateral branches, and present a most robust and healthy appearance."

4. The analysis of the barks has exhibited a further increase in the yield of alkaloids. Mr. Howard having obtained 6 per cent. of purified alkaloids, while Dr. deVry found in one specimen as much as 8.49 per cent. of alkaloids, being fully five times the average quantity found in the barks of commerce.

5. In the oldest plantations the branches of the plants 10 and 12 feet apart are now touching each other, the bark has much increased in thickness. The characteristic markings of the finest Peruvian bark are becoming more and more apparent, lichens and mosses being freely developed. The plants are flowering freely, and perfect seeds have already been obtained; in short there is no room to doubt that the Chinchona can be grown on the Neilgherries to as great perfection as in the most favorable localities in which it has been found, and the "Crown" bark species is found to do well in almost every soil on the plateau of the hills, in grass land as well as in forest, so long as land-locked hollows are avoided in which it suffers from frost.

6. Additional hardening houses and nurseries have been provided.

7. At Neddiwuttum 64 more acres have been planted, and a total area of 284 acres is there under cultivation. About 50 more acres have been pitted, and 20 acres of forest felled.

8. A building to be used temporarily as a Jail for 270 Convict laborers, and ultimately as a bark store and drying house, is under construction.

9. At Pykara 63 more acres have been planted, making a total of 71 acres under cultivation, and a further extent of 40 acres is under preparation.

10. At Doddabett 57 more acres have been planted, making a total of 152 acres cultivated, and 70 more acres are under preparation.

11. A building to be temporarily occupied by 100 Convict laborers, and ultimately converted into a bark store, has been completed.

12. On the Koondahs 193 acres are in different stages of preparation. A Superintendent's house has been built, and much road work done.

13. A building to be temporarily used as a Jail for Convict laborers is under construction, and about 5,000 plants have been placed in the nurseries.

14. Thus altogether an additional area of 184 acres has been planted during the season, and a further area of 373 acres is under preparation.

*Proceedings of the Madras Government, Revenue Department,
27th September 1865.*

15. The total extent planted is 507 acres, viz. :—

	Acres.
Neddiwuttum	284
Pykara	71
Doddabett	152
	507

16. The total cost of the operations up to 30th April 1865 was Rupees 2,12,602, thus distributed—

	RS.
Establishment	81,872
Buildings	40,988
Plantations	62,459
Roads	12,474
Tools	8,178
Sundry contingencies	6,631
	2,12,602

17. The Government consider that the progress in the operations has been very satisfactory, and they congratulate Mr. McIvor on the important success that has attended his labors in this national undertaking.

18. He will act as he thinks best in regard to the removal of the forest trees referred to in paragraph 13.

19. The subject of paragraph 31 will be submitted for the consideration of the Secretary of State. The Government fully appreciate the importance of obtaining Mr. Markham's opinion and advice as to the best method of harvesting and preparing the bark.

20. Mr. McIvor has full permission to carry out the experiment proposed in paragraph 35, for extended mowing.

21. The subject of completing the road to the Koondahs from Ootacamund, will be considered in the Department Public Works.

22. The Government are glad to note the favorable terms in which Mr. McIvor notices the services of his Assistants.

23. As requested 300 copies of paragraphs 2 to 13, and 19 to 35 inclusive, of the Report will be struck off separately, printed uniformly with the Manual to which they will be added.

24. The account of the Botanical gardens is very satisfactory, and the Government are glad to learn that a Catalogue *raisonné* of its contents is under preparation.

25. In the Tea plantation, which is intended to be a source for supplying seed to planters, seven acres have been planted with about 9,000 plants of the China and Assam varieties, and the plants have done well.

26. At the sites for the new Lawrence Asylums 10,300 Eucalyptus trees (Blue gum and stringy bark) have been planted out for shelter in masses, bordered by some 6,000 trees of more ornamental kind.

*Proceedings of the Madras Government, Revenue Department,
27th September 1865.*

27. The Government have to thank Mr. McIvor for the zeal and energy to which they are indebted for the valuable results recorded in the above Report.

28. His proposal to fix the future price for Chinchona plants at one Anna each when 5,000 and upwards are taken, and two Annas each for any number under 5,000, is approved and sanctioned.

(True Extract.)

(Signed) W. HUDLESTON,
Acting Secretary to Government.

To the Superintendent Government Chinchona Plantations.
„ the Board of Revenue.
„ the Collector of Coimbatore.
„ the Conservator of Forests.
„ the Department Public Works.

Read the following letter from the Superintendent Government Chinchona Plantations, to the Acting Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 25th September 1865, No. 79.

With reference to my letter No. 59, dated 16th August 1865, submitting the Report on the Government Chinchona Plantations and Botanical Gardens for 1864-65, I have the honor to inform you that in consequence of the result of Mr. Howard's analysis of the bark forwarded in May last, I beg to withdraw paragraphs 29 and 30 of the Report above alluded to, as the views set forth in these paragraphs now appear immature, and will require further consideration, and more experience prior to their being laid before the public.

Read the following letter from the Superintendent Government Chinchona Plantations, to the Private Secretary to His Excellency the Governor, Ootacamund, dated Ootacamund, 3rd October 1865, No. 81.

I have the honor to enclose a copy of a detailed analysis by J. E. Howard, Esq., of Neilgherry Chinchona barks submitted in June last, and request the favor of your being so good as to submit the same to His Excellency the Governor, in order that it may be printed as an Appendix to my Report for 1864-65 on the Government Chinchona Plantations and Botanical Gardens.

APPENDIX TO REPORT ON CHINCHONA PLANTATIONS AND BOTANICAL GARDENS FOR 1864-65.

Analysis of Chinchona Bark and Leaves. (Received June 21st, 1865.)

From the Superintendent of the Government Chinchona Plantations, Ootacamund, to the Secretary to Government, Revenue Department, dated Ootacamund, 3rd May 1865.

1. I have the honor to forward, by banghy, a box containing a further supply of Chinchona bark, as per Memorandum annexed, for transmission to the Right Honorable the Secretary of State for India, in order that it may be submitted to Mr. Howard for analysis and report.

2. The bark now forwarded was removed from the plants in the early part of April last, or as the sap begins to rise, as at this season the bark separates freely from the wood.

3. Specimens Nos. 2 and 3 are renewed barks; these attain extraordinary thickness in a short period of growth; and if they contain a proportionate quantity of alkaloids, this system of treating the plants appears to offer greater advantages than the other methods proposed.

4. I may observe that further observation seems to establish that this system of removing strips of bark from the stems of the plants can be practised without injury, provided the wound is instantly covered with damp moss; inattention to covering the wounds having produced the bad effects detailed in my letter of the 17th March 1864.

MEMORANDUM.

Chinchona Succirubra.

No. 1. Bark of three years and five months' growth, thickened by the application of moss.

No. 2. Renewed bark of one year and five months' growth, being re-produced on the same portion of a stem which produced the bark given to Doctor de Vry in November 1863, and from which that gentleman obtained 8.409 per cent. of alkaloid.

No. 3. Renewed bark of one year's growth, and gathered from portions of the stem which yielded No. 1 bark, submitted to Mr. Howard in the spring of 1864.

No. 4. Bark of two years and five months' growth, not thickened by the application of moss.

Chinchona Calisaya.

No. 5. Bark of two years and five months' growth.

Chinchona Condamenia.

No. 6. Bark of one year and seven months' growth.

Chinchona Micrantha.

No. 7. Bark of two years and five months' growth, thickened by the application of moss.

No. 8. Ditto of same growth, but not thickened by the application of moss.

(Signed) W. G. McIVOR,

Superintendent of the Government Chinchona Plantations.

Report of an Analysis of the Fourth Remittance of Bark from India.

From J. E. HOWARD, Esq., F. L. S., to the Under Secretary of State for India, dated August 1st, 1865.

I have the honor to report that I received, and have during the past month devoted much careful attention to the analysis of eight specimens of Bark, referred to in a letter from Madras, dated 3rd May 1865.

The whole of the samples were in excellent condition, shewing the care and skill bestowed on their cultivation. They contrasted most favorably with specimens from South America, of bark used at the present moment in the extraction of quinine.

The mode of analysis I have followed, in the present instance, is that which is employed to ascertain the *commercial value*, which rests almost entirely with the *crystallizable sulphates*, with perhaps some slight loss of the residuary product. The results will compare well with those given in Delondre's *Quinologie*.

No. 1 gave of crystallized sulphate, per 100 parts
of alkaloid soluble in extra light ether ... 6.00
of alkaloid insoluble in the above (therefore Chinchonine) ... 0.94

Memo.—The sulphate refined into white sulphate of quinine in appearance, but this did not stand the test used for commercial sulphate of quinine.

No. 2 gave of crystallized sulphate
of alkaloid sol. in E. L. ether ... 5.00
of alkaloid insol. in E. L. E. (Chinchonine) ... 0.90

Memo.—Refined as above. ... 1.80

No. 3 gave of cryst. sulphate ... 2.72
of alkaloids, sol. in *alcohol* ... 7.00

Memo.—As I could only submit to examination 165 grains of the bark, the above result must be taken with reserve.

No. 4 gave of cryst. sulphate ... 2.43
of alkaloid sol. in E. L. E. ... 2.03
of alkaloid insol. in E. L. E. (Chinc.) ... 0.60

Memo.—This specimen gave a product not refining quite so well as No. 1.

No. 5 gave of cryst. sulphate ... 0.70
of alkaloid sol. in E. L. E. ... 0.10
of do. do. but crystallized by evaporation. ... 0.26
of do. insol. in E. L. E. (Chinc.) ... a trace.

Memo.—This sulphate did not stand the ether test.

No. 6 gave of cryst. sulphate ... 0.90
of alkaloid sol. in E. L. E. ... 0.60
of do. insol. (Chinc.) ... a trace.

Memo.—The tests shewed Quinine and Chinchonidine.

No. 7 gave of cryst. sulphate ... 5.82
of alkaloid sol. in E. L. E. (Aricine) ... 0.29
of alkaloid insol. in E. L. E. (Chinc.) ... 0.39

Memo.—This sulphate is that of *commercial* Quinidine, and contains probably no Quinine.

No. 8 gave of cryst. sulphate ... 1.26
of alkaloid sol. in E. L. E. ... 0.60
of alkaloid insol. in E. L. E. (Chinc.) ... a trace.

Memo.—The product similar to that of No. 7.

I beg to direct special attention to the remark, that the fine white crystallized *Sulphate of Quinine* (apparently) made from the bark of *C. Succirubra* will not stand the test which is employed to distinguish the pure article in commerce. The cause of this I stated in my first Report, viz., that "the crystallizations obtained are mixed with some Sulphate of Chinchonidine, which is commercially (but not medicinally) a disadvantage, and one which always attends the products of Red Bark." It is, of course, possible to separate the Chinchonidine, but then this must very seriously diminish the per-centage of six per cent. I obtained from this gross product little more than four per cent. refined in the first instance (though more subsequently), and of this I ascertained about 10 per cent. as Chinchonidine. This difficulty must be looked steadily in the face, and I would suggest that it may be obviated, either by a change being wrought in the opinion of the medical world as to the value of Chinchonidine as a medicine, or by the plant being encouraged to produce Quinine instead of Chinchonidine.

The first might be, very probably, the result of a commission of inquiry composed of competent medical practitioners. I may mention that the late Dr. Royle entered zealously, at my suggestion, into the question, and satisfied himself by experiment as to the value of Chinchonidine, but I am not aware that he left any written record of the result he attained. My own experiments confirm this view of the question, and I have shewn* that this alkaloid (which must not be confounded with Chinchonine) must have constituted (in whole or in part) the ther-

* "Illustration of Nueva Quinologia sub. voc. Chatnuarjuera."

with previous

peutic agent in the cure of the Countess of Chinchon, as also that it was the alkaloid successfully employed at Philadelphia. The second alternative may seem visionary at first sight, but when we consider the results at which Mr. McIvor has arrived, and further the circumstances under which Chinchonidine is produced, this view of the case may be altered.

In No. 7, we have an illustration of what careful cultivation will do, as the plant, *C. micrantha*, which (with its congeners the Grey Barks) produces largely and chiefly Chinchonine in its native climate of Huanuco,* now produces a very small portion of Chinchonine, and a large quantity of the allied alkaloid Quinidine. This is, then, a hopeful change, if time should confirm the observation.

Then Chinchonidine seems almost always to accompany Quinine in greater or less abundance. It does so in the *Calisaya* of Bolivia, in the *Lancifolia* barks of new Granada, and in various barks of Ecuador and Peru, and markedly in the best of the barks of Loxa. It is highly probable that a very slight circumstance in the growth may determine the production of one or other alkaloid. Dr. Heraclitus Chinchona Alkaloids,† that the Quinine and Chinchonidine salts agree closely among themselves, and differ widely from the Quinidine and Chinchonine compounds.

I may further remark, that the *Chinchona Succirubra* is a tree which varies greatly in its products in its native forests, and that the *Chinchona Micrantha*, in Bolivia, approaches to the character of a *Calisaya*, as I have noticed under that head; its bark has a different appearance from that of Huanuco, and again this now sent home varies widely from either of the above. I noticed in examination, the peculiar yellow coloring matter common, it seems, to all the forms of the plant, as I have before noticed.

The *Calisaya* bark sent this time by Mr. McIvor is, I fear, an illustration of the possibility of change in the wrong direction, as it contains far too large a percentage of Chinchonidine in proportion to the Quinine. The appearance of the bark indicates a not very vigorous growth, or at all events it differs from that it assumes in its native locality. It would never be recognized as the bark of *Chinchona Calisaya*.

The bark of No. 6 is recognized by an experienced dealer as "thin rusty crown, worth 1s. 3d. to 1s. 4d. per lb.‡ It is, I presume, the bark of the variety *Bonplandiana*, i. e., the *colorada del Rey*, as brought home by Cross; it is remarked as more red than is customary with rusty crown.

As the quantity of bark in No. 1 and No. 4 was not exhausted in my experiments, I have returned 1,000 grains of each of these, thinking that it would be a satisfaction to the Government to engage Dr. de Vry, whose chemical skill and experience are so well known, in further researches on the subject.

* A peculiar climate, of which I have recorded Mr. Pritchett's description under head *C. micrantha*.

† Dated 19th June 1857.

‡ From Messrs Jenkin and Phillips to Mr. J. E. Howard.—"51, Lime Street, 21st July 1865.—

"The sample of bark you left with us appears to be thin rusty crown, worth 1s. 3d.—1s. 4d. per lb.
"We thank you for the sight of it."

10-20-65
Read the following from
the Capt. W. L. Anderson
letter to ~~the~~ of 18th/65.

The results of the various
operations detailed in
the above report under the
briefly epitomised as
follows:

The average monthly increase
in the number of plants by
propagation was 21,200
& the total number of plants
on 1st Aug 65. was
558,105 inclusive of
178,672 plants issued to
the public.

Shrublet plants of
bark planted out in
August 65, are now
from 8 to 12 feet in
height. & from 6 to
12 inches in girth.
The bark from the
new "bark furnished
to the public."

The analysis of the bark
exhibited a further increase
in the yield of alkaloids. W.

Known having obtained 6 per
cent of purified alkaloids.

While Dr. de Vry found in
one specimen as much as 8.49
percent of alkaloids being
fully 5 times the quantity
found in the bark of Concombre.

In the oldest plantations the branches
of the plants 10. & 12 feet apart
are now touching each other.
The bark has much increased in
thickness - the characteristic
markings of the finest Peruvian
bark are becoming more & more
apparent. Lenticles & mosses
being fully developed. The plants
are flowering freely. & perfect
buds have already been obtained -

In short there is no room to doubt
that the Cinchona can be grown
in the highlands with as great
perfection as in the most favorable
localities in W. It has been
found, and the bark has
been found to dwell in bark species
soil on the plateau of the almost every
land as well as in hills - in grass
land as well as in wet - & long
avoided

Additional landings
houses & nurseries have
been provided.

At Redivertum 64
more acres have been
planted & a total area
of 284 acres is then under
cult. About 50 more
acres have been fitted &
20 acres of forest felled
a building has been
temporarily as a jail
for 270 convict laborers
ultimately a bark
store & drying house, is
under construction.

At El Kana 63 more
acres have been planted
making a total of 71 acres
under culture & a further
extent of 40 acres is under
preparation.

At Doda bett 57 more
acres have been planted
making a total of 152
acres, and 70 more acres
are under preparation.
A building has been
occupied by 100 convict
laborers ultimately
converted into a bark
store has been begun.

W. H. H. H.

Pages of Preparation -

printing and house has an
 built much woodwork and
 a building & a temporary house
 as a jail for convict laborers
 in under construction. and
 about 5000 plants have been
 placed in the nurseries.

Thus altogether an addition
 of 184 acres have been planted
 during the season. & a further
 area of 373 acres are in under
 preparation.

The total extent planted is
 507 acres. viz: Acres.
 Redwood 284
 Sycamore 71
 Cottonwood 152
 507

The total cost of the operations
 up to 30th April 55 has been \$2,12,602
 the following

General Account	\$1872
Buildings	2988
Plantations	2459
Roads	1474
Tools	178
Landry contingencies	831
	<u>21202</u>

and they are confident
 Mr. Linn the importance
 success that has attended
 his labors in this national
 undertaking.

He is as he thinks
 best in regard to the
 removal of the forest
 trees upon the land from
 13.

The subject of para 31.
 like he has for the consid-
 of the Sec. of State. The
 Govt. fully appreciate the
 importance of obtaining
 Mr. Mackenzie's opinion
 and advice as to the best
 method of harvesting &
 repairing the track.

Mr. W. Linn has full
 commission to carry out
 the experiment proposed
 in para 35. for extended
 harvesting.

The subject of the road
 of the Roadways from
 the road. which is considered
 in the D. R. R.

The Govt. are glad to
 have the favorable
 terms in B. W. Linn

copies of forms 2 & B. & C
 inclusive of the report will be
 struck off separately, printed
 uniformly with the Manual &
 so they will be added.

The account of the Botanical
 gardens is very satisfactory
 and the Gov. are glad to learn
 that a catalogue raisonné of
 its contents is under preparation.

In the tea plantation Gov. is
 intended to be a source for
 supplying seed & planters -
 7 acres have been planted
 with about 9000 plants
 of the China & Assam varieties -
 and the plants have done well.

At the sites for the new Lawrence
 Asylum 10,000 Eucalyptus trees
 (blue gum & string bark) have been
 planted out for shelter in masses
 bordered by much more trees
 of more ornamental kind.

The Gov. have to the Gov.
 been for the year.

The valuation results
 decided in the above
 report.

His proposal to fix
 the future price for
 Cinchona plants at
 One Anna each 5000
 & upwards are taken
 and Two Annas each
 for any number under
 5000 is approved &
 sanctioned.

L.R.

15.9.05 -
 To The Sup't. Govt. Cinchona
 Plantations, Des. Moor

To The B. of Ind. S.
 14 - Govt. of India S.
 9 - Govt. of India S.
 4 - Govt. of India S.
 21 - Govt. of India S.

100
 10

Report to Comd

13 November 65 12 08 hrs

13 Nov 65 12 08 hrs

2325

13 Nov 65 12 08 hrs

2325

Reviewing Cinichona

Report 1864/65

12542 + 543