EAST INDIA (CHINCHONA CULTIVATION).

FURTHER RETURN to an Address of the Honourable The House of Commons dated 8 July 1875;—*for*,

COPIES

OF THE

CHINCHONA CORRESPONDENCE

(In continuation of Return of 1870)

FROM AUGUST 1870 TO JULY 1875.

India Office,
20 June 1877.

GEORGE HAMILTON,
Under Secretary.

(*Mr. Muntz.*)

Ordered, by The House of Commons, *to be Printed*,
21 *June* 1877.

TABLE OF CONTENTS.

CORRESPONDENCE

RELATING TO

CHINCHONA CULTIVATION IN INDIA.

— No. 1. —

(No. 6—Revenue.)

From the Government of Madras to the Secretary of State for India.

Fort St. George, 7 February 1871.

My Lord Duke,

WE have the honour to reply to your Despatch, dated 19th May 1870, No. 13, relating to the maintenance of the chinchona plantations and the utilisation of the bark in this Presidency. In our Proceedings, marginally noted (which accompany), are recorded the views of the Commissioner of the Neilgherries, of the Government Quinologist, and of the Superintendent of the plantations, on the questions raised by your despatch. It remains for us briefly to state our own views.

Proceedings of Government, 7th February 1871, Nos. 87 and 91.
Proceedings of Government, 21st December 1870, Nos. 401–403.

2. In determining the position which the State is hereafter to hold with regard to the supply of quinine, a choice lies between the following courses of action, or an intermediate policy :—

(1.) The retention and maintenance by the State of the chinchona plantations, and the institution of a regular system of quinine manufacture by the State for Indian requirements.

(2.) The abandonment by the State of both branches of industry in favour of private enterprise.

(3.) The retention of the plantations by the State with a view to the manufacture of quinine from the bark in England.

(4.) The sale of the plantations, but the retention by the State of the process of quinine manufacture for Indian requirements at Ootacamund.

3. The plantations on the Neilgherries (which have now been completely occupied) are four in number, and comprise an aggregate area of 1,200 acres, as marginally shown. The two last named are the least important; it is doubtful whether their probable future utility justifies the annual outlay on them, and the inconvenience resulting from two separate establishments. We therefore propose to relinquish all further attempts at cultivating the Mailkoondah Estate, a considerable portion of which has proved a complete failure; and if we can obtain a reasonable price from a purchaser whose position and means offer some guarantee that the care and expenditure already bestowed on the plantations will not be thrown away, owing to subsequent neglect, we would propose to sell both the Mailkoondah tract, and also the plantation at Pykara. As an alternative arrangement, tending to economy, they may be permitted to develope, as uncultivated chinchona copses or forest, the condemned portion of the Mailkoondah Estate being abandoned altogether.

	Acres.
At Dodabetta - -	375
„ Neddivuttum -	450
„ Pykara - - -	300
„ Mailkoondah -	75
Total -	1,200

4. The two remaining estates should, we consider, certainly be retained in the hands of Government. State supervision cannot ordinarily compete with ably-directed private enterprise; but it does not follow that a project should be relinquished when the cost of it is rapidly decreasing, while the profits are only beginning

beginning to be realised. Up to the present time the total outlay* on the Neilgherry chinchona plantations has exceeded five lakhs of rupees.

5. Even if it were certain that greater economy would in the end be attained by the sale of the plantations, it must be remembered that chinchona-planting in India, although a proved success, has not yet altogether lost the character of an experiment, which it would be unsafe to entrust to private hands; for the barks of the already discovered species of chinchona yield a varying ratio of alkaloids at different stages of their growth, and it is possible that the species now least valued may, when more matured, be found rich in alkaloids, and *vice versâ*. The questions raised by the frequent discovery of fresh varieties of chinchona, or of an unprecedentedly large proportion of alkaloids in some of the known varieties, will be most expeditiously solved under Government supervision, which allows the freest scope for experiments.

6. The next question to be decided is, whether the requisite process for preparing quinine from the bark is to be conducted entirely at Ootacamund, or whether the whole or a portion of the bark is to be sent to the London market to be worked up there.

7. We are of opinion that the Quinologist should be allowed every facility for developing the preparations of bark febrifuge best suited for Indian requirements. It is difficult to predict now whether 10 years hence it will be cheaper to manufacture quinine in this country, or to send the bark to England for manufacture; because all calculations founded on existing data may be inapplicable when the process of manufacture is cheapened in England by large imports of bark from the numerous foreign plantations which will soon be productive. As, however, the "Amorphous Quinine," which Mr. Broughton is now manufacturing at an estimated cost of one rupee per ounce, is found highly efficacious, there can be no doubt as to the expediency of continuing *its* preparation in this country. The quinologist has also shown that, by working up the bark on the spot, many difficulties incident to the conduct of the process at a distance from the plantations are avoided, and much weight is due to this argument.

8. It is, however, evident from Mr. Broughton's letter that, unless a reduced price operates in increasing the consumption of quinine far beyond its present rate, the supply of bark procurable from the Government plantations will soon exceed the demand. We deem it, therefore, highly advisable that samples of Neilgherry bark should be sent to the home market. We learn that 900 kilos of bark have already been shipped from Java, that 1,000 kilos are ready for shipment, and 2,000 kilos more were expected to be collected and shipped before the end of last year. With this and other additional sources of supply, the price of the bark must soon fall, and we have, therefore, ordered 4,000 lbs. to be prepared for early shipment. We purpose to continue the exportation of as much bark as is not required for use in India.

We have, &c.
(signed) *Napier*, &c.

Enclosure 1, in No. 1.

From the Commissioner of the Neilgherries to the Secretary to Government, Revenue Department, Madras; dated Ootacamund, 28th May 1870, No. 25.

I HAVE the honour to forward the Superintendent's Annual Report on the Government Chinchona Plantations and Botanical Gardens of Ootacamund for 1869-70.

2. I have lately seen the plantations at Dodabetta, Neddivattum, Pycarah, and Mailkoondah; and the three former retain their high character, and do great credit to Mr. McIvor's horticultural skill, and to the zeal and industry of all connected with the plantations. I regret I cannot speak so satisfactorily of the Mailkoondah plantation, which I shall refer to more particularly by-and-by.

3. During the year the superintendent reports that 254,367 plants were planted out, against 153,145 in 1868-69; and 17,526 plants were propagated, against 19,703 in 1868-69.

Since the receipt of Government Order, dated 9th November 1869, the superintendent has devoted his attention to the propagation of the Pitayo variety, and the newly-discovered variety of *Chinchona officinalis*.

4. The

4. The Government will observe that 1,200 acres, the area originally fixed as the limit to which the chinchona plantations were to extend, have now been planted up as follows:—

	Acres.
At Dodabetta	375
„ Neddivattum	450
„ Pycarah	300
„ Mailkoondah	75
Total	1,200

The superintendent estimates that adjoining the three plantations of Neddivattum, Pycarah, and Mailkoondah, about 1,000 acres suitable for chinchona are still available if wanted.

5. Up to 31st March 1870 the total expenditure on account of chinchona on the Neilgherries amounted to 557,699 rupees, which may be subdivided as follows:—

		Rs.	Rs.
Superintendent and office			65,860
Propagation and nursery			54,498
		Rs.	
Dodabetta	Establishment	38,371	
	Buildings, &c.	22,486	
	Plantation work	67,689	
			1,28,546
Neddivattum	Establishment	79,274	
	Buildings, &c.	27,958	
	Plantation work	94,692	
			2,01,924
Pycarah	Establishment	11,746	
	Buildings, &c.	6,188	
	Plantation work	46,762	
			64,696
Mailkoondah	Establishment	9,005	
	Buildings, &c.	3,778	
	Plantation work	29,392	
			42,175
TOTAL		Rs.	5,57,699

This gives a total expenditure of 464 rupees per acre.

6. I believe the Government of India have in Sikkim about 1,250 acres under chinchona, the total cost of which, up to the 31st March 1870, has reached *Rs.*3,43,518. 10. 5. It would be interesting to have the acreage and expenditure verified, so as to institute a comparison between our plantations and theirs. The information would aid towards forming some conclusion as to the probable cost per pound of bark at which each species can be grown in different parts of India.

It is very probable that the Sikkim plantations, from climate and other reasons, will be unable to compete with ours in the growth of the Officinalis and such species, while they will outstrip us in the rapid and cheap growth of the Calisaya and Succirubra.

7. 4,000 Succirubras and 2,000 Condamineas have been mossed. Under Mr. Broughton's hands the value of this process will in due course be effectually tested by periodical analysis.

8. Up to 31st March last 42,175 rupees have been spent upon the Mailkoondah plantation. The plantation consists of two clearings in the great forest which covers the hills to the south-west of the village of Mailkoondah. The clearing on which the gaol and the superintendent's cottage have been built is at a higher elevation than the other, and may contain 20 or 30 acres. The superintendent's cottage has tumbled down; the few acres planted seemed to be eaten off by the sambar; I saw nothing but here and there a few chinchona-sticks without leaves.

The gaol-walls are cracked in every direction, and the approaching monsoon will, I fear, bring the building to the ground.

The lower clearing is about 1½ miles from the gaol, and is situated on the slope of a spur of the Koondah Hills.

Here the Succirubra seemed to be doing fairly well; the trees were about two feet high, but suffer greatly, I was informed, from the violence of the monsoon winds. With reference to my remarks, in paragraphs 4 and 5 of my letter to Government, dated 18th October 1869, I am still of opinion that it is not worth while incurring further expense on this plantation.

9. I am disposed to recommend that the Government should cease all further outlay whatever on the plantation, and endeavour to sell the upper clearing, with its buildings and materials as they stand.

The lower plantation, if the Government thought proper, might be left, as an experiment, to see how the chinchona trees will fare when left entirely to themselves in a clearing in the heart of the forest.

10. The Botanical Gardens have received some important contributions from Messrs. E. B. Thomas and Deschamp, Colonel Denison and Major Beddome. Some improvement has, I think, been made in the general up-keep of the gardens under the immediate direction of Mr. Jamieson.

It would be desirable, in future years, to keep the report of the Botanical Gardens altogether distinct and seperate from the Chinchona Report, so as to admit of more detail as to the number of hands employed in the gardens during the year, the nature of work performed, the introduction of new species by exchange or otherwise, and the stock of plants available for distribution and sale, &c., &c.

A statement of the year's receipts and disbursements should also be given. Without such a detailed report it is impossible to institute a satisfactory system of exchange with other gardens in other parts of the world, nor can we say whether the utility of the Ootacamund gardens is properly maintained, nor can the public know what facilities exist of stocking their gardens with useful and ornamental plants.

Ootacamund, 28 May 1870.

REPORT on the GOVERNMENT CHINCHONA PLANTATIONS and BOTANICAL GARDENS, *Ootacamund, Neilgherries*, for the Official Year 1869–70.

DURING the past year we have completed planting the sanctioned extent of our chinchona plantations, namely, 1,200 acres; a few additional acres are reserved for planting with the new varieties recently introduced, and the lanceolate-leaved variety of Officinalis.

2. During the year 12 cooly, 76 bullock, and 21 cart-loads of fresh bark were supplied for manufacture to Mr. Broughton, the Government Quinologist. At present we are supplying that gentlemen with about 2,000 lbs. of fresh bark weekly. We may therefore calculate the yield this year of fresh bark from the plantations to be upwards of 100,000 lbs., or about 45 tons.

3. The past season has been very favourable for planting operations, and the growth of the plants very satisfactory.

4. The plants permanently planted out in August and September 1862 have attained heights varying from 20 feet to 25 feet, the circumference of the stems, at one foot above the ground, measuring from 25 inches to 32 inches.

5. The number of plants planted out during the year were 254,367, making the total number 1,148,424. The number of plants propagated were 17,526, against 19,703, the result of the last year. Our propagation has lately been principally confined to the Pitayo varieties and the new variety of Officinalis.

6. The number of plants distributed to the public during the year were 7,755, making the total number 178,605. Private planters now prefer seeds, and a large quantity of these have been distributed.

7. With the foregoing observations I shall proceed to the details of this report, which are arranged under the following heads:—

I. Condition and growth of plants.
II. Propagation.
III. Cultivation.
IV. Results obtained by private planters.
V. Chinchona, new varieties, remarks on.
VI. Formation of alkaloids.
VII. Establishment.
VIII. Progress of operations.
IX. Botanical Gardens.
X. Tea plantation.
XI. Freshwater fish.
XII. Appendix A, Accounts from commencement to 31st March 1870.
XIII. Appendix B, Meteorological Observations at Neddivattum.
XIV. Appendix C, Meteorological Observations at Ootacamund.

I. *Condition and growth of plants.*—The red bark (*Cinchona succirubra*) continues to be the most luxuriant of all the species we have introduced. The grey barks also maintain a very luxuriant growth, while the crown-barks and our new varieties of yellow bark rank third. The new lanceolate-leaved variety of *Cinchona officinalis* ranks fourth in its rate of growth. These facts are important in determining what species will be most profitable in cultivation, as the most hardy and luxuriant species, although yielding a bark somewhat inferior, may nevertheless be the most profitable plant to grow, in consequence of the greater produce

produce of bark in the same space of time; and this more especially when the species is hardy, and not liable to be injured by wild animals or adverse seasons, as is the case with the red bark, which does not appear to be injured by wild animals, even in situations where they entirely destroy the crown-barks. We have collected this season a large quantity of seeds, and again raised some very interesting hybrid varieties. Chinchona are particularly easy to hybridise, and in this way varieties may be obtained possessing the highest degree of excellence as regards the quality of the bark, the rapidity of the growth of the plant, its ability to endure extremes of seasons, etc.

To develope a variety in this way, such as will meet all requirements with regard to rapidity of growth, hardiness, and value of bark, will occupy some years; but the subject appears to be one well worth undertaking, and, if carefully carried out, could not fail in securing a plant much superior to any of our original species. About 50 acres of grass-land has been planted out this year with *Cinchona officinalis* and *Cinchona succirubra*. These plants continue to grow nearly as well on the grass-land as they do on the forest-land. One thousand five hundred plants of *Cinchona condaminea* have been planted out at three feet apart, in order to test what effect close planting may have upon the bark. When plants are placed close together, if not thinned out in a few years, the stronger-growing will overtop and destroy the weaker plants. During the year 4,000 plants of *Cinchona succirubra* and 2,000 of *Cinchona condaminea* have been mossed, in order to test the value of this process when applied on a large scale. All our species of chinchona, with the exception of *Cinchona lancifolia* and the Pitayo-barks, have produced abundance of seeds; these have been extensively distributed, and large numbers of plants are now produced from seeds. The weather during the past year has been most favourable for planting operations; we have had rain during every month of the year, except February. Our frost has not been severe, and done no damage whatever to the plants.

As suggested by Mr. Broughton, a number of trees have been manured with guano, sulphate of ammonia, and stable-manure, in order to ascertain what effect these manures have upon the secretion of alkaloids. The bark of the *Cinchona pahudiana* has very much improved in appearance. The *Cinchona lancifolia*, received from Java, flourishes well in this climate, and promises to be a very valuable species; this plant has somewhat the habit of *Cinchona officinalis*, but is of slower growth.

II. *Propagation.*—During the present year our stock of plants for filling up failures has been entirely raised from seeds; some of these have been successfully grown when sown in open beds and shaded with fern only. The more valuable species are now propagated by cuttings, such as the lanceolate-leaved variety of *Cinchona officinalis*, *Cinchona lancifolia*, and some of the more valuable of the yellow barks. The number of plants of these kinds were, on the 31st of March, as follow:—

Lanceolate-leaved variety of *C. officinalis*	1,563
Cinchona lancifolia	279
Pitayo-barks	123
The varieties of yellow bark	52,395
Total	54,360

III. *Cultivation.*—The system of cultivation described in previous reports has been carried out without variation in our operations of this season. All the species of chinchona have been found to thrive best when planted in the open; when the plants are first planted, they are protected for about a year with turf, wood, or fern. The plants originally planted as an experiment under the shade of living trees have made unsatisfactory growth, especially where the shade has been dense. During this season we therefore found it necessary to destroy the forest trees by depriving them of their bark.

IV. *Results obtained by private planters.*—Chinchona cultivation, as a private speculation, has, during the last two years, made very little progress in this district; the value of estates, whether of tea, coffee, or chinchona, have fallen greatly in the market, and become almost unsaleable: thus there is no inducement to speculators to invest their capital in these undertakings. Among the plantations which are still maintained may be mentioned Deva Sholah, the largest private plantation in Southern India, and next in extent to this the Ossington Estate, which contains nearly 400 acres of promising young chinchona plants. Among smaller estates, those of Mr. James Morgan, Dr. Colvin Smith, Colonel Scott, Captain Jennings, Colonel Fyers, and Mr. R. F. Phillips, deserve mention. A large quantity of our chinchona-seeds have been sent to private planters in the Himalayas and Ceylon, where private plantations appear to be making considerable progress.

V. *Chinchona, new varieties.*—Perhaps the most valuable variety in our possession is the lanceolate-leaved sort of *Chinchona officinalis*, from which Mr. Broughton has procured the unprecedented quantity of quinine, 10·13 per cent. of the weight of the bark. This variety is being propagated as rapidly as possible, and plants have already been distributed to private planters on the Neilgherries; also to Mr. Clark, Acting Superintendent, Chin-

chona

chona Plantations, Bengal; and to Mr. Thwaits, Superintendent, Chinchona Plantations, Ceylon. These plants have yielded a few seeds, from which we have raised a number of seedlings; but as the seeds may or may not possess the properties of the parent plant, they have been kept separate. To perpetuate this plant in a manner so as to secure all its qualities, it can only be increased by cuttings, layers, or grafting.

The Pitayo barks, received from Mr. Cross during last year, have now been increased to 123, and we trust that during the present season we will be able to increase the varieties of this very valuable species to at least 1,000 plants. Some of the varieties of this species have the appearance of a hybrid between the red and crown barks; they are all rich in alkaloid, and appear to be hardy, and well suited to this climate. The new variety of *Chinchona calisaya*, presented to the Indian Government by Mr. Howard in the autumn of 1867, has now been increased to 1,300 plants; it is one of the most robust and free-growing of all the varieties of calisaya, and in consequence is a great acquisition to our collection. Of the plants raised from the calisaya seeds procured from Mr. Money, three of the varieties are very free-growing and hardy. Mr. Broughton has procured from the bark of these young plants 4·53 per cent. alkaloids. Among our crown-barks we have this year discovered a very interesting and apparently a new species, with soft downy leaves and a rough corky bark, but deficient in alkaloid. This plant was raised from the original seeds introduced by Mr. Cross, through Mr. Markham, and must have been gathered by accident. The hybrids raised from the seeds produced here have not attained a sufficient age to pronounce authoritatively upon the quality of the bark. The plants, however, are highly ornamental, some of the varieties very robust and free-growing, and no doubt may ultimately prove of value.

VI. *Formation of Alkaloids.*—This subject has been fully treated in the able reports of Mr. Broughton, the Government Quinologist, and it only remains for me to notice the very interesting fact that the yield of alkaloid in our barks still continues to increase with the age of the trees. Another fact noticed in my Report of the 27th April 1867—namely, that trees with "abundant and luxuriant foliage always yields more alkaloid than trees "with spare foliage;" also, that "trees with foliage freely exposed to light and air, "while their stems are under dense shade, are rich in alkaloids"—seems to be fully established by subsequent experience, and indicates a course of inquiry which may prove both interesting and profitable.

VII. *Establishment.*—I have much pleasure in being able to report the willing co-operation and the zeal with which my assistants have carried out the various duties entrusted to their care. Mr. Jamieson, the deputy superintendent, has now been 17 months in the country, and has, during that time, had charge of the gardens and the propagating establishment. Mr. Dawson, assistant superintendent in charge of Neddivattum, has carried out the various works connected with this plantation to my entire satisfaction. Mr. Rowson, the assistant superintendent in charge of Dodabetta Plantation, has taken a considerable interest in carrying out the operations entrusted to his charge. The head overseer, S. Narrainsawmy Naidoo, has been placed in charge of the Hooker and Wood Plantation under Mr. Dawson. In the office establishment, Mr. M'Nair, the office manager, has given every satisfaction in the performance of his duties.

VIII. *Progress of operations.*—No new buildings have been erected during the past year, the principal work performed being the completion of the roads, drains, and pitting of the Napier Estate at Neddivattum, and finishing the planting at Dodabetta. The establishments have been principally occupied in filling up failures and maintaining the plantations.

IX. *Botanical Gardens.*—During the present year no new works have been undertaken in the Botanical Gardens. Some very interesting plants, however, have been introduced and cultivated. The quinoa, a plant of great economic value, has been successfully cultivated in the gardens, and the seeds thus produced were distributed by the Commissioner to the native cultivators, and the plant is now pretty extensively grown throughout the district. The dry Burmese paddy, or rice, the seeds of which were kindly furnished to me by Captain Seaton, the Conservator of Forests, British Burmah, has been grown in the garden, but not successfully, the climate being apparently too cold. Among economic plants which grow luxuriantly may be mentioned the jalap, scammony, rice-paper plant of China, and the New Zealand flax. Our plants of the ipecacuanah still continue stunted and of unsatisfactory growth; I therefore took the opportunity of forwarding by Mr. Broughton two plants to Mr. Ferguson, the Assistant Conservator of Forests of Nelamboor. We are indebted to Mr. E. B. Thomas, late collector of this district, for seeds of numerous European trees and shrubs, as also for plants of the true olive, currants, and other fruit trees; to Major Beddome we are indebted for numerous new ferns and orchids; to Colonel Denison, for a fine collection of ferns and rose-cuttings; and to Mr. Deschampe, for a very select collection of ornamental flower-seeds. The various species of Japanese trees and shrubs, introduced in 1867, continue to grow well. Many of the more valuable and handsome species have been propagated to a considerable extent.

The

The following Table shows the distribution of plants and seeds from the garden for 1869-70:—

Months.	Fruit-trees.	Timber-trees.	Flowers and Shrubs.	Packets of Seeds.	Amount.
					Rs. a. p.
April - 1869 - - -	2	200	246	90	124 4 –
May - „ - - -	- -	604	194	98	129 14 –
June - „ - - -	40	650	338	187	202 4 –
July - „ - - -	80	412	449	187	198 6 –
August - „ - - -	10	72	156	487	147 5 –
September „ - - -	- -	220	286	272	127 6 –
October - „ - - -	108	301	595	234	247 12 –
November „ - - -	7	2	655	113	142 – –
December „ - - -	- -	158	390	54	127 8 –
January - 1870 - - -	- -	25	38	20	15 13 –
February - „ - - -	12	- -	639	16	16 2 –
March - „ - - -	- -	2,040	135	79	106 7 1
Total Distribution - -	259	4,684	4,121	1,837	1,585 1 1

X. *Tea plantation.*—The tea plantation has not been further extended, but a large number of the more valuable varieties of the Assam and Chinese tea have been raised from cuttings, as only by this method of propagation can the qualities of the parent plant be perpetuated.

XI. *Freshwater fish.*—The experiment of acclimatising and breeding European freshwater fish has been most successful; the trout, tench (the common sort, and also the beautiful golden German variety), rudd, carp, gold and silver fish, are all increasing rapidly and making very satisfactory growth; we may, therefore, shortly hope to be able to stock the rivers of the district with these valuable fish.

Concluding remarks.—The extent of land having been planted to which the Government limit their operations in chinchona cultivation, the principal work now to be done is to maintain the plantation, to plant out annually a few acres of our recently introduced and more valuable varieties, and to collect the harvest of bark. In concluding this report, I beg to tender my gratified acknowledgments to the Madras Government for the liberal support they have given in bringing this national undertaking to its present satisfactory condition; to Mr. J. E. Howard, for his valuable contributions; and to Mr. Clements R. Markham, of the India House, for the active interest he has taken in the development of chinchona cultivation.

Ootacamund, 16 May 1870.

APPENDIX (A.)

SANCTIONED ESTIMATE COST of each CHINCHONA PLANTATION

PARTICULARS.	SUPERINTENDENT AND OFFICE ESTABLISHMENT.				NURSERY DEPARTMENT.				DODABETTA PLANTATIONS.				
	1860 to 1867.	1867-68.	1868-69.	1869-70.	1860 to 1867.	1867-68.	1868-69.	1869-70.	1860 to 1867.	1867-68.	1868-69.	1869-70.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	
Establishment, including salaries, &c.	42,151	8,804	8,672	8,532	23,945	4,684	3,636	2,516	40,154	8,044	4,284	2,760	1
Buildings	–	–	–	–	4,000	100	250	800	10,660	1,600	1,950	700	2
Tool and store-rooms	–	–	–	–	–	–	–	–	700	100	50	50	3
Coolies' quarters	–	–	–	–	–	–	–	–	900	200	200	–	4
Felling	–	–	–	–	–	–	–	–	2,850	–	1,000	–	5
Clearing and weeding, &c.	–	–	–	–	–	–	–	2,834	2,630	1,000	3,000	5,800	6
Pitting	–	–	–	–	–	–	–	–	3,250	500	1,000	–	7
Carriage of plants	–	–	–	–	–	–	–	–	1,700	700	500	300	8
Planting and shading	–	–	–	–	–	–	–	–	1,950	700	500	250	9
Trenching	–	–	–	–	–	–	–	–	3,208	–	100	–	10
Inclosing	–	–	–	–	756	–	–	–	6,000	–	150	–	11
Road-making	–	–	–	–	–	–	–	–	2,825	–	250	150	12
Tools	–	–	–	–	400	200	200	150	3,525	200	300	300	13
Contingencies	95	100	200	250	1,596	200	500	400	3,799	1,000	800	600	14
Clothing	–	–	100	60	100	30	50	50	150	100	100	80	15
TOTAL	42,246	8,904	8,972	8,842	30,797	5,214	4,636	6,750	85,201	14,144	14,184	10,990	16

PARTICULARS.	SUPERINTENDENT AND OFFICE ESTABLISHMENT.				PROPAGATION AND NURSERY DEPARTMENT.				DODABETTA PLANTATIONS.				
	1860 to 1867.	1867-68.	1868-69.	1869-70.	1861 to 1867.	1867-68.	1868-69.	1869-70.	1860 to 1867.	1867-68.	1868-69.	1869-70.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	
Establishment, including salaries, &c.	40,069	8,116	8,449	8,373	23,346	6,832	3,152	2,430	25,093	6,380	4,355	2,549	17
Buildings	–	–	–	–	12,229	660	280	680	15,638	3,200	767	676	18
Tool and store-rooms	–	–	–	–	–	–	–	–	450	200	–	30	19
Coolies' quarters	–	–	–	–	–	–	–	–	1,058	350	157	–	20
Felling	–	–	–	–	–	–	–	–	4,207	–	361	–	21
Clearing and weeding, &c.	–	–	–	–	–	–	–	1,000	3,578	1,160	4,300	5,000	22
Fitting	–	–	–	–	–	–	–	–	5,492	1,011	2,567	–	23
Carriage of plants	–	–	–	–	–	–	–	–	1,785	1,330	140	60	24
Planting and shading	–	–	–	–	–	–	–	–	4,686	1,163	360	150	25
Trenching	–	–	–	–	–	–	–	–	3,400	289	70	–	26
Inclosing	–	–	–	–	–	548	–	–	4,707	590	40	–	27
Road-making	–	–	–	–	–	–	–	–	6,295	644	120	50	28
Tools	–	–	–	–	170	70	204	50	3,204	350	1,280	150	29
Contingencies	250	–	222	200	1,533	170	320	300	4,077	989	280	250	30
Excavating	–	–	–	–	–	–	–	–	450	644	–	–	31
Clothing	–	–	64	67	–	54	75	43	–	120	80	50	32
Various	–	–	–	–	–	–	352	–	–	1,900	310	–	33
TOTAL	40,319	8,116	8,785	8,640	37,278	8,334	4,383	4,503	84,090	20,329	15,167	8,960	

Ootacamund, 16 May 1870.

APPENDIX (A.)

from Commencement of Operations to 31st March 1870.

	NEDDIVUTTUM PLANTATIONS.				PYKARA PLANTATIONS.				MAILKOONDAH PLANTATIONS.				TOTAL.
	1861 to 1867.	1867-68.	1868-69.	1869-70.	1862 to 1867.	1867-68.	1868-69.	1869-70.	1863 to 1867.	1867-68.	1868-69.	1869-70.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
1	70,300	17,120	4,872	2,928	20,471	3,036	1,440	1,800	12,945	4,376	1,320	660	2,99,450
2	14,630	2,500	2,000	1,500	3,530	–	400	700	4,325	200	400	300	50,545
3	650	250	100	80	975	200	100	50	675	100	50	40	4,170
4	3,000	200	300	–	1,300	150	100	–	950	–	70	–	7,370
5	7,700	–	1,500	–	3,950	500	1,500	–	7,930	300	1,000	–	28,250
6	7,550	1,500	4,000	8,800	3,650	500	3,000	4,900	1,700	100	2,000	4,000	56,964
7	8,300	500	2,000	–	2,600	500	1,000	–	1,700	300	1,000	–	22,650
8	3,200	1,000	500	400	1,000	150	500	350	350	100	200	150	11,160
9	3,250	1,000	500	450	2,500	150	500	350	100	100	200	150	12,650
10	6,000	–	200	–	9,950	–	100	–	1,792	–	50	–	21,400
11	5,850	–	300	–	1,500	–	200	–	1,825	–	50	–	17,531
12	2,970	–	356	300	2,600	–	200	150	3,108	–	50	50	13,102
13	4,382	400	400	350	2,382	180	200	150	2,441	100	100	100	20,460
14	6,934	1,600	1,000	2,500	3,396	300	300	450	1,896	400	200	300	20,815
15	200	200	150	150	50	70	50	70	50	100	50	50	2,000
16	1,45,016	26,270	18,178	17,458	59,854	5,736	9,590	8,970	41,807	6,176	6,740	5,790	5,02,485

	NEDDIVUTTUM PLANTATIONS.				PYKARA PLANTATIONS.				MAILKOONDAH PLANTATIONS.				TOTAL.
	1861 to 1867.	1867-68.	1868-69.	1869-70.	1862 to 1867.	1867-68.	1868-69.	1869-70.	1863 to 1867.	1867-68.	1868-69.	1869-70.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
17	54,888	15,861	5,993	2,532	7,509	1,686	1,132	1,419	5,692	2,163	670	480	2,39,213
18	18,404	2,117	1,024	900	1,683	87	773	620	2,182	375	426	100	62,821
19	1,469	–	35	50	845	–	20	20	300	–	–	20	3,419
20	3,650	–	309	–	1,900	–	240	–	250	–	125	–	8,019
21	7,863	720	1,244	–	5,750	436	1,350	–	3,251	101	1,600	–	26,283
22	5,600	1,614	9,882	7,686	5,697	408	5,902	4,000	2,865	597	4,087	3,000	66,376
23	7,651	859	6,465	–	2,955	660	2,632	–	1,728	856	1,984	–	34,860
24	3,811	849	129	80	1,215	264	125	60	150	441	140	50	10,629
25	4,877	1,078	330	200	915	426	344	150	250	445	294	100	15,768
26	6,491	–	151	–	2,000	35	30	–	400	175	–	–	18,041
27	3,490	887	90	–	1,629	156	40	–	1,050	–	30	–	13,257
28	5,457	100	70	100	3,066	275	30	50	2,199	90	32	50	16,628
29	3,757	441	1,300	300	2,950	50	700	100	1,350	81	500	50	17,057
30	5,722	978	460	450	1,160	207	257	190	610	190	150	116	19,081
31	1,195	–	–	–	–	–	–	–	–	–	–	–	2,289
32	– –	159	100	80	–	38	80	40	–	35	40	10	1,135
33	– –	2,250	326	–	–	200	190	–	–	235	60	–	5,823
	1,33,725	27,913	27,908	12,378	39,274	4,928	13,845	6,649	22,227	5,784	10,138	3,976	5,57,699

W. G. McIvor, Superintendent,
Government Chinchona Plantations.

Appendix (B.)

Meteorological Observations from 1st April 1869 to 31st March 1870, made on the Government Chinchona Plantations at *Neddivattum*.

MONTHS.	Monthly Mean of Dry Bulb Hygrometer.				Monthly Mean of Wet Bulb Hygrometer.				Minimum observed during the Month.	Rainfall.			
	7 a.m.	2 p.m.	6 p.m.	Daily Mean.	7 a.m.	2 p.m.	6 p.m.	Daily Mean.		Inches.	Cents.	Days With Rain.	Days Without Rain.
April 1869	63·23	74·60	69·70	69·17	56·80	65·40	62·06	61·02	58 00	1	35	4	26
May „	62·48	75·12	60·77	69·12	64·38	67·54	64·12	65·34	59·66	5	41	17	14
June „	59·26	64·63	59·56	61·18	54·83	62·03	59·66	59·14	51·66	20	03	25	5
July „	59·45	61·61	55·48	58·84	58·48	63·32	57·58	59·76	56·57	32	54	28	3
August „	59·06	65·70	60·96	61·90	57·90	64·03	59·96	60·63	56·29	18	29	30	1
September „	59·10	66·43	62·20	62·91	64·36	63·56	59·70	62·54	56·20	12	77	26	4
October „	56·74	62·25	63·09	60·69	53·96	59·39	56·06	56·47	52·00	–	07	1	30
November „	57·63	61·96	59·40	59·66	54·20	58·03	56·10	56·11	52·13	–	63	5	25
December „	57·16	69·87	64·38	63·80	53·48	58·93	55·12	55·84	52·70	–	–	–	31
January 1870	51·70	63·03	56·67	58·13	54·70	59·64	54·83	56·39	52·06	–	..	–	31
February „	56·21	75·92	60·53	67·22	53·39	62·67	54·67	56·91	48·00	–	–	–	28
March „	55·16	71·22	65·05	63·81	52·06	59·16	56·00	55·74	44·35	1	28	5	26
Total	–	–	–	–	–	–	–	–	– –	92	37	141	224
Annual Mean	58·09	67·69	63·23	63·03	56·54	62·05	58·08	58·87	53·40	–	–	–	–

Ootacamund, 16 May 1870.

W. G. McIvor,
Superintendent of Government Chinchona Plantations.

Appendix (C.)

Meteorological Observations from 1st April 1869 to 31st March 1870, made at the Government Gardens, *Ootacamund*.

MONTHS.	Monthly Mean of Dry Bulb Thermometer.				Monthly Mean of Wet Bulb Thermometer.				Maximum observed during the Month.	Rainfall.			
	7 a.m.	2 p.m.	6 p.m.	Daily Mean.	7 a.m.	2 p.m.	6 p.m.	Daily Mean.		Inches.	Cents.	Days With Rain.	Days Without Rain.
April 1869	57·00	72·05	61·70	63·58	53·20	60·90	57·20	57·10	79·28	4	54	8	22
May „	58·05	71·26	61·53	63·61	55·32	62·37	58·21	58·63	73·90	6	37	16	15
June „	55·67	02·29	56·33	58·10	54·54	60·00	56·62	57·05	65·22	5	41	24	6
July „	54·36	62·73	56·77	57·95	54·14	60·09	55·82	56·68	65·22	4	91	23	8
August „	55·41	64·88	57·35	59·21	54·65	61·71	56·53	57·63	68·67	4	82	20	11
September „	54·91	66·39	56·83	59·38	54·09	62·13	55·61	57·28	69·11	2	37	16	14
October „	53·92	65·29	56·79	58·67	52·79	60·71	55·21	56·24	68·87	5	38	8	23
November „	52·18	62·41	54·41	56·33	51·00	58·59	53·05	54·21	65·79	4	44	15	15
December „	53·30	67·00	55·57	58·62	49·91	59·30	53·65	54·29	69·73	3	28	12	19
January 1870	53·41	66·65	55·59	58·55	47·41	57·82	50·53	51·92	70·92	–	53	3	28
February „	52·29	70·93	56·79	60·00	45·57	57·14	49·86	50·86	73·35	–	–	–	28
March „	55·11	69·44	58·06	60·87	51·00	60·94	53·50	55·15	74·21	2	25	5	26
Total	–	–	–	–	–	–	–	–	– –	44	30	150	215
Annual Mean	54·63	66·78	57·31	59·57	51·97	60·14	54·65	55·59	70·36	–	–	–	–

Ootacamund, 16 May 1870.

W. G. McIvor,
Superintendent of Government Chinchona Plantations.

Enclosure 2, in No. 1.

From the Commissioner of the Neilgherries to the Secretary to Government, Revenue Department, Fort Saint George; dated Ootacamund, 14th Sepember 1870, No. 46.

I have the honour to forward the report of the Superintendent Government Chinchona Plantations for the half-year ending 31st July 1870.

2. I regret the delay in forwarding the report, but the very unsatisfactory result of the half-year's propagation rendered necessary a reference to the Superintendent, whose reply, dated 10th September, I enclose.

3. In my letter to Government of the 5th March, No. 18, forwarding the previous half-yearly report, I stated, on the authority of the Superintendent, that since the receipt of the Government Order, 9th November 1869, No. 2,936, attention had been devoted to the Lanceolate-leaved *C. Officinalis* * and the *C. Pitayensis*, and that they were being propagated as fast as possible.

* The valuable variety discovered by Mr. Broughton.

4. I regret to say, by the return now forwarded, that this appears not to have been the case. None of the Officinalis, only 161 of the Pitayo, and 1,500 of the Calisaya varieties, have been propagated during the half-year—a highly unsatisfactory outturn, considering that there are six propagators on the establishment.

From the Superintendent Government Chinchona Plantations to the Commissioner of the Neilgherries; dated Ootacamund, 10th September 1870, No. 225.

In reply to your letter of the 23rd ultimo, No. 162, I have the honour to inform you that 1,661 Chinchona plants of the most valuable kinds have been propagated during the half-year ending 31st July last—viz., 161 of Pitayo, and 1,500 of the best Calisaya varieties. This result is certainly unsatisfactory. Mr. Jamieson has hitherto had charge of the propagation of the Pitayo and Lanceolate-leaved Chinchonas, and I regret the want of success in the management of these plants now renders it necessary to remove the propagation from under his care.

2. With reference to paragraph 2 of your letter under reply, I beg to inform you that the 3,500 plants were planted out on the Pykara and Neddivuttum Plantations. All these plants were of the valuable Calisaya varieties.

Report of the Number, Distribution, and Condition of Chinchona Plants on the *Neilgherries*, for the Half-year ending 31st July 1870.

Species.	Botanical Names.	Commercial Names.	Number of Plants.	Value per Lb. of Dry Bark in the London Market.
				s. d. s. d.
1	C. Succirubra	Red bark	1,215,963	2 6 to 8 9
2	C. Calisaya C. Calisaya Frutex C. Calisaya Vera	Yellow bark	41,895	2 10 „ 7 –
3	C. Officinalis. C. var. Condaminea C. var. Bonplandiana C. var. Crispa	Original loxa bark Select crown bark Fine crown bark	1,183,159 87,509 4,355	2 10 „ 7 – 2 10 „ 7 – 2 10 „ 6 –
4	C. Lancifolia	Pitayo bark	279	1 8 „ 2 10
5	C. Nitida	Genuine grey bark	2,786	1 8 „ 2 9
6	C. Species without name	Fine grey bark	8,500	1 8 „ 2 10
7	C. Micrantha	Grey bark	46,730	1 8 „ 2 9
8	C. Peruviana	Finest grey bark	3,389	1 8 „ 2 10
9	C. Pahudiana	Unknown	426	– Unknown.
10	C. Lanceolate-leaved variety of C. Officinalis.	Seedlings Rooted cuttings	1,100 463	– – ditto.
11	C. Pitayo, from the seeds sent by Mr. Cross.	Seedlings Rooted cuttings	196 88	– – ditto.
		Total Number of Plants	2,596,887	

TABLE showing the Growth of the different Species of Plants planted out in the Plantations, for the Half-year ending 31st July 1870.

No. of Plants.	Species.	Where Planted.	When Planted.	Maximum Growth.	Average Growth.	Height of the tallest Tree.	Girth near the Ground.
				Inches.	*Inches.*	*Feet.*	*Inches.*
12	C. Succirubra - -	Neddivuttum -	30 Sept. 1862	23	14	26	34½
12	C. Micranthra - -	- ditto - -	„ „	18	13	24½	26
11	C. Officinalis - -	Dodabetta -	„ 1863	16½	8½	18½	13½

TABLE showing the Propagation, Distribution, &c. of Plants and Seeds during the Half-year ending 31st July 1870.

DATE.	Total Number of Plants Propagated.	Total Number permanently Planted out.	Total Number of Plants distributed to Private Individuals.	Total Quantity of Seeds distributed.
February 1870 - - - - -	—	—	—	—
March „ - - - - -	340	—	—	—
April „ - - - - -	201	- - -	- - -	6
May „ - - - - -	450	- - -	108	—
June „ - - - - -	300	1,200	524	2
July „ - - - - -	310	2,300	—	—
	1,661	3,500	632	8
Previously - - - - -	2,505,176	1,148,424	178,605	295
GRAND TOTAL - - -	2,596,837	1,151,924	179,237	303

REMARKS.

The number of plants permanently planted out in the plantations is 3,500, making the total 1,151,924.

The increase by propagation is 1,661, the monthly average being 277, making the total 2,596,837.

The number of plants distributed to private individuals is 632, giving the total distribution of 179,237.

Eight ounces of Chinchona seeds have also been gratuitously distributed, making the total 303 ounces.

Ootacamund, 18 August 1870.

Enclosure 3, in No. 1.

ORDER of the Government of Madras, 21st December 1870.

THE Commissioner of the Neilgherries, in submitting Mr. McIvor's report for 1869–70, testifies generally in favour of the results attained during the year, but, on the other hand, calls attention to the serious decline of the Mailkoondah plantation, the state of which contrasts most unfavourably with the outlay expended on it.

2. The expense of the plantations has varied considerably: the Pykara estate having cost 215 rupees, the Dodabetta plantation 346 rupees, and that at Neddivuttum 448 rupees per acre; but the cost of the Mailkoondah plantation (562 rupees per acre) has exceeded that of all the rest. The cause of this large excess and of the unsatisfactory condition of the estate should be explained. The Government do not now consider it expedient to incur any further expense on the Mailkoondah plantation; but they wish to have Mr. McIvor's opinion as to the best mode of utilising the outlay already incurred, and to be informed what

what extent of land has been cleared and prepared for planting. Mr. McIvor should also explain why the buildings have not been kept in repair.

3. The Government regret that in another important respect the results of the year have not been satisfactory. In his letter dated 14th September 1870, No. 46, Mr. Breeks remarks on the very unfavourable results of propagation during the half-year ending 31st July 1870; and, in addition to this, he observes that "none of the Officinalis, only 161 of "the Pitayo, and 1,500 of the Calisaya varieties have been propagated during the half-year "referred to."

4. The Government regret the unsatisfactory nature of this report, and they are unable to account for Mr. McIvor's non-compliance with the marginally noted orders, in which it was enjoined that the planting of red-bark trees should be discontinued in favour of the varieties mentioned by Mr. Breeks. An early and full explanation should be sent in by the Superintendent.

Government Order, dated 19th June 1869.
Government Order, dated 9th November 1869.
Government Order, dated 22nd February 1870.

5. In other respects there is much that is encouraging to note regarding the state of the plantations. The aggregate increase by planting out during the year was 254,367, and by propagation 17,526—the former number representing an increase of more than 100,000 over the number planted in the preceding year. The Government are gratified to learn that the trees are now sufficiently advanced to permit of the supply to the Government Quinologist of 100,000 lbs. of fresh bark per annum.

6. Last year his Excellency the Governor in Council recorded with satisfaction the fact that the lanceolate-leaved variety of *C. Officinalis* had yielded the then unprecedentedly large proportion of 9·75 per cent. of quinine. The yield of this bark of this variety has increased with its growth, and during the year under review has yielded 10·13 per cent., a result which fully justifies Mr. Broughton's anxiety that the propagation of the "lance-"olate-leaved *C. Officinalis*" should be extended.

7. Several experiments have been conducted during the year, in order to determine the conditions most favourable to the growth of chinchona; of these, the most important is the "mossing process," to which 6,000 trees have been subjected. Manuring the plants with guano, sulphate of ammonia, and stable-manure has also been tried. The results of all these experiments should be carefully noted and reported.

8. The extent of land originally sanctioned for chinchona-planting (1,200 acres) has now been fully occupied; but it is estimated that about 1,000 acres, adjoining the three out-lying plantations, are still available for the same purpose, if required. The Government do not consider it advisable that the plantations at Pykara and Mailkoondah should be increased in size, and any additions to those at Dodabetta and Neddivuttum must be limited to the cultivation of those varieties of chinchona the superiority of which has been and may hereafter be determined by Mr. Broughton's analysis. The Commissioner is requested to state the area of land available at Neddivuttum, and what expense will be involved in taking it up.

9. From Appendix A. of the Report, it appears that the actual expenditure on the chinchona plantations during the year under review was 45,106 rupees, being 13,684 rupees less than the Budget Estimate (58,790 rupees).

10. The report on the Botanical Gardens does not specify with sufficient distinctness the work which has been performed during the year under review. The freshwater fish introduced from Europe by Mr. McIvor have thriven, and largely increased in number. The lake at Ootacamund has already received a stock of them, and there is every reason to hope that some, if not all, of the different species will succeed in the Hill streams.

11. The Government approve of Mr. Breeks's suggestion that the Government gardens should, in future, form the subject of a separate report from that relating to the chinchona plantations, and that details of the nature of those adverted to by the Commissioner in paragraph 10 of his letter* should be inserted in it.

* Dated 28th May 1870.

Enclosure 4, in No. 1.

From the Government Quinologist to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 31st August 1870.

IN the following pages I have the honour to communicate some results obtained connected with the subject of the employment of the chinchona febrifuge in this country, also some statistical considerations having reference to the future yield of the plantations.

2. In the original instructions* I had the honour to receive from the Home Government, I am told (in paragraph 3) that it was required "to ascertain the preparation of the febri-"fuge which will combine cheapness with efficacy in the greatest degree" (and in paragraph 4), "and, finally, it will be expected from the chemist that he should, through his "investigations, enable Her Majesty's Government to arrive at a decision with respect to

* Letter from the Under Secretary of State, dated 22nd September 1866.

"the best and cheapest method of preparing the febrifuge for use among the labouring "classes of the natives of India. He will also be required to consider the questions "connected with the manufacture of the chinchona febrifuge for the use of hospitals and "troops in India."

3. In a report appearing in Proceedings of Madras Government, Revenue Department, No. 240, of 13th December 1867 (paragraph 10), I had the honour to propose a preparation which I then believed would combine the qualities desired in the febrifuge to be extensively used in this country. During the subsequent two years I prepared small quantities of this substance for medical trial in my experimental laboratory, and finding the results of its medical employment as encouraging as I expected from its composition, I commenced in January last to manufacture it on a larger scale in the small manufactory then just erected near the gardens at Ootacamund.

4. Up to the present date about 70 lbs. of this febrifuge have been prepared and supplied to the medical stores. As it consists of the alkaloids (mixed as they naturally occur in the plant) precipitated from solution in an uncrystallised but tolerably pure state, it has been appropriately named by Dr. Mackenzie "Amorphous Quinine," by which name I trust it may henceforward be called. The results of its actual medical use seem to have been very satisfactory. I learn from the Medical Inspector General that he intends to submit these results to Government, with his own opinion of the value of the febrifuge. On general grounds, I strongly recommend the extensive adoption of amorphous quinine as a febrifuge that appears to meet the full requirements of the case; but it is of course on the medical testimony to its qualities that the decision must finally rest. I now await the opinion and directions of Government on this point.

5. I find that the bark of *C. Succirubra*, of which half of the plantations consist, is exceedingly well adapted for the preparation of amorphous quinine. I have had occasion in several foregoing reports to point out certain disadvantages which attach to this bark for the preparation of pure crystalline salts of the respective alkaloids. These do not, however, in the least affect the manufacture of amorphous quinine, while the large total yield of the bark renders it particularly suited to the extensive and cheap manufacture which it appears to me should be established on the Neilgherries. Hence, in all plans and considerations connected with the preparation of amorphous quinine, I shall only consider the bark of *C. Succirubra*. The bark of *C. Officinalis* will find its best application in the manufacture of pure crystalline sulphates of the alkaloids, either in this country or in Europe.

6. In order to produce as cheap a product as possible, it will be necessary to manufacture on the spot on which the bark grows. The cost of conveying the bark from Neddivuttum to Ootacamund and the price of fuel at the latter place entail so much expense, that there can be no question as to the expediency of working up the bark on the plantations themselves. The irregular and defective supply of bark has been the source of the main difficulty in carrying on the manufactory at Ootacamund. I reckon that when working at Neddivuttum, with a rough but effective "plant," with bark of mean quality, and preparing 800 lbs. of alkaloid per annum, the cost of the same (including that of the bark) will be about one rupee per ounce. A large outturn would still further diminish the price.

7. Having had in view, for some time the eventual manufacture of considerable quantities of amorphous quinine, I have taken some pains to estimate the amount of that substance in the red barks of the plantations. My estimations were made last spring, and depend on data given in Appendix:—

Number of Trees.	Age.	Bark.	Quantity of Alkaloids contained in Lbs.
	Years.		*Lbs.*
19,500	7½	Trunk	1,833
"	"	Branch	815
29,400	6½	Trunk	2,095
"	"	Branch	605
45,300	5½	Trunk	2,810
"	"	Branch	860
68,650	4½	Trunk	3,205
"	"	Branch	1,105
73,430	3½	Trunk	1,468
"	"	Branch	279
152,050	2½	Trunk	632
"	"	Branch	156
		Total	15,363

8. Thus

8. Thus at the present time the red barks alone of the Neilgherry Government plantations contain 15,000 lbs., or nearly seven tons, of a febrifuge which I learn is equal, or nearly equal, to ordinary quinine sulphate in efficacy. I cannot therefore think that it is premature to endeavour to prepare sufficient febrifuge to supply the hospitals and dispensaries during the forthcoming year.

9. In 1867 a considerable number of our oldest trees of red bark were cut down in order that the bark might be sent to England for sale. From the stumps have sprung vigorous shoots, that have at the present time attained a height of 12 to 15 feet. I recently collected a mean specimen of the bark of these shoots. Its analysis gave, in 100 parts of dry bark—

Total alkaloids	6·34
Quinine	1·37
Chinchonidine and chinchonine	4·97
Pure sulphate of quinine, obtained crystallised	1·14
" " chinchonidine, obtained crystallised	4·29

10. When it is considered that the shoots were but three years old, this analysis must be considered most satisfactory. It seems to justify the anticipation that coppicing will hereafter be an important means of cropping the plantations. This method has the further recommendation of furnishing excellent fuel without the necessity of destroying the sholahs. It appears to me to be very necessary that a considerable number of trees of seven years old should be cut down, in order that the method of coppicing should be tried, and the expenses, as compared with the plan of mossing, be accurately determined.

11. I will assume that after a tree aged eight years has been cut down, that the shoots, after a lapse of eight years, will produce as much bark as the original tree, an assumption that will not under any circumstances entail a great error. The number of growing trees of red bark on the plantations is about 591,600. If an eighth part of these be annually cut down, the bark of 73,955 trees will be annually available. This amount will yield no less than 10,323 lbs. of mixed alkaloids, a quantity which must be in considerable excess of any possible demand for febrifuge in this presidency. The same number of trees will yield 1,730 cwts. of dry red bark, of which about 1,400 cwts. would be fit for export. This latter amount would be about a seventeenth part of the quantity of bark annually imported from South America into England.

12. I conceive that the foregoing arithmetical considerations justify the conclusion that the extension of chinchona planting by Government has already reached its limit. From the returns of the plantations here there is a gross total of one and a quarter million of trees planted. The returns of the plantations in Bengal give 1,465,999 trees planted. In Java the returns give 1,532,148. The private plantations on these hills contain at least a million trees, and as many more may be certainly reckoned for the private plantations in the Himalayan valleys. I do not possess definite information of the numbers planted in Ceylon, but they number at least 250,000 trees. In Jamaica 70,000 trees, principally red barks, are planted, and flourishing exceedingly. At St. Helena, in 1868, 5,000 trees were planted, and it was expected in a year to have 20,000 planted. At Oratava, in Teneriffe, the cultivation is commenced with success. On the Organ mountains, in Brazil, the same success is attained. The only place where the cultivation has apparently been unsuccessful is at Chiffa, in Algeria, where the cold winds appear to have at length nearly extinguished the plants, originally supplied from this presidency.

13. Altogether, it may be estimated that 7,000,000 of chinchona trees are under cultivation in various parts of the world, and that the number is increasing annually. It appears, therefore, that unless it be to supply an urgent local want, there can scarcely be further necessity for Government pressing chinchona cultivation in other parts of this presidency. It is most desirable for the interests of the cultivation that the demand for bark be not exceeded.

14. It would be of considerable service if a probable estimate could be formed of the amount of febrifuge that would be consumed in this presidency if the price were reduced to one rupee the ounce. I am informed that the mean annual consumption at the Medical Stores, for the five years ending 31st March 1867, was 344 lbs. of quinine sulphate and [illegible] lbs. of chinchona bark, or, in round numbers, 475 lbs. of quinine sulphate altogether. I am informed* by some authorities that four times, and by others that 10 times, the amount would be consumed if the cost were reduced. It appears to me that it would be well worth while to endeavour to procure some definite information on this point before manufacture be commenced on an extensive scale.

15. If pure crystallised sulphate of quinine be prepared in this country, the *C. Officinalis* and *C. Calisaya* will be the fittest sources. I have hitherto made no attempt to manufacture pure sulphates, except on a small scale. The red bark, from the difficulty of

* I learn from the Medical Inspector General that the amount used last year was 700 to 00 lbs., and that the demand is annually increasing.

of purification, would be a comparatively costly source; and the trees of *C. Officinalis* are scarcely enough developed to take their bark except at a loss. I propose eventually to make use of the small manufactory at Ootacamund for an attempt at the preparation o pure sulphate of quinine from the crown-barks of the Dodabetta plantations, thougl whether this salt can be profitably made in this country there are at present no trust worthy experimental data to determine. The question will be attacked as soon as a supply of suitable bark is available; I am already in possession of fit apparatus for thi purpose.

16. On the presumption that the Report of the Medical Inspector General above mentioned, respecting the results of the employment of amorphous quinine, will be found satisfactory to Government, I have the honour to propose the following request:—

17. That I be permitted to expend all the savings I can effect out of my total sanctioned budget grant, in converting, as far as possible, the now-disused gaol at Neddivuttum into a suitable place for performing at least the preliminary extraction of the bark on the spot, in order to avoid the cost of carriage of bark to Ootacamund.

18. I would also advise that a certain number of trees of those planted in 1863 be cut down when the season of maximum yield arrives, in order to test practically the method of cropping the plantations by coppicing. I would also recommend that a considerable part of the best bark thus obtained be sent to England for sale in open market, and the remainder be worked up in the alkaloid manufactory. As soon as a sufficient amount of our admirable crown-bark is fit for cropping, I think that a supply should also be sent to the English market, as I am convinced that its good quality will give a reputation to the Indian chinchona barks.

19. In accordance with Government Order, No. 426, of 19th February 1869, a considerable number of trees were treated by Mr. McIvor's mossing process, in order that the practical and financial consequences might be determined on a sufficient scale. I presume, from the tenor of the various orders on the matter, that Government intend that I should examine and report on the results of the experiment. It appears to me that in order to arrive at a definite decision as to the practical value of the process, which will require an accurate consideration of the entailed expenses, the matter might be advantageously referred to a third person. I propose, therefore, that the various results be communicated to the Commissioner of the Neilgherries as they are obtained, who will thus be able to give Government an unbiassed opinion of the gross result, and who can be referred to on the occurrence of any difference of opinion in the conduct of the experiment. If Government think fit, I will, therefore, report on this subject to Mr. Breeks instead of to Government.

APPENDIX.

Data of Estimates concerning C. Succirubra.

Trees of the planting of 1862 yielded a mean per tree of 3·9 lbs. of trunk bark, containing 67·13 per cent. of water, and 4·6 lbs. of branch bark, containing 70·79 per cent. of water. Trunk bark dry contained 7·55 per cent. alkaloids; branch bark, 3·2 per cent. of alkaloids.

2. Trees of the planting of 1863 yielded a mean of 3·6 lbs. of trunk bark, containing 67·88 per cent. water, and 2·8 lbs. of branch bark, containing 71·87 per cent. of water. Trunk bark contained 6·23 per cent. of alkaloids in dry bark; branch bark, 2·63 per cent. alkaloids.

3. Trees of the planting of 1864 yielded a mean of 1·775 lbs. of trunk bark, containing 60·78 per cent. of water, and 1·3 lbs. of branch bark, containing 51·64 per cent. of water. Bark was allowed to get partially dry before weighing. Trunk bark contained, when dry, 7·33 per cent. of alkaloids; branch bark, 3·07 per cent.

4. Trees of the planting of 1865 yielded a mean of 2·66 lbs. of trunk bark, containing 73 per cent. of water, and 2·83 lbs. of branch bark, containing 75 per cent. of water. Trunk bark contained 6·49 per cent. alkaloids when dry; branch bark, 2·28 per cent.

5. Trees of the planting of 1866 yielded a mean of 0·84 lbs. of trunk bark, containing 66·94 per cent. of water, and 0·66 lbs. of branch bark, containing 73·68 per cent. of water. Trunk bark when dry contained 6·61 per cent. of alkaloids; branch bark, 4·96 per cent.

6. Trees of the planting of 1867 yielded a mean of 0·68 lbs. of trunk bark, containing 73·09 per cent. of water, and 0·37 lbs. of branch bark, containing 65·67 per cent. of water. Trunk bark contained 2·21 per cent. of alkaloids, and branch bark 0·81 per cent.

Enclosure 5, in No. 1.

From the Commissioner of the Neilgherries, to the Secretary to Government, Revenue Department; dated Ootacumund, 2nd September 1870.

I ENCLOSE replies from Messrs. Broughton and McIvor to the inquiries of the Secretary of State in his Chinchona Despatch, dated 19th May 1870, No. 13, embodied in Proceedings of Government, Revenue Department, 11th July 1870, No. 27.

2. I requested the two gentlemen to record their opinions in the form of answers to the following queries:—

I. *What system of cropping the bark is the best?*

Two methods are proposed—firstly, barking the trees, and covering them with moss to induce a rapid reproduction of the bark; secondly, coppicing.

Mr. McIvor advocates the former. Mr. Broughton thinks that we have not yet sufficient data for deciding on the comparative advantages of the two methods, but he is "led "to hold the opinion that a great part of the Neilgherry and the whole of the smaller "plantations of Southern India will be advantageously treated as coppice."

3. The information we have at present with regard to either mode is scanty. Mr. Howard, in his Analysis Reports,* supports Mr. McIvor's statement that the yield of alkaloids is increased by the mossing process.

In one instance, however, he says: "The effect of the application of moss for a few "months to No. 2 (Succirubra) does not show, as compared with the original unmossed "bark of No. 3 (Succirubra), so much real advantage as might have been expected." †

And again, reporting on the third harvest of renewed bark (Succirubra), he remarks: "I hoped to obtain a larger produce than last time, but was disappointed in finding a "smaller amount of salts of quinine, namely, 6·15 per cent., against 8·45 per cent. in the "specimen of renewed bark from the same tree on which I had the honour to report in "February 1867." ‡

Mr. Broughton has reported that "the advantages of the mossing process applied to "this bark (red bark), makes itself at once evident to the worker by the readiness and "purity with which the sulphates crystallise." §

4. The experiments, however, from which these results have been deduced have been necessarily conducted on a very limited scale, and in all cases refer to the bark of young and individual trees only. Moreover, as yet we have no information of the cost of mossing, nor do we know what amount of bark can be annually taken from a tree without injury to its growth.

I need hardly say that I do not share in the summary condemnation of the mossing process expressed by Mr. Clarke in his report to the Bengal Government, dated 10th February 1870, paragraph 27. He says: "Dr. Anderson has decided, after no very "long experimenting, to have nothing to do with that process. About that decision "there is no second opinion at Rungbee. Any person may, however, quickly decide it "for himself in Calcutta."

That the value of the mossing process for India should be decided by an experiment in Calcutta seems to me a most eccentric proposal. Moss is abundant on the Neilgherries, and the process is undergoing a careful and systematic trial, in accordance with Government Order, Revenue Department, 9th February 1869, No. 426. Until the results are known it will be well to defer judgment.

5. Messrs. Howard and Broughton's reports point out, with regard to the yield of quinine, differences in the different varieties of chinchona, and in the same trees under different conditions.

Thus the percentage‖ of quinine in the Succirubra appears to decrease with age; this is not the case with the Officinalis. Again, "the yield of alkaloids varies greatly with "the vigour of growth, size of tree, and consequently with character of soil. The most "vigorous and quickly-grown trees yield a far richer bark than the more stunted ones of "the same age." ¶

These circumstances may have some bearing on the point under consideration, and may possibly render different methods of cropping the bark desirable with different varieties of chinchona and different plantations.

6. Between

---

* *See* Proceedings of Government, 27th September 1865; Mr. Howard's Report, 15th June 1864; Proceedings of Government, 31st October 1865; Mr. Howard's Report, 1st August 1865; and Proceedings of Government, 20th June 1867; Mr. Howard's Report, 4th February 1867.

† Mr. Howard's Report, 4th February 1867.

‡ Proceedings of Government, 8th August 1869; Mr. Howard's Report, 1st September 1868.

§ Proceedings of Government, 12th April 1867; Mr. Broughton's letter, 1st April 1867.

‖ Paragraph 7, Mr. Broughton's Report, 9th December 1869, in Proceedings of Government, Revenue Department, 22nd February 1870.

¶ Paragraph 6, Mr. Broughton's Report, 9th December 1869, in Proceedings of Government, Revenue Department, 22nd February 1870.

6. Between the two methods of cropping proposed, I take it the question to be determined is, whether an acre of land will yield more alkaloids in a given time under the mossing than under the coppicing system; and if so, whether the increased yield more than covers the increased expense.

7. I would suggest that a certain number of trees of the same age of each variety of chinchona should be treated on each of the two systems. The bark harvested under this experiment might be annually sent home and sold, for the reasons given in paragraph 12 under.

In four years it would be evident which of the two systems was the best, and the experiment would be of practical value to many who have embarked in chinchona cultivation.

8. The second question is, *whether the bark should be manufactured in India, or sent home for sale; or whether a portion should be sent home and a portion worked up on the spot?*

Mr. Broughton is entirely of opinion that the amount of febrifuge required for use in India should be manufactured in this country, because the expense of drying, powdering, conveying the bulky bark home, and importing the manufactured alkaloids, are thereby avoided; because the process of manufacture can here be simplified and cheapened by employing *fresh* bark, and by preparing the alkaloids in a cheaper form than that of crystalline sulphates; and because the necessary materials are as readily and, with the exception of sulphuric acid, almost as cheaply procurable here as in England.

Mr. McIvor is unable to give a decided opinion, but imagines that it would be more economical for Government to sell their bark and purchase the alkaloids than to manufacture them.

9. Both gentlemen recommend that Government should send into the home market a considerable quantity of bark, so as to enhance the reputation of the India-grown barks, and remove certain prejudices arising out of occasional peculiarities in their appearances which may at first interfere with their sale.

10. The Inspector-General of Her Majesty's Indian Medical Department (Dr. Mackenzie, C.B., C.S.I.) reports to me that the future yearly requirements of the Madras Presidency may be put at 700 or 800 lbs. of alkaloids. Allowing the same for Bombay, and double for Bengal and the North of India, some 3,200 lbs. of alkaloids will be required annually.

11. For the reasons alleged by Mr. Broughton, I am of opinion that it will be more economical to manufacture in India.

12. In the interests, however, of those who have embarked in chinchona cultivation, the Government may well send home, as suggested by Messrs. Broughton and McIvor, about 3,000 lbs. of bark annually to accustom home-buyers to the Indian product.

There is often a difficulty in establishing a demand for an article which, although intrinsically superior, differs somewhat in externals from what brokers and buyers have been long accustomed to.

In sending bark of the different varieties home for sale, the Government might do good service.

This, however, should only continue for three or four years, or until such time as Indian bark finds its way home from private sources, for under no circumstances should Government, as an exporter of bark, enter into competition with private planters.

13. The third question is, *should the plantations remain permanently in the hands of Government for the supply of quinine in the hospitals and the distribution of seed and plants; or should the plantations be sold, as in the case of the Government tea plantations?*

"Mr. McIvor thinks that Government having firmly established this cultivation should "dispose of their plantations, and leave the further extensions to private enterprise," for the same reasons that induced the sale of the Government tea plantations; and he states that private planters are now quite able to supply the demand for plants and seeds without the aid of Government.

Mr. Broughton thinks that Government should retain as much of their plantations as will supply a febrifuge in a cheap form and sufficient for their wants, because Government being a large consumer of the produce will thus obtain it most cheaply, and because Government can only secure for the masses a supply of febrifuge at the *cheapest* price by retaining control over all stages of its production.

14. Mr. Broughton remarks that the case of the Government tea plantations is not a parallel one, because Government are not large consumers of tea, and had no object in introducing its cultivation but that of developing trade and agriculture, whereas in the case of chinchona these objects are secondary to that of ensuring a cheap and indigenous supply of an important medicine.

In support of his opinion he gives an estimate of the plant and working expenses for manufacturing here, annually, 800 lbs. of amorphoses alkaloids.

He calculates that the cost of such alkaloids would be one rupee an ounce, that of imported quinine being at least three rupees.

15. It seems to me somewhat premature to decide *now* whether the Government should

retain the plantations permanently in their own hands and manufacture the alkaloids they want.

But, as far as I can see, I am of opinion that Government should retain possession of the plantations, at any rate for a considerable time longer, for reasons which I will give by-and-by; and by manufacturing for themselves they will, I think, for some years obtain their annual supply of alkaloids at a cheaper rate than if they imported them.

16. I am aware that it is seldom or never that Government can grow or manufacture so cheaply as private individuals, nor is the attempt generally desirable; but there are circumstances connected with the questions under consideration, which seem to me to make it exceptional. It is highly improbable that any alkaloid manufactory will be established in India except by Government. We have a gentleman on the spot, in the service of Government, whose scientific attainments excellently qualify him to introduce the manufacture; and, in my judgment, the most weighty argument for the Government retaining the whole process of production in their own hands will be found in the opportunity thereby afforded to the Government Quinologist for simplifying and cheapening the manufacture of an efficient febrifuge for the use of the population at large.

17. It is evident,* from the report of the Madras Chinchona Commission, that "the four alkaloids occurring in our barks are nearly equal in febrifuge power." If Mr. Broughton is successful in the preparation of a substance from them which can be conveniently administered, which is equal or nearly equal to quinine-sulphate in its medicinal effects, and which can be made so cheap as to be within reach of the million, the object of the introduction of chinchona cultivation into India, as described in the Secretary of State's Despatch, No. 27, 30th September 1875, will have been attained.

18. Still it may be said that Government, in the interests of the public, and for the furtherance of Mr. Broughton's experiments, might establish a manufactory, and yet sell their plantations, buying bark from private growers. This I am disposed to think will be the course ultimately taken. But for some time to come plantations will be wanted for the quinologist's experiments as to the influence of season, age, altitude, climate, and cultivation on the amount of alkaloids in the bark of the different varieties of chinchona.

The investigation of these and similar problems is of great moment and will take time to complete. The information when obtained will have an important effect in determining the conditions under which the various varieties of chinchona will repay cultivation.

19. No doubt the annual working expenses of the Neilgherry plantations have been heavy. To attain the object aimed at, namely, the introduction of chinchona into India, no expense has been spared; but the working charges now should be cut down to somewhat the same level as those on private estates, two or three extra hands being retained for propagation and for planting out more than, say, five acres of each new variety that may come to hand.

20. The fourth question is, *if you are of opinion that the plantations should be eventually sold, at what stage of their development should they be sold?*

Mr. McIvor thinks three or four years hence would be the best time to dispose of the plantations, when the youngest plants will be sufficiently established. Mr. Broughton is against the sale of the plantations, but thinks it possible that it may eventually be found that Government possess larger plantations than they require, and that it may be advisable to sell a part.

21. If it be determined to dispose of the plantations on the ground that Government have fulfilled their mission, and "firmly established chinchona cultivation in India,"† and that the further development of the industry may well be left to private enterprise, the mode, time, and place of sale most likely to fetch the best price have only to be considered.

†Mr. Mc Ivor's letter enclosed, para. 4.

The Government chinchona trees have this advantage, that their growth is in advance of all others, and their bark by being first in the market will go off at present high rates. This advantage will be lost if the bark is not sent home and the sale of the plantations is deferred for several years.

22. As explained in my letter‡ to Government, submitting the Chinchona Superintendent's annual report for 1869–70, I am of opinion that it is not worth while incurring any further expense on the Mailkoondah plantation.

‡ 28th May 1870.

Up to the 31st March 1870, 42,175 rupees had been spent on this plantation, of which 75 acres have been planted out.

I take leave to refer to paragraphs 8 and 9 of my letter above quoted.

If my suggestion with regard to the Mailkoondah plantation be approved, the remaining

* Mr. Broughton's Report, 28th November 1867; Proceedings of Government, Revenue Department, 13th December 1867.

ing plantations, which I would recommend the Government to retain possession of, all be situated within easy reach of each other, and would consist as follows:—

	Acres.
Dodabetta	375
Neddivuttum and Pykarrah	750
	1,125

23. I add some general remarks. At page 141 of M'Culloch's Dictionary I see it recorded that "the sum expended by the Indian Government in the purchase of this "valuable medicine (quinine) is stated to exceed five lakhs annually." Considering this, it seems to me that the main intention of the chinchona undertaking will be incompletely carried out, unless India be placed in a self-supplying condition. I consider it both politically and economically desirable that the febrifuge employed in this country should be supplied from internal sources, more especially if the chinchona undertaking be intended to have the effect of providing "an abundant supply of this febrifuge at so "cheap a rate as to be within the means of the population at large, the coolies employed "on works and private plantations, the small cultivators, their wives and families," as stated in the Secretary of State's Despatch above mentioned. I can see no probability of this intention being speedily realised, unless Government lead the way in every stage of production.

24. I ought to say that it was altogether at my instance that Mr. Broughton inserted in his report an estimate of the plant and working expenses for manufacturing some 800 lbs. of alkaloids annually.

I suggested this, not under the idea that the time had come for applying to Government to sanction such an outlay, but in order to have on record in some data towards forming an opinion as to the desirability of Government becoming by-and-by manufacturers of their own alkaloids.

Proceedings of Government, Revenue Department, 13th December 1867.

25. For the present I am quite of Mr. Broughton's opinion, as expressed in his report,* dated 28th November 1867, namely, that he should steadily persevere in his endeavours "to find a process which would yield the alkaloids in a state of sufficient purity by simple "means," "and to produce an efficient febrifuge which can be prepared by a method "which an ordinary apothecary would have little difficulty in learning to follow." Since January last he has already produced 70 lbs. of such a substance, and if this prove completely successful in the Medical Department, he can, as he suggests, "extend the manu-"facture, and, as opportunity offers, include that of crystalline sulphates."

26. Working steadily with this end in view, Mr. Broughton will, in the course of a year or two, be able to supply reliable data:—

(1.) As to the best mode of cropping the bark.

(2.) As to the most favourable conditions for the growth of the several varieties of chinchona.

(3.) As to the extent of plantations that will have to be retained by Government in order to supply the quantity of febrifuge they require.

(4.) As to the cost of establishing a Government manufactory equal to the supply of India's wants.

With reliable information before them on these points, it will be easy for Government to decide whether or no it be desirable to retain the plantations in their own hands, and to establish a manufactory at Ootacamund, or Rungbee, or elsewhere.

Enclosure 6, in No. 1.

From the Government Quinologist, to the Commissioner of the Neilgherries; dated Ootacamund, 8th August 1870.

I AM in receipt of your letter, No. 140, of 23rd July 1870, which reiterates the inquiries contained in the Despatch of the Secretary of State, which appeared in Proceedings of Government, Revenue Department, No. 27, of 11th July 1870. To these inquiries I have the honour to append answers to the best of my opinion and present knowledge.

INQUIRY I.—*What systematic course would you recommend with reference to procuring and utilising annually the very large quantity of febrifuge alkaloids stored in the bark of the trees?*

I am of opinion that our present experience has hardly been sufficiently matured to permit the laying down of a definite and unalterable system of cropping the plantations. There are two modes, on the results of whose trial the method ultimately adopted of harvesting will depend. These are, first, the method of mossing the trees, of taking the bark from the living tree, and allowing it to renew under moss, advocated by Mr. McIvor; second, the method of coppicing. The first of these methods has hitherto been carried

carried out on so small a scale that the best mode of [illegible] have not been ascertained. At my recommendation the Government [illegible] (No. 2453 of 22nd September 1868, and No. 426 of 19th February [illegible]) that a considerable number of trees should be *treated by moss*. This was done in May 1869 and following months, and the results obtained, together with the cost of the same, will furnish trustworthy data for determining whether the method of mossing be finally adopted. The method of coppicing appears a very suitable mode of cropping the plantations. In 1867 some hundred trees of *C. Succirubra* were cut down, in order that their bark might be sent to the English market. In the early part of this year the vigorous shoots that had sprung from the stumps had reached a height of 15 feet, and furnished bark of good quality. I am led to hold the opinion that a great part of the Neilgherry and the whole of the smaller plantations of Southern India will be advantageously treated as coppice. This plan offers the further advantage of supplying abundance of excellent fuel without encroaching on the sholas.

In a report to Government now under preparation, I propose to recommend that a considerable number of trees be cut down, in order to make a full trial of the coppice system.

It seems therefore to follow that it will be advisable to await a fuller experience before the exact and permanent method of taking the bark of the plantations can be decided. It will, however, be necessary, as I had the honour of showing in a late report (appearing in Proceedings of Government, No. 235, of 22nd February 1870) to avoid the months from May to November for taking the bark.

INQUIRY II.—*Should the bark be used in the manufactory at Ootacamund for the supply of hospitals in India, or should the bark be sent to the London market for sale, or should a portion be sent home and a portion be worked on the spot?*

I am entirely of opinion that the amount of febrifuge required for use in India should be prepared in this country. The grounds for this opinion are mainly economical, and are as follow:—The cost of drying and powdering the bark is dispensed with. The alkaloids are more readily and less expensively extracted from the bark while it is fresh. The cost of conveying the bulky bark to England and the importation of the manufactured alkaloids to India is avoided. The manufacture by Government of the alkaloids permits of a great reduction in the labour and consequent cost of manufacture by allowing of the preparation of a cheaper form than that of the crystalline sulphates. The necessary materials are as readily and, with the exception of sulphuric acid, are almost as cheaply procured in this country as in England. But I consider that Government could, if it be thought fit, act most usefully in reference to the private growers of chinchona by serving as a pioneer in the European market, accustoming it to the qualities of Indian barks, and thus overcoming certain prejudices which will arise from the different appearance occasionally presented by these barks as compared with the South American. Again, the qualities possessed by the crown-barks of these plantations are such as are highly prized by the home manufacturers of quinine, so that I think a considerable quantity should eventually be sent home, in order to enhance the reputation of India-grown barks. The febrifuge preparations employed in this country can be more advantageously made from the coarser *C. Succirubra*, since the authority of Government will avoid the influence of the *traditional* prejudice which exists in Europe against the alkaloids other than quinine which abound in the red barks.

INQUIRY III.—*Should the plantations remain permanently in the hands of Government for the supply of quinine in the hospitals, and the distribution of seeds and plants; or should the plantations be sold, as in the case of the Government tea plantation?*

I am decidedly of opinion that as much of the plantations as hereafter will be found necessary to provide febrifuge for the supply of the hospitals and dispensaries in India should be permanently retained in the hands of Government, as I understand it forms no part of the scheme of Government to make a profit by the direct sale of bark in opposition to the private growers. But Government are very large consumers of the direct product of the plantations, and in that capacity will obtain the product at less cost than if it passes through several hands before it reaches the Medical Stores, as would be the case were Government purchasers of the febrifuge, and not proprietors. It appears to me that the ultimate end of the chinchona undertaking, namely, that of supplying the febrifuge in the cheapest possible form to the ryots, will be only effected with certainty by Government having the complete control over all stages of its production. The case of the Government tea plantation is not a parallel one, since Government are not large consumers of tea, as they are of the products of the chinchona plantations. In the former the intention of the introduction of tea cultivation into India was the development of Indian agriculture and commerce; in the chinchona undertaking these are only accessories to the main object, which is that of obtaining a cheap and indigenous supply of the most important medicine employed in the country.

2. In order to justify the opinions I have ventured to state above, I beg to adduce a rough estimate, showing the relative cost of the febrifuge made on the spot, and that imported from Europe.

3. In carrying out the instructions I had the honour of receiving from the Home Government, I have paid much attention to the production of a febrifuge, for use in Indian hospitals and dispensaries, cheaper than the quinine sulphate. In the small manufactory at Ootacamund have been prepared, since January last, 70 lbs. of such a preparation, consisting of the mixed alkaloids precipitated in an amorphous but tolerably pure state. This has been largely used in dispensaries and hospitals, and with such success that I believe I am justified by the evidence in stating that it may nearly entirely replace the quinine sulphate hitherto employed therein. I now subjoin an estimate for the conversion of the now disused gaol at Neddivuttum into an alkaloid manufactory, and also estimate for the yearly cost of preparing 800 lbs. of amorphous alkaloids:—

	Rs.
Six large copper boilers	1,500
Eight large percolators	1,600
Setting of boilers and percolators	2,500
Sundry alterations in building	1,000
Sundry fittings	1,500
Water supply	350
Vessels	400
Presses	900
Stock of alcohol	900
Contingencies	500
Still for recovering and rectifying alcohol	700
Native mills for grinding, &c.	40
	Rs. 11,890

Yearly Expenses to produce 800 *lbs. of Alkaloids.*

I am informed by Mr. McIvor that the cost (*on the spot*) of red bark will range from 4 *d.* to 6 *d.* a pound. I adopt the higher price in the estimate, and reckon its mean yield at the low one of 4 per cent.:—

	Rs.
Bark	5,000
Cost of acid	600
„ lime	100
„ soda from native sources	150
Labour, 24 coolies: 12 at 8 *rs.*, 12 at 7 *rs.* per month	2,160
Superintendent's pay, at 100 *rs.* per month	1,200
Waste of alcohol	300
Fuel	720
Filters, bags, &c.	500
Contingencies	800
	Rs. 11,530

2. Dividing these yearly total expenses by 800, we get the cost per pound. Hence the cost of a pound of alkaloid is *Rs.* 14. 6. 7., or, reckoning interest at 5 per cent. on "plant," about one rupee per ounce.

3. The cost of quinine sulphate is not accurately known in this Presidency, the purchasers for the Medical Stores being effected in England. It cannot, however, be less, when brought to this country, than 3 rupees per ounce, and probably averages considerably more.

4. It is difficult to estimate accurately the amount of quinine that would be used in this Presidency when its cost is thus reduced, but it will certainly exceed 800 lbs per annum. A larger quantity would be prepared at a still less cost. I content myself with estimating the comparative costs of entirely indigenous and imported febrifuges of equivalent therapeutic value at one rupee and three rupees respectively per ounce.

INQUIRY IV.—*If you are of opinion that the plantations should be eventually sold, at what stage of their developement, that is, when do you think they ought to be sold?*

As I have stated above, I am not of opinion that the amount of plantations requisite to supply the febrifuge required in the Government dispensaries should be allowed to pass out of the hands of Government. But it is very possible that the whole of the plantations may not be required for this purpose. If this eventually be found to be the case (respecting which contingency I can offer no well-grounded opinion at present), it may be found advisable to sell a part; but this is, obviously, a matter that cannot be decided for several years to come.

Enclosure 7, in No. 1.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Neilgherries; dated Ootacamund, 5th August 1870.

I HAVE the honour to acknowledge the receipt of your letter, dated 23rd July 1870, calling upon me for an opinion upon the various points raised by the Secretary of State in his Despatch, No. 13, dated 19th May 1870.

2. With reference to the first point, namely, what systematic course should be adopted with reference to procuring and utilising the very large quantity of alkaloid stored in the bark of the quinine-yielding chinchona, I would recommend that the trees should never be cut down, except when absolutely necessary for the purpose of thinning the plantations. The leaves are the means by which a continuous supply of bark can be produced. The bark of an old tree may be removed, and in one year the reproduced bark will be richer in alkaloid than that which had been the growth of years. This process may be continued year by year, and without injury to the tree. Thus a never-failing supply of bark rich in alkaloid may be secured. The process under which this result may be obtained is, that which has before been brought to the notice of Government, and is generally known as my mossing process. By this process the bark may be removed annually from the trunk of the tree, also from the larger branches, and the reproduced bark of one year's growth will be richer in alkaloid and almost equal in weight to the original bark of seven or eight years' growth. Thus, a harvest may be annually obtained nearly equal in quantity and exceeding in value what would be got were the entire plantation cut down. In the latter case another valuable crop would not be obtained under seven or eight years, being the time required for the plants to grow to size to produce bark of value. Another advantage of this system would be, that only the very best and richest bark would be sent into the market.

3. With regard to the advisability, or otherwise, of Government manufacturing quinine from bark produced on their own plantations, I feel incompetent to give a decided opinion; but my impression is, that it will cost the Government as much to produce a given quantity of quinine or any equivalent alkaloid as they could purchase it for in the market. I imagine it would be more economical for the Government to sell their bark and purchase the manufactured article. To establish the value of our plantations, and to show the success which has attended the cultivation of chinchona in India, I think not less than 3,000 lbs. of bark should be sent this year into the home markets.

4. Adverting to the question whether the plantations should remain permanently in the hands of Government or not, it appears to me that Government, having firmly established this cultivation, should dispose of their plantations, and leave the further extension to private enterprise. The distribution of seeds and plants from Government plantations is no longer necessary, as private planters who have largely entered upon this cultivation now produce plants and seeds to an unlimited extent, and in this respect are quite independent of Government aid.

5. The reasons that rendered it advisable for Government to dispose of their tea plantations after having established teas as a product of India will, I think, be found to bear with equal force in the present instance.

6. Should Government decide to dispose of their plantations, it appears to me that the time for so doing with safety would be in three or four years hence, when our youngest plants will be sufficiently established to be out of reach of all danger, and the more valuable species recently introduced would also be firmly established.

7. With reference to your concluding paragraph, I have issued strict injunctions that the instructions contained in paragraph 4 of the Secretary of State's Despatch shall be carried out.

Enclosure 8, in No. 1.

From the Superintendent of the Chinchona Plantations, Ootacamund to the Governor of Madras; dated Madras, 26th January 1871.

WITH reference to our conversation this morning, I have the honour to observe that, in my opinion, it would be desirable not to incur any further expenditure on the Upper Chinchona plantation at Mailkoondah, as this plantation is yearly injured by frost.

2. The chinchona plants in the lower plantation are making very satisfactory growth, and it appears to me that it would be desirable to maintain this plantation, and fill up the vacancies for the next two years, when the plants will be sufficiently established to make head against the natural growth of weeds and jungle.

3. The cost of maintenance need not exceed 400 rupees annually.

Enclosure 9, in No. 1.

No. 91.—ORDER of Madras Government, 7th February 1871.

THE Government proceed to dispose of the papers recorded above, which relate to the maintenance of the existing chinchona plantations, and the extent to which the manufacture of quinine is to be carried on in this Presidency.

2. In the first recorded letter Mr. Broughton proposes:—

(1.) That he be authorised to expend the savings from the sanctioned budget grant for his establishment in converting the disused gaol at Neddivuttum into a suitable place for the manufacture of "amorphous quinine."

(2.) That a certain number of the trees planted in 1863 be cut down, in order to test the method of "coppicing" the plantations.

*G. O. (Public), 11th Jan. 1871, No. 29.

3. The propriety of adopting the first proposition hinges on the value of "amorphous quinine," on which point the report* of the Inspector General, Indian Medical Department, dated 21st December 1870, is so favourable that the Government have no hesitation in adopting Mr. Broughton's proposal, and authorising him to carry it out, provided that the building in question can be spared for the purpose, on which point the Commissioner will report.

4. A provision of 7,280 rupees has been made in the Budget for 1871-72 for converting and fitting up the building, and any expenditure on the work which it may be desirable to incur in the short remaining period of the current official year can doubtless be met from savings.

5. It is satisfactory to learn that so considerable a per-centage of quinine is yielded by shoots from the stumps of trees which have been felled; and in order that the value of the quinine so obtained may be tested, as also with a view to the early introduction into the English market of the Indian-grown barks, the Superintendent of the Chinchona Plantations will be directed to fell a moderate number of trees at the proper season, the bark of which Mr. Broughton will prepare for shipment to England.

6. The Government have already decided not to incur any further expense on the *extension* of the Neilgherry chinchona plantations, and further operations in regard to chinchona will be confined to the maintenance of the existing plantations, and the introduction of such superior varieties as may from time to time be discovered both on the Neilgherries and in those districts which offer suitable sites for the purpose. They are, however, inclined to believe that the Government Quinologist has under-estimated the demand for quinine which is likely to exist when the price is considerably lowered. It must be remembered that the drug at present fetches a scarcity price, and that even in India, where its effects have been experienced, the bulk of the people are altogether unacquainted with it.

7. In accordance with the request contained in paragraph 19 of Mr Broughton's letter, the Commissioner will be requested to test by a careful examination of results the value of the "mossing process," and submit his opinion to Government.

8. The Commissioner's letter, dated 2nd September 1870, No. 42, in which are enclosed letters from Messrs. McIvor and Broughton, supplies information on the points indicated by the Secretary of State's Despatch, dated 19th May 1870, No. 13, calling for a report on the course to be adopted with reference to the Government plantations and the manufacture of quinine. Mr. Brecks has dealt thoroughly with the question, and it is unnecessary to review in detail the subject-matter of his communication, which embraces the suggestions of Messrs. Broughton and McIvor. It will be forwarded to the Secretary of State, whose reply will influence the future position of the State in regard to the Dodabetta and Neddivuttum plantations, and the export or manufacture of quinine.

9. However the main question of the relative merits of State control and private enterprise may be hereafter decided, the Government are desirous of effecting a sensible reduction in the charges of the Neilgherry chinchona plantations. The actual expenditure of 1869-70 was 47,055 rupees, the budget-estimate for the current year was 45,400 rupees, and that sent in by the Superintendent for 1871-72 is 39,100 rupees. The Government desire to see the annual expenditure still further reduced, and, as a step in this direction, the Commissioner of the Neilgherries will be called on for a report as to the prospect of being able to effect a sale on reasonable terms of both the Mailkoondah plantation (which he has recommended should be sold), and *also the plantation at Pykarra*—an arrangement which would still leave 825 planted acres available for State purposes. Should he be of opinion that a sale cannot be effected on terms which the Government ought to accept, *he will consider the* expediency of abandoning the upper portion of the Mailkoondah plantation altogether, and of filling up with chinchona plants and fencing in the lower portion of that plantation and the Pykarra tract, and allowing them to develope as chinchona copses or forest, stopping all further expenditure on them, save such as may be necessary for fencing and watching them, and for collecting the bark. He will submit his opinion on these suggestions at an early date.

10. Ordered, that the following letter be despatched to the Secretary of State:—

(Here enter Letter No. 6, dated 7th February 1871.)

See page 1.

— No. 2. —

(No. 7—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 14 February 1871.

We have the honour to state, for the information of your Grace, that we have permitted Mr. Broughton, Government Quinologist, whose term of engagement with the Home Government, namely, three years, had expired, to continue in office, on the understanding that he is not to resign it without giving six months' notice, except in case of sickness or other urgent emergency, to be explained to our satisfaction.

We have, &c.
(signed) *Napier*, &c.

— No. 3. —

(No. 10—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 28 February 1871.

In continuation of our Despatches, dated 21st March 1870 and 7th February 1871, Nos. 7 and 6, we have the honour to forward, for your Grace's information, the accompanying tabular report on the progress and condition of the chinchona plantations on the Neilgherries, for the half year ending 31st January 1871.

We have, &c.
(signed) *Napier*, &c.

Enclosure in No. 3.

From the Commissioner of the Neilgherries, to the Secretary to Government, Revenue Department, Madras; dated Ootacamund, 15th February 1871.

I have the honour to forward the chinchona report for the half-year ending 31st January 1871.

2. Plants 13,994 have been propagated during the half-year, viz.:—

Of C. lanceolata - - - - -		259
„ calisaya - - - - -		12,986
„ pitayo - - - - -		749
		13,994

3. I see no object in propagating more calisayas if these 12,986 plants are all of one variety. I shall address Messrs. Broughton and McIvor on the subject on their return from Bengal.

REPORT on the Number, Distribution, and Condition of Chinchona Plants on the Neilgherries, for the Half-year ending 31st January 1871.

Species.	BOTANICAL NAMES.	Commercial Names.	Number of Plants.	Value per Pound of Dry Bark in the London Market.
				s. d. *s. d.*
1	C. succirubra	Red bark	1,215,963	2 6 to 8 9
2	C. calisaya C. calisaya frutex C. calisaya vera	Yellow bark	54,881	2 10 to 7 -
	C. officinalis	—	—	—
3	C. var. Condaminea C. var. Bonplandiana C. var. Crispa	Original loxa bark Select crown bark Fine crown bark	1,183,159 87,509 4,355	2 10 to 7 - 2 10 to 7 - 2 10 to 6 -
4	C. lancifolia	Pitayo bark	279	1 8 to 2 10
5	C. nitida	Genuine grey bark	2,786	1 8 to 2 9
6	C. species without name	Fine grey bark	8,500	1 8 to 2 10
7	C. micrantha	Grey bark	46,730	1 8 to 2 9
8	C. Peruviana	Finest grey bark	3,389	1 8 to 2 10
9	C. Pahudiana	Unknown	425	Unknown.
10	C. lanceolata-leaved variety of C. officinalis	Seedlings Rooted cuttings	1,100 722	- ditto. - ditto.
11	C. Pitayo raised from imported seeds		1,033	- ditto.
	C. Pitayo plants brought out by Dr. Simpson		76	- ditto.
	TOTAL Number of Plants		2,610,907	

TABLE showing the Growth of the different Species of Plants planted out in the Plantations, for the Half-year ending 31st January 1871.

Number of Plants.	SPECIES.	Where Planted.	When Planted.	Maximum Growth.	Average Growth.	Height of the Tallest Tree.	Girth near the Ground.
				Inches.	*Inches.*	*Feet.*	*Inches.*
12	C. succirubra	Neddiwuttum	30 Sept. 1862	14	9½	26½	37
12	C. micrantha	ditto	30 „ „	15	12	25½	27½
12	C. officinalis	Dodabetta	30 „ 1863	32½	16	19	14

TABLE showing the Propagation, Distribution, &c. of Plants and Seeds during the Half-year ending 31st January 1871.

DATE.	Total Number of Plants propagated.	Total Number permanently planted out.	Total Number of Plants distributed to Private Individuals.	Total Quantity of Seeds distributed.
				Oz.
August 1870	375	- -	- -	8
September „	540	- -	- -	5
October „	1,020	- -	- -	3
November „	2,335	- -	- -	3
December „	3,780	- -	30	- -
January 1871	5,944	- -	- -	- -
	13,994	- -	30	19
Plants received from England	76	—	—	—
Previously	2,596,837	1,151,924	179,237	303
GRAND TOTAL	2,610,907	1,151,924	179,267	322

REMARKS.—The number of plants permanently planted out in the plantations is ,151,924.

The increase by propagation is 13,994, the monthly average being 2,332, making the total 2,610,907.

The number of plants distributed to private individuals is 30, giving the total distribution of 179,267.

Nineteen ounces of chinchona seeds have also been gratuitously distributed, making the total 322 ounces.

Ootacamund, 9 February 1871.

— No. 4. —

(No. 11 —Public.)

From the Secretary of State for India to the Government of Madras.

India Office, 27 April 1871.

My Lord,

1. I HEREWITH transmit a copy of a paper by Dr. De Vrij, the Dutch Quinologist, of a letter from Dr. De Vrij to Mr. Markham, and a circular, on the subject of the use of quinovin (or chinchona bitter) in the cure of dysentery.

2. The substance in question is one of the waste products of the chinchona plants, and it is very desirable that its alleged virtues should be investigated and reported upon by means of some such machinery as was used for testing and reported upon by means of some such machinery as was used for testing the relative values of the different chinchona alkaloids as febrifuges. Mr. Broughton will probably be able to supply a sufficient quantity of quinovin from the waste of his amorphous quinine manufactory, to enable the medical officers of your presidency to make the investigation, and I desire that I may be furnished with their report as soon as they have had time to form a reliable opinion on the subject.

I have, &c.
(signed) *Argyll.*

Enclosure 1, in No. 4.

From Dr. *J. E. De Vrij*, to *C. R. Markham*, Esq., dated Hague, 17 April 1871.

IN reply to your letter of the 14th instant, about the use of quinovic acid, I send you, with this post, two copies of a paper on this subject published by me about seven years ago. Since that time the use of this medicine has made great progress, and it is now recognised also in Europe as an excellent cure for dysentery and diarrhœa. When I returned from India, in January 1864, the manufacturers of quinine threw it away, but at my suggestion one of them, Mr. Limmer at Frankfort-on-the-Maine, introduced it into the trade, and since that time its use has been increasing. Last year, being on a visit in England, I found that it had also been introduced there, and I join to the copies of my paper an advertisement of a wholesale chemist in London to prove the use of it in England. Although I am not at liberty to contend that the quinovic acid is even *superior* to ipecacuanha, I am quite sure that its action on the peristaltic motion is similar to it, so that, referring to the scarcity and high price of ipecacuanha, the use of quinovic acid for the cure of a disease so common in India like dysentery deserves all attention. This is the more the case, as quinovic acid can be prepared in India at almost no cost. The leaves of all the chinchonas contain that acid; those of *C. succirubra* coniain in average a little more than one per cent. To prepare the acid from them, they want only to be pounded with the addition of a little slaked lime and water. This mixture is diluted with cold water, the liquid filtered, and the clear liquor precipitated by hydrochloric acid. Still cheaper would it be to use directly the filtered liquor which contains quinovate of lime. In this form every native would be able to prepare his own medicine, not only for dysentery, but also for slight attacks of fever.

Enclosure 2, in No. 4.

On the Use of Quinovic Acid (*Chinchona Bitter*) in Medicine, by Dr. *J. E. De Vrij.*

When I found, in 1859, that all parts of the different species of chinchona growing in Java contained quinovic acid, of which I detected in the wood of the roots of *C. calisaya* so much as 2·57 per cent., it appeared to me very probable that the tonic properties of some preparations of bark, particularly of an aqueous infusion, such as the *infusum corticis peruviani cum magnesia frigide paratum*, which formerly was frequently prescribed by many Dutch physicians, might be at least partially ascribed to quinovic acid. I therefore employed the wood of several dead chinchona plants at my disposal for the preparation of this acid, which, by order of the Governor General, was, at my request, experimentally tried by the medical staff of the army. The official report on these experiments was so favourable, that the chief of the medical staff, Dr. Wassink, requested a further supply, in order to continue the experiments on a larger scale. As I had no more material at disposal with which to prepare quinovic acid, I wrote to my friend Mr. A. Delondre, at Havre-de-Grace, who was kind enough to send me not less than five kilogrammes of the crude acid from his manufactory of quinine. Although my laboratory in Java was perfectly adapted for all kinds of chemical researches, the purification of such a quantity of a substance famous for its bulky volume gave me not a little trouble, but at length I succeeded in preparing two kilogrammes of quinovic acid sufficiently pure for medical use. This quantity was used by the medical staff of the army for experiments on a larger scale in the hospitals of Java and Sumatra. The general report on these experiments, the result of which was very favourable, has been sent by the chief of the medical staff, Major General Dr. G. Wassink, to the Governor General of Dutch India, under date 5th March 1863. It appears from this report, that the quinovic acid has been used in the hospital of the west coast of Sumatra in 65 cases of intermittent fever with or without complications, and in the great majority of cases with perfect success. In the hospital at Samarang it has been used with the same success in 45 cases, and it is with great satisfaction that I quote the following passage from the report respecting the experiments at Samarang:—

"The application of quinovic acid in diarrhœa and dysentery was made in consequence of the observation of its physiological action in diminishing the secretion of the intestines, which was attributed to a diminution of the peristaltic motion. In this aspect also the results were very satisfactory, and it is therefore a new property of the quinovic acid discovered, which agrees with the tonic properties which have been ascribed to it by Dr. de Vrij."

It appears, therefore, not only that my suggestion about the tonic properties of the quinovic acid is well-founded, but also that it is a remedy against intermittent fever I therefore venture the suggestion to use the leaves of chinchona in British India against jungle-fever, which is in many districts a real plague. If the leaves are collected in the different chinchona plantations, which can be done without great cost, a tincture could be prepared from them with *proof spirit*, in which menstruum quinovic acid is easily dissolved, but not chlorophyll and some other inactive substances. I have much expectation that the proper use of such a tincture as a prophylactic would prevent many cases of jungle-fever in the localities where they are endemic. As the manufacturers of quinine throw away every year some hundred pounds of a substance containing quinovic acid, there is abundance of material for further experiments. I have found, besides, that the so-called *naucleic acid*, discovered by Mr. C. Bernelot Moens, military pharmaceutist at Batavia, in a species of *nauclea*, is identical with quinovic acid; and as, according to my investigations, all the species of *nauclea*, which are plentiful in the forests of Java, contain this acid in their bark, we have here another source whence an abundant supply could be obtained.

The Hague, 23 April 1864.

Enclosure 3, in No. 4.

Quinovate of Lime.

The tonic properties of Peruvian bark are due to quinovic acid; this has been separated from the other constituents of the bark and combined with lime, forming a definite compound, and is offered with confidence to the medical profession as a valuable substitute for the vegetable tonic bitters in general use, which, according to the report * of Dr. G. Kerner, of Frankfort, the quinovate of lime far surpasses in efficacy; the same authority states that its use in large quantities does not produce congestion of the brain, which

* Zur Pharmacodynamik der Chinarinden-Bestandtheile und ihrer Praparate. Kliene Beitrage von Dr. G. Korner, n. Frankfurt a. M.

which has been known to occur when the nitrogenous quina alkaloids have been continuously administered in full doses.

Quinovate of lime has been given with great success in cases of diarrhœa and dysentery by Drs. Neufville and Wallach in the military hospital at Frankfort, and it is recorded that in Italy its administration in the early stages of cholera was attended with very satisfactory results. Dr. De Vrij, of the Hague, speaks very highly of its efficacy in dysentery as well as in ague, having observed its favourable effects in these maladies when superintending the introduction and acclimatisation of the Peruvian bark trees in Java.

When quinovate of lime is taken internally it is readily decomposed by the acids of the stomach, and can be administered in doses of two to eight grains every hour as a powder, mixed with a little sugar of milk or phosphate of lime, or in the form of solution; the latter has been found to be the most convenient form of exhibition.

Formula for Solution.

R. Calcis Quinovatis, 96 grains.
Pulv. Tragacanth, 10 grains.
Acid Phosph. Dil., q. s.
Aquæ, 6 ounces.

Rub together the quinovate of lime and the powdered tragacanth with the water, add the dilute phosphoric acid drop by drop, until the quinovic acid separates in a finely divided state, which may be recognised when the mixture has a slight acid reaction on litmus-paper, and assumes a gelatinous condition.

(*Dose.*—From one drachm to four drachms every hour.)

— No. 5. —

(No. 15, Public, of 1871.)

From the Secretary of State for India to the Government of Madras.

India Office, London, 29 June 1871.

My Lord,

I herewith transmit, for distribution among officers and others connected with chinchona cultivation, 100 copies of Dr. Weddell's recent paper on the classification of the chinchona genus, which I have caused to be translated from the French and printed; and 30 copies of Mr. Cross's report* on his recent mission to collect plants and seeds in the Pitayo chinchona forests in New Grenada.

*See Part I., page 37.

I have, &c.
(signed) *Argyll.*

— No. 6. —

(No. 17.—Revenue.)

From the Government of Madras to the Secretary of State for India.

Fort St. George, 4 April 1871.

My Lord Duke,

The Government Quinologist, in reporting the receipt by him, in May 1870, of the 4¼ tons of acid referred to in the Despatch of your Grace, dated 27th January preceding, No. 1, applied to us for a statement of the total outlay incurred in England on account of this acid, including its packing and freight to India. We have now the honour to request your Grace will cause us to be furnished with the information asked for by Mr. Broughton, which is necessary in order to calculate the cost to the State of the quinine manufactured in this country.

We have, &c.
(signed) *Napier*, &c.

— No. 7. —

(No. 17.—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 6 July 1871.

1. In accordance with the request conveyed in your Despatch in this department, No. 17, dated 4th April 1871, I forward for your information a statement of the cost of certain acids sent to Madras in February 1870, for the preparation of quinine.

2. I may add that these particulars were entered in the invoice of the "Surbiton," the vessel which conveyed the acids to Beypoor. The invoice in question was sent to the Accountant General at Madras on 17th April 1870.

I have, &c.
(signed) *Argyll.*

Enclosure in No. 7.

"Surbiton" S.S., February 1870.——Beypoor, *viâ* Suez Canal.

Civil Stores (Revenue), Madras.

Per Letter, No. 69, of 3rd December, and Indent 6th November 1869.

			s. d.	£. s. d.	£. s. d.
68	68 cases:				
	Acid, Sulphuric - - - lbs.	8,960	2	74 13 4	
	249 sealed bottles - - -	–	–	24 18 –	
	Acid, Hydrochloric - - lbs.	560	– 2	4 13 4	
	22 sealed bottles - - -	–	–	2 4 –	
	Whiting, for packing - - - cwt.	131	2 –	13 2 –	
	Cases - - - - - -	68	–	27 4 –	
	Freight paid in England - - - - - -			- - -	146 14 8
					18 8 8
				£.	165 3 4
	Freight payable in India - - - -			£. 36 17 6	

— No. 8. —

(No. 18—Public.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, 13 July 1871.

1. With reference to the Despatch of my predecessor, dated 9th May 1866, on the subject of the transmission of a supply of chinchona seeds, grown in India, to Mexico, I have now received an application for a second supply from the gentleman who was placed in charge of the cultivation by the late Emperor Maximilian.

2. I have to request, therefore, that you will direct Mr. McIvor to send to this office, for transmission to Mexico, parcels of well-developed ripe chinchona seeds, as soon as they are available.

I have, &c.
(signed) *Argyll.*

— No. 9. —

(No. 41—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 21 September 1871.

In continuation of our Despatch, dated 28th February 1871, No. 10, we have the honour to forward, for your Grace's information, the accompanying tabular report on the progress and condition of the chinchona plantations on the Nilgiris for the half-year ending 31st July 1871.

We have, &c.
(signed) *Napier*, &c.

Enclosure 1, in No. 9.

Report on the Number, Distribution, and Condition of Chinchona Plants on the Neilgherries, for the Half-year ending 31st July 1871.

Species.	Botanical Names.	Commercial Names.	Number of Plants.	Value per Pound of Dry Bark in the London Market.
				s. d. s. d.
1	C. succirubra - - - - -	Red bark - -	1,215,963	2 6 to 8 9
2	C. calisaya - - - - -	Yellow bark - -	54,881	2 10 to 7 -
	C. calisaya frutex - - - -			
	C. calisaya vera - - - -			
	C. officinalis - - - - -	—	—	—
3	C. var. Condaminea - - -	Original loxa bark -	1,183,159	2 10 to 7 –
	C. var. Bonplandiana - - -	Select crown bark -	87,509	2 10 to 7 –
	C. var. Crispa - - - - -	Fine crown bark -	4,855	2 10 to 6 –
4	C. lancifolia - - - - -	Pitayo bark - -	279	1 8 to 2 10
5	C. nitida - - - - -	Genuine bark - -	2,786	1 8 to 2 9
6	C. species without name - - -	Fine grey bark -	8,500	1 8 to 2 10
7	C. micrantha - - - - -	Grey bark - -	46,730	1 8 to 2 9
8	C. Peruviana - - - - -	Finest grey bark -	3,389	1 8 to 2 10
9	C. Pahudiana - - - - -	Unknown - -	425	Unknown.
10	C. lanceolate-leaved variety of C. officinalis - - - - -	- - - -	3,387	- ditto.
11	C. Pitayo raised from imported seeds	- - - -	4,339	- ditto.
	C. Pitayo plants brought out by Dr. Simpson - - - - -	- - - -	76	- ditto.
		Total Number of Plants - -	2,615,778	

Table showing the Growth of the different Species of Plants planted out in the Plantations for the Half-year ending 31st July 1871.

Number of Plants.	Species.	Where Planted.	When Planted.	Maximum Growth.	Average Growth.	Height of the Tallest Tree.	Girth near the Ground.
				Inches.	*Inches.*	*Feet.*	*Inches.*
12	C. succirubra - - -	Neddivuttum -	30 Sept. 1862	37	18	27½	37
12	C. micrantha - - -	- ditto - -	30 „ „	22	8	27	39
12	C. officinalis - - -	Dodabetta -	30 „ 1863	19	10	21	16

TABLE showing the Propagation, Distribution, &c. of Plants and Seeds during the Half-year ending 31st July 1871.

DATE.	Total Number of Plants propagated.	Total Nunber permanently planted out.	Total Number of Plants distributed to Private Individuals.	Total Quantity of Seeds distributed.
				Oz.
February 1871	530	- -	- -	4
March „	458	- -	- -	6
April „	623	- -	- -	3
May „	913	- -	- -	1
June „	1,092	1,250	- -	4
July „	1,255	800	- -	2
	4,871	2,050	- -	20
Previously	2,610,907	1,151,924	179,267	322
GRAND TOTAL	2,615,778	1,153,974	179,267	342

REMARKS.—The number of plants permanently planted out in the plantations is 2,050, making the total 1,153,974.

The increase by propagation is 4,871, the monthly average being 812, making the total 2,615,778.

No plants were distributed to private individuals during the half-year; the total therefore is the same as in last report, viz., 179,267.

Twenty ounces of chinchona seeds have been gratuitously distributed, making the total 342 ounces.

Ootacamund, 18 August 1871.

Enclosure 2, in No. 9.

From the Superintendent of the Government Chinchona Plantations, Ootacamund, to the Commissioners of the Nilgiris; dated Ootacamund, 23rd August 1871, No. 67.

IN reply to your letter of the 22nd instant, I have the honour to inform you that 2,050 chinchona plants were permanently planted out on the plantations during June and July last, viz., 1,250 of *C. calisaya* at Neddivuttum, and 800 of Pitayo at Dodabetta.

— No. 10. —

(No. 5—Forests.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 20 October 1871.

WITH reference to paragraph 4 of your Grace's Despatch, dated 28th December 1869, No. 36 (Public), we have the honour to forward, for information, the accompanying papers relative to the experimental cultivation of chinchona in the districts of Malabar, South Canara, Ganjam, Tinnevelly, and Madura.

2. In Wynaad (Malabar district), the growth of the tree is reported by the Conservator of Forests to be admirable, and he suggested its extended cultivation there by the formation of a large plantation in the vicinity of Manantoddy; but we did not adopt the suggestion, as our object in propagating the growth of chinchona, namely, its introduction into as many districts as possible, has already been attained in Wynaad, where the tree is grown by planters.

2 In

3. In the South Canara district a plantation was formed, in December 1869, at Nagodi, above the Koloor Ghaut; but it will be perceived, from our proceedings of 27th July 1871, No. 1,314, that the experiment there is not likely to be productive of very useful results.

4. On the Conservator's suggestion we have, in a recent order (16th January 1871, No. 109), sanctioned the formation of a small plantation in the Ganjam district, on the Mahendra mountain. The Khond Hills in that district were represented by Major Beddome to be unsuitable for chinchona cultivation.

5. In the Tinnevelly district no fresh experiments have been made in this cultivation. The proposal made by Mr. Stuart, in July 1869, for forming a plantation on the Kumeri clearing, near the Paupanassum garden, and which is adverted to in paragraph 2 of the Despatch under reply, has not been acted upon, as Major Beddome reported that the site was too much exposed. This officer proposed that a tract of virgin forest, to the west and north-west of the Paupanassum plantation, should be cleared for chinchona; but as the Tinnevelly District already possesses three chinchona-gardens, we doubted (Proceedings, 14th May 1870, No. 706, paragraph 4) the expediency of forming another, especially at the expense of valuable timber.

6. Of the result of the experiment on the Pulnies (Madura district) we have as yet received no information, and have called for a report on the subject.

7. Our proceedings, marginally noted, embody a letter from a Mr. Campbell relative to his chinchona plantations on the Siroomallays, and on the Lower Pulnies, in the Madura district; also a report from the Government Quinologist on a sample of succirubra bark forwarded to him by Mr. Campbell for analysis. 17 August 1870. 1 November 1870. 14 November 1870.

I have, &c.
(signed) *F. Haines*, &c.

Enclosure 1, in No. 10.

PROCEEDINGS of the Madras Government, dated 12th March 1870, No. 349, Revenue Department.

ABSTRACT.—*Chinchona Cultivation in the Hill Districts.*—Despatch from Home Government, reviewing reports on the results of various experiments for its introduction, with orders thereon.

In paragraph 2 of their Order of the 25th October, the Government, while stating that they were disposed to entertain favourably the proposal for further experiment, referred to Mr. Stuart's report as showing that the broad-leafed variety of chinchonas flourished at as low an elevation as 1,000 or 2,000 feet, and questioned the accuracy of the data on which Mr. Stuart's conclusions were based.

2. In paragraph 2 of their Order of the 12th March, Government request to be informed what has been done as to ascertaining the correct elevation. The Board have obtained from the late Sub-collector of Tinnevelly barometrical readings, recorded on the Tinnevelly Hills, which, after correction by the Government Astronomer, show that the elevation of the Chinna Kuluratti plantation is 2,727 feet, and that of the Kumari clearing on the Paupanassum Hills, alluded to by the Secretary of State, 2,777.

3. The plantation on the Paupanassum Hills is shown as 3,300, and that on the Peria Kuluratti Hill, where the plant failed from exposure, is 4,262.

4. The Secretary of State having now directed that the experiment should be carried on in the Kumari clearing, the Board have requested the Conservator to state what he proposes, and on receipt of his reply will again address Government on the subject. The month of July is the most favourable season for planting.

5. The Board are disposed to concur in the advisability of the experiment being further carried out by the Forest Department.

Enclosure 2, in No. 10.

From the Officiating Conservator of Forests, to the Acting Secretary to Government, Revenue Department; dated Madras, 28th March 1870, No. 2,016.

WITH reference to paragraph 2 of the Government Order, 12th March 1870, No. 349, I have the honour to inform you that the elevations of the sites in question have been ascertained by the Board of Revenue, from rough notes of barometrical readings taken by the late sub-collector; these, corrected (so far as the details admitted of) by the Government Astronomer, give the heights of various places as noted in the margin.

	Elevation in Feet.
Plantation at Perea Kuluratti	4,262
Plantation at Paupanassum Hills	3,360
Hill-tribe clearing on Paupanassum Hills	2,777
Plantation on Chinna Kuluratti	2,727

2. With reference to paragraph 3, I must inform you that any attempt at chinchona cultivation on the Khond Hills, in the Ganjam district, would be a complete failure. These hills have only an elevation of about 2,000 feet, but there is very sharp frost in December and January, which would prove quite fatal to the *succirubra*, and burning hot winds prevail in April and May, through which no species of chinchona could live; there would be far less chance of success in these localities than on the Nullay Mullays, in the Kurnool district, where we were unable even with the greatest care and attention to keep the plant alive through the hot weather. As far as I know, the only locality in this district where the tree could be grown is the Shola, near the top of the Myhendra mountain, a little to the south of Berhampore. The elevation of this Shola is between 4,000 and 5,000 feet, there are no hot winds, and the mountain is free from frost owing to its proximity to the sea (about 12 miles as the crow flies); the area is very limited, but a small plantation might prove of considerable interest and value in a scientific point of view.

3. There can be no doubt that all the different species can be successfully cultivated on the Pulnies, and all or most of them on the Shervaroys; but it is a question how far plantations in these localities are desirable, when the cultivation can be increased to any required extent on the Neilgherries and Pulnies under Mr. McIvor's supervision at a less expense. For the present I would only recommend small experimental plantations; it would, however, be desirable at once to introduce into both these localities plants of the new variety of *Lancifolia*, which has lately been found to yield such an immense percentage of quinine in comparison with all other species or varieties.

4. Beyond perhaps a few plants, as an experiment, I would not advise the formation of any plantations in South Canara. The crest of the ghauts is the boundary between this district and Mysore, so that plantations in South Canara would have to be opened out on the south-west face of the ghauts, and would be exposed to the full violence of the monsoon. The *succirubra* would grow very well in the Shola land over the crest of the ghauts (elevation about 3,000 feet); but, with the exception of a very small tract near Nagodi, this is all Mysore territory. There are very favourable localities about the head of the Andar Ghaut, and between that and Kig, and all along towards Naggur and the head of the Hossangady Ghaut. The Mysore Government might be recommended to open some plantations in these localities, and our Government might give assistance in plants and trained gardeners; the rainfall, soil, and other conditions of the localities alluded to are far more favourable than the site lately selected by the Mysore Government for a plantation on the Balarangams.

5. With reference to Tinnevelly, the Board of Revenue have called upon me to report what steps I propose to take for carrying out the suggestion of planting the hill-tribe's clearing below the present small plantation on the Paupanassum Hills. I have been on this clearing several times, in bursts of the monsoon, when the wind was so violent that I could hardly stand; it is too much exposed, I think, for a plantation, and it is well known how very difficult it is to raise trees on these Kumari clearings, where all the virtue has been taken out of the soil by several crops of ragee, &c. A plantation in this locality would start at great disadvantages; to the west and north-west of the present chinchona garden there is a very large tract of superb land for the purpose, all clothed with heavy forest, stretching away to the Ayen Coil Pass on the north, and to the Attraymallay on the west, and with an elevation of from 3,500 to 5,000 feet. All this tract belongs to Government, the Travancore boundary being close to the Attraymallay bungalow, at an elevation somewhat over 5,000 feet. If a plantation is to be opened, a site should be selected in this tract (avoiding only a western or south-western exposure), and the virgin forest should be felled. If the plant is to be propagated from seed, a brick and glass-house will be absolutely necessary, and an overseer and several gardeners should be trained under Mr. McIvor at Ootacamund. Nothing but failure can be expected without these preliminaries.

6. I request that you will let me know to what extent Government wish chinchona-planting to be carried out in this district, and whether it is to be under the supervision of my department or that of the collector. I shall be visiting the localities in question in July or August next, and might select sites if necessary.

7. I have

7. I have, on former occasions, mentioned how admirably the *succirubra* grows in the Wynaad, at an elevation of about 3,000 feet; a few plants are to be seen on most coffee estates, and at Goodalore, and Manantoddy and elsewhere; its extended cultivation at Manantoddy or elsewhere in Wynaad and in Coorg is well worth consideration.

ORDER of Madras Government, dated 14th May 1870.

THE Officiating Conservator of Forests now replies to Government Order, dated 12th March 1870, in which he was requested to supply information on certain points connected with chinchona cultivation. The attention of the acting collector of Ganjam is called to the opinion expressed in paragraph 2 of Major Beddome's letter, that the Shola near the top of the Myhendra mountain is the only place in the Ganjam district where the chinchona is likely to flourish, and Mr. Ellis is requested to report whether it would be feasible to form a small chinchona plantation there, and, if so, by what agency.

2. With reference to paragraph 3 of Major Beddome's letter, the Government observe that the chinchona has already been acclimatised on the Shervaroys, and that Mr. J. R. Arbuthnott has been directed to obtain a supply of plants for the Pulnies from Mr. McIvor. Acclimatisation on these hills having been effected, the Government consider that the extension of chinchona cultivation may be left to private enterprise.

3. With the exception of a small tract near Nagodi, Major Beddome does not consider the climate of the ghauts in South Canara adapted for the growth of chinchona. The Government observe that Mr. H. S. Thomas, in his letter, dated 26th July 1869, No. 941, expressed a similar opinion. Mr. Thomas has already been directed to place himself in correspondence with Mr. McIvor, as a preliminary step to the introduction of chinchona into his district; and as soon as the acting collector is prepared with a suitable establishment for the maintenance of a small plantation near Nagodi, the Government will authorise Mr. McIvor to supply him with plants or seeds, unless Mr. Webster is of opinion that the plantation might with advantage be entrusted to the Forest Department.

4. Paragraphs 1, 5, and 6 of Major Beddome's report relate to the Tinnevelly District, and in commenting on paragraph 3 of Government Order, dated 25th October 1869, No. 2,841, Major Beddome shows that the site selected by Mr. Stuart is too much exposed, and that the fact of its having been cleared for Kumari cultivation would operate unfavourably to the growth of chinchona. Major Beddome therefore proposes that a tract of virgin forest to the west and north-west of the existing plantation at Paupanassum should be cleared for chinchona. As the Tinnevelly district already possesses three chinchona gardens, the Government doubt the expediency of forming another, especially at the expense of valuable timber.

5. Major Beddome should explain at greater length his views as to the extended cultivation of chinchona in the Wynaad

---

Enclosure 3, in No. 10.

PROCEEDINGS of the Board of Revenue, dated 4th June 1870.

THE Board are not disposed to agree with Major Beddome as to the unsuitability of the Khond Hills for the cultivation of chinchona. They, however, entirely concur with the Government in thinking that when the experiments in acclimatisation now being made have been completed, the extension of this cultivation should be left to private enterprise.

Enclosure 4, in No. 10.

From the Conservator of Forests, to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Camp at Ootacamund, 15th June 1870.

WITH reference to paragraph 5 of the Government Order of the 14th of May 1870, I have the honour to inform you that I only wished to point out how admirably the chinchona-tree grew in Wynaad, in case its extended cultivation in this quarter might at any future time seem desirable; it is, however, probable that the area now under cultivation on the Neilgherries is sufficient. At the same time, I may draw attention to the fact that a large plantation in the vicinity of Manantoddy would be a great boon to the surrounding coffee districts in the Wynaad and Coorg, where fever is so very prevalent, and that fine sites are available both on bamboo land and heavy forest.

ORDER of Madras Government thereon, 8th August 1870.

THE Government observe that in propagating the growth of chinchona, their objec (with the single exception of the plantations on the Neilgherries) is not the formation c plantations, but the introduction of the tree into as many districts as possible. Thi object has already been attained in the Wynaad, where the tree is grown by planters.

Enclosure 5, in No. 10.

From the Acting Collector of Ganjam, to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Chetterpore, 2nd July 1870.

WITH reference to paragraph 1 of the Government Order of the 14th May last, I have the honour to report that it would be feasible to form a small chinchona plantation in the locality selected by Major Beddome, near the top of the Mahendra mountain, under the superintendence of the overseer of the Parlakimedy forests. This overseer, however, has no practical knowledge of the chinchona plantation, but, with the aid of the notes contained in the pamphlet on the propagation and cultivation of the medicinal chinchonas, he would, I think, be able to superintend the plantation. Should it be determined to form a plantation there, a large well will have to be sunk, as there is no water available close at hand, and a thick hedge made. Four gardeners will have to be employed, on a monthly salary of not less than four rupees each.

2. The zemindar of Mundasa has kindly promised me to procure the gardeners, and to take the steps for looking after the plantation, provided an experienced person be present until the operation of planting is over, and the gardeners have been instructed how to take care of the plants.

3. I doubt, however, whether in the end these detached plantations will not prove rather costly experiments; and I would respectfully suggest that the cultivation of the chinchona is more likely to be successful and remunerative when confined to the Neilgherries, and to the superintendence of those officers of Government whose skilled labour have proved how adapted its soil is to the production of this medicinal bark.

ORDER of Madras Government thereon, 18th August 1870.

THE Acting Collector is requested to state what will be the probable cost to Government of a small plantation at the spot referred to. It is important that the chinchona tree should be acclimatised in the Ganjam district.

2. Mr. Ellis will also convey to the zemindar of Mundasa the thanks of Government for his offer to maintain the plantation.

Enclosure 6, in No. 10.

From the Acting Collector of Ganjam, to the Secretary to Government, Revenue Department, Fort St. George; dated Chetterpore, 16th December 1870.

WITH reference to the Government Order of the 18th August last, I have the honour to submit an estimate showing the probable cost of maintaining a small plantation of chinchona on the Mahendra mountain, amounting in the aggregate to 200 rupees a year; the preparation, &c. of the ground will cost about 50 rupees.

2. On my asking the zemindar of Mundasa to inform me of the probable cost of reclaiming and hedging the spot selected by the overseer of the Parlakimedy forests, and of sinking a well, he informed me that the site selected by the overseer, which is situated at a distance of about a mile to the north of the bungalow erected by Mr. Forbes, and at present belonging to Mr. Carmichael, is a good one, but that there is no water close at hand; he therefore recommended the selection of another site at a distance of about half a mile to the east of the above-mentioned bungalow, a watercourse being not far off, which is not quite dry even in the hottest weather.

3. During my late tour to the southern portion of the district, I took an opportunity of visiting Mahendra; the spot recommended is in view of the bungalow, and has the advantage of a watercourse. Its extent is little over 4½ acres, being 160 by 140 yards; that selected by the overseer is nearly 4⅛, being 150 by 133 yards.

4. The presence of an experienced person is necessary, until the operation of planting is over, for the purpose of instructing the gardeners how to take care of the plants.

ESTIMATE showing the Probable Cost of forming a Chinchona Plantation on the Mahendra Mountain.

		Rupees.
Reclaiming and levelling the site		30
Hedging - ditto		10
Cost of tools, &c.		10
	Rs.	50

Annual Charges.

	Rupees.
Pay of four gardeners, at 4 rupees each per mensem	192
Sundries	8
Rs.	200

(signed) *George Ellis,* Acting Collector.

ORDER of Madras Government thereon, 16th January 1871.

As Mr. Ellis's report shows that a small chinchona plantation can be formed in the Ganjam district, at very light cost to Government, Mr. McIvor will at once place himself in communication with the acting collector, with a view to the despatch to the district of a sufficient quantity of both plants and seeds. Mr. McIvor will select the species of plants which he deems most likely to succeed in the locality.

2. Experience in other districts has shown that the chinchona tree can, in many localities, be acclimatised by the exercise of ordinary care, and the overseer of the Purlakimedy forests will doubtless be able to establish the plantation, with the aid of such advice as he may receive from Mr. McIvor and the acting junior assistant agent.

3. The Accountant General will report how the small necessary expenditure can be provided for.

Enclosure 7, in No. 10.

From the Acting Collector of South Canara, to the Acting Secretary to the Board of Revenue; dated Mangalore, 13th June 1871.

WITH reference to the Board's proceedings, dated the 7th March last, No. 728 (Miscellaneous), I have the honour to submit the report therein called for on the experimental cultivation of chinchona in this district.

2. In the month of December 1869 my predecessor, Mr. Thomas, in accordance with the arrangement sanctioned in paragraph 2 of the proceedings of Government, dated the 20th September 1869, No. 2,610, obtained from the superintendent of the Government plantations at Ootacamund 53 plants of the *Chinchona succirubra.*

3. The plants suffered a good deal in transit. They were sent to Nagodi as soon as received, and were planted, on the 27th December 1869, on a plot of land about 1¾ acre in extent, which had been previously selected and enclosed for the purpose. A gardener was entertained on a salary of 7 rupees per month, and the potail of the village was entrusted with the general care of the plantation.

4. Owing to the damage sustained by the plants in transit, several of them never showed any signs of vigorous life; but 38 survived transplantation, and, with the exception of two, which have since died, are now in a thriving condition.

5. The height and girth of the 36 plants which are now growing are as follow:—

Height.	Number of Plants.
6 feet high	1
5 ditto	20
4 ditto	15
Total	36

Girth.	Number of Plants.
4½ inches in girth	1
4 - - ditto	2
3¾ - - ditto	3
3½ - - ditto	10
3¼ - - ditto	2
3 - - ditto	11
2¾ - - ditto	5
2½ - - ditto	2
Total	36

6. The head assistant collector, who occasionally visits the plantation, informs me that while the plants are in as good condition as can be desired, the leaves suffer a great deal from a large green caterpillar. The gardener goes round daily and removes the insects, but in a large plantation it would be impossible to keep the caterpillars down in this way; and I intend, therefore, to send a specimen to the superintendent of the Nilgiri plantations, and to ask his advice as to the best method of preserving the trees from their attacks.

7. Besides the plants received from Ootacamund, four were obtained from Mercara, and put down on the same place in July 1870. Of these, three have survived transplantation, and are doing well, two of them being three feet high and one two feet. The girth of one is 1¾ inches, and that of the other two about two inches.

8. Some tea-plants were also put down, and are promising well. The height of Nagodi (about 2,500 feet) is, however, not sufficient for their successful cultivation.

9. The experiment has, up to the end of the last official year, cost *Rs.* 227. 3 *a.* 5 *p.* in wages of the gardener, and other sundry charges, the whole expenditure being defrayed from the Jungle Conservancy Fund.

Submitted to the Government with reference to paragraph 3 of Government Order, 14th May 1870, No. 706, Revenue Department.

2. As an experiment, the plantation at Nagodi seems to have done well; but the Board remark that Major Beddome, in his letter, recorded in the Government Order above quoted, advised that plantations should not be formed in South Canara, except as a mere experiment with a few plants.

Order of Madras Government thereon, 27th July 1871.

The experiment does not seem likely to be productive of very useful results. The collector will consider whether it is worth while to continue the employment of the gardener. The chinchonas could be entrusted to the potail, with the promise of an annual gratuity if they were well cared for. They are now nearly large enough to take care of themselves. Private individuals might also receive seed and plants in time.

Enclosure 8, in No. 10.

Extract from Proceedings of the Madras Government, Revenue Department, 11th October 1871.

In Government Order, 14th May 1870, the Government, in passing orders on a letter from the Conservator of Forests respecting chinchona cultivation in certain districts of this Presidency, remarked in paragraph 2 that "Mr. J. R. Arbuthnott has been directed "to obtain a supply of plants for the Pulnies from Mr. McIvor." No information has yet reached the Government of the result of this experiment, and they desire that the Conservator will place himself in communication with the Collector, and submit an early report on the subject for transmission to the Secretary of State.

Enclosure 9, in No. 10.

From *E. A. Campbell*, Esq., Madura, to the Acting Secretary to the Board of Revenue; dated Dindigul, 18th June 1870.

I send you to-day, for analysis by the Government Quinologist (should the Board deem the analysis worth making), the stem of a chinchona-plant (broad leaf), raised on the Siroomullay Hills, Madura District.

2. The tree was two years old, and stood 6½ feet high. I have an acre of chinchonas of the same age on the Siroomullays, and an acre on the Lower Pulneys.

3. As fever prevails on these ranges, I shall be much pleased to hear that the plant now sent yields a fair sample of quinine.

4. I should note that though the other trees are remarkably vigorous, and that the plant thrives well on both ranges of hills, the particular plant now sent was drooping when cut; something seemed to have injured its roots.

5. Should the Quinologist deem that the secretions of the bark have been injured from the above cause, I will send samples of vigorous and healthy trees.

6. I have grown the dhinchonas in "the open," merely planting them in pits 20 by 10, and leaving them to take their chance. Drought does not seem to have affected them in the least, though a few, which were watered for experiment, have attained a greater height and circumference than those not watered at all. Again, some watered to excess have failed entirely.

Order of Board of Revenue thereon, forwarded to the Government Quinologist, who is requested to favour the Board with his opinion of the bark.

2. The Collector of Madura will be requested to thank Mr. Campbell for his communication, and to ascertain from him, as nearly as may be, the respective heights of his two plantations.

3. A copy of these proceedings will be submitted to Government, with reference to Major Beddome's letter, No. 2,916, of the 28th March last. It will be observed that no forest appears to have been felled for Mr. Campbell's plantations.

Enclosure 10, in No. 10.

From the Collector of Madura to the Acting Secretary to the Board of Revenue, dated 19 September 1870.

Adverting to paragraph 2 of the Proceedings of the Board, dated 9th July 1870, I have the honour to state that the height of Mr. Campbell's chinchona garden at Periyar is 3,600 feet, and that on the Sirumalais 3,500 feet.

2. With reference to the remark of the Board in the latter part of paragraph 3, Mr. Campbell states that the former plantation was made on cultivated land, and the latter on forest.

Enclosure 11, in No. 10.

From the Government Quinologist, to the Acting Sub-Secretary to the Board of Revenue; dated Ootacamund, October 1870.

REFERRING to Proceedings of Board of 10th August 1870, I have the honour to report on a sample of *Chinchona Succirubra* bark received from the Collector of Madura.

2. The bark received was of a very immature description, and appeared mere scrapings of the bark of branches, or else of very young trees. Such bark would, in the English market, be worthless from its unpromising appearance. Its analysis gave, in 100 parts of dry bark—

Total alkaloids - - - - - - - -	2·53 per cent.
Quinine - - - - - - - - -	0·76 „
Chinchonidine and chinchonine - - -	1·77 „

3. These alkaloids yielded a fair amount of crystalline sulphates.

4. According to the high standard of Indian chinchona barks, I cannot consider the above a good result. In the case of the bark being (as it certainly appears) that of either trees two years old, or else of branches, the above analysis is tolerably encouraging, and equal to that of barks of same age grown in Wynaad or on the Shervaroys. A more careful collection will, however, be necessary, if it be proposed, at any subsequent time, sending it to the European market.

From the Government Quinologist, to the Acting Sub-Secretary to the Board of Revenue; dated Ootacamund, 22nd July 1870.

I HAVE had the honour to receive a parcel of chinchona bark, together with a copy of Proceedings of the Board of Revenue, No. 4,785, dated 9th July 1870.

2. The bark sent is of very inferior quality, and is apparently the product of an unhealthy tree. There will obviously be no interest in making an analysis of other than a normal specimen of the chinchona-bark of the Siroomullays. I therefore request that I may be supplied with one-third pound of the trunk-bark from at least three healthy trees. This might be collected and sent to me at once in the undried state, when I shall have much pleasure in making an analysis.

PROCEEDINGS of Board of Revenue, 10th August 1870.

COMMUNICATED to the Collector of Madura, in continuation of Board's Proceedings, dated 9th July 1870.

2. Mr. Arbuthnott is requested to ask Mr. Campbell to be so good as to send the bark required by Mr. Broughton, to enable him to make a satisfactory analysis.

— No. 11. —

(No. 12—Revenue Forests.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 20 December 1871.

1. I HAVE received and considered in Council your Excellency's Despatch, dated 20th October (No. 5) 1871, forwarding papers relating to the cultivation of chinchona plants in the various hill districts of your Presidency.

2. I observe with satisfaction that gardens have been successfully established on the Sherwaroy Hills and in Tinnevelly, while Mr. Campbell is taking pains to secure satisfactory results on the Lower Pulney and Siroomullay Hills, and is persevering with a steadiness of purpose which deserves to be rewarded by success. The healthy growth of the plants in the open grass-land called *patena* in Ceylon, seems to be an important feature in Mr. Campbell's experiment.

3. The district of Wynaad, owing to the very large annual influx of labourers from Mysore, and the prevalence of fever among them, is not in quite the same category as the frequented hill regions. I am of opinion that the circumstances of Wynaad give that district a special claim to assistance from your Government in establishing an adequate extent of chinchona cultivation. It is for your Government to decide whether this object may best be secured by forming a plantation in accordance with the advice of Major Beddome, or by encouraging the planters to cultivate chinchona on their own land. But the measure is one which should be supported by the influence of your Government, and, as I observed in my Despatch, dated 29th July 1869, all reasonable assistance should be extended to the Assistant Collector, or to private persons, who may be induced to exert themselves in furthering and extending the cultivation. I look upon the extensive cultivation of the febrifuge plants in Wynaad as a measure of great importance, not only to the inhabitants of the district, but also to the numerous class of labourers who annually resort to it from a distance, and I desire that I may be regularly informed of the progress of the cultivation, and of the actual localities where it has been undertaken.

I have, &c.
(signed) *Argyll.*

— No. 12. —

(No. 49—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 14 November 1871.

WITH reference to your Grace's despatch, dated 13th July 1871, No. 18, we have the honour to report that a case containing chinchona-seeds* from the Government plantation at Neddivuttum, Nilgiris, has been forwarded by steamer to the India Office for transmission to Mexico. Mr. McIvor's letter forwarding the seeds is enclosed.

We have, &c.
(signed) *Napier*, &c.

---

* Two packets of *Chinchona succirubra*, one packet of *Chinchona officinalis*, and one packet of *Chinchona Condaminea*. Proceedings of Government, 13th November 1871, Nos. 82, 83.

Enclosure in No. 12.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 24th October 1871.

WITH reference to the despatch of the Secretary of State for India of the 13th July last, No. 18, and the Order of Government of the 22nd August 1871, No. 1449, I have the honour to enclose four ounces of fresh-gathered seeds of *Chinchona Succirubra* and four ounces of *Chinchona officinalis* seeds. The other species will be forwarded for transmission to Mexico so soon as ripe seeds can be gathered.

— No. 13. —

(No. 36—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 21 August 1871.

WITH reference to the despatches marginally noted,* we have the honour to advise your Grace of the transmission to the India Office, by steamer, *vid* the Suez Canal, of twenty-one cases, received from the Commissioner of the Nilgiris, containing in all 3,188½ lbs. of chinchona-bark for sale in the English market.

* To Secretary of State, 7th February 1871, No. 6, paragraph 8, Miscellaneous. From Secretary of State, 4th April 1871, No. 7, paragraph 6, Public.

2. The Commissioner's letter on the subject, with its enclosures, and another from the Government Quinologist, reporting the results of the analyses of the barks in question, are herewith forwarded.

We have, &c.
(signed) *Napier*, &c.

Enclosure 1, in No. 13.

From the Commissioner of the Nilgiris, to the Secretary to Government, Revenue Department, Fort Saint George; dated Ootacamund, 2nd August 1871.

WITH reference to the Order of Government, dated 5th December 1870, Revenue Department, and to enclosed letter from Mr. McIvor, I have the honour to request that you will be so good as to inform me to whom the chinchona-bark proposed to be shipped to England should be consigned, and through whom forwarded.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 29th July 1871.

WITH reference to the Order of Government, No. 1941, under date 5th December 1870, I have the honour to inform you that I have packed 3,188½ lbs. of dry chinchona bark for despatch to England, and shall feel obliged by your being so good as to inform me to whom it should be consigned, and how it should be forwarded.

ORDER

ORDER of Madras Government thereon, 4th August 1871.

THE packages should be forwarded to the Government Office, Madras, for immediate despatch to the Secretary of State, *viâ* the Suez Canal.

Enclosure 2, in No. 13.

From the Government Quinologist, to the Secretary to Government, Reveue Department, Fort Saint George; dated Ootacamund, 3rd August 1871.

THE cases of Chinchona Bark now packed, in order to send to England, are as follows:—

		lbs.			lbs.
1	Box old mossed Succirubra -	135	13	Box small mossed Succirubra -	90
2	„ „ „ -	135	14	„ old mossed „ 14½	137½
3	„ „ „ -	135		unmossed „ 123	
4	„ „ „ -	145	15	„ „ „ -	145½
5	„ „ „ -	155	16	„ „ „ -	142
6	„ „ „ -	161	17	„ mossed Condaminea (officinalis).	108
7	„ „ „ -	150	18	„ „ „ -	182½
8	„ small mossed „ -	141	19	„ „ „ -	179
9	„ „ „ -	143½	20	„ „ „ -	173½
10	„ „ „ -	200	21	„ unmossed „ -	180
11	„ „ „ -	164			
12	„ „ „ -	186			3,188½

The above have been analysed, for the purpose of ascertaining, as nearly as possible, their mean yield in per-centages of dry bark:—

	Old mossed Succirubra.	Small mossed Succirubra.	Unmossed Succirubra.	Unmossed Officinalis.
Total alkaloids - - - - - - -	7·61	6·56	5·43	4·96
Quinine - - - - - - - - -	1·17	1·74	2·09	3·03
Chinchonidine and chinchonine - - -	6·44	4·82	3·34	1·93
Sulphate quinine, obtained crystallised - -	0·71	1·25	0·95	3·14
Sulphate chinchonidine, crystallised - - -	4·66	2·63	2·18	1·05
Total crystalline sulphates, excluding chinchonine	5·37	3·88	3·13	4·19

The mossed crown-bark is of two ages, which have been unfortunately mixed in cases; their analyses yielded:—

	Oldest trees.	Second age.
Total alkaloids - - - - -	7·41	4·73
Quinine - - - - - -	4·57	2·96
Chinchonidine and chinchonine - -	2·84	1·77
Sulphate quinine, obtained crystallised -	4·46	2·55
Sulphate chinchonidine, crystalised -	1·74	0·94
Total sulphates, excluding chinchonine -	6·20	3·49

As at the present time the prices of chinchona bark in English market are high, I should strongly recommend that the bark be sent *viâ* Suez Canal, in order to avoid delay.

The Government will, of course, do as is considered best about making the analyses of the barks known before sale. But of the red barks I should certainly recommend that only the amounts of "Total alkaloids" and "Total sulphates, excluding chinchonine," be made known.

— No. 14. —

(No. 3—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 11 January 1872.

1. With reference to your Excellency's Despatch, dated 21st August (No. 36) 1871, reporting the transmission, by the Suez Canal, of 3,188½ lbs. of chinchona bark for sale in the London market, I have now to inform you that the bark was sold in the ordinary way, with other lots from South America, on the 22nd of last December, without any reserve price.

2. The prices obtained at the sale are satisfactory, ranging from 2*s.* 1*d.* to 2*s.* 10*d.* the lb. The highest prices were fetched by the unmossed Succirubra and the unmossed Condaminea barks, which reached to 2*s.* 9*d.* and 2*s.* 10*d.* the pound. The old mossed Succirubra only sold for 2*s.* 3*d.* the pound.

I have, &c.
(signed) *Argyll.*

— No. 15. —

(No. 9—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 25 January 1872.

With reference to my despatch dated 11th instant, (No. 3), announcing the result of the sale of chinchona bark from the Neilgherry plantations, I now have to inform you that the gross sum realised was 353 *l.* 10*s.* 8*d.*, and that the net sum paid by the broker was 333 *l.* 8*s.* 6*d.*, which has been placed to the credit of Revenue, in the Home Account.

I have, &c.
(signed) *Argyll.*

— No. 16. —

(No. 45—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 7 November 1871.

We have the honour to forward, for the information of your Grace, the accompanying report from the Government Quinologist on the chinchona barks of the Government plantations, together with our proceedings thereon, dated 26th September 1871, No. 1686.

2. Our proceedings of 22nd September 1868 and 22nd February 1870, referred to in Mr. Broughton's report (paragraphs 2, 4, and 11), were forwarded to the Home Government, with our despatches dated respectively 6th October 1868, No. 49, and 21st March 1870, No. 8.

We have, &c.
(signed) *Napier*, &c.

Enclosure in No. 16.

From the Government Quinologist to the Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 31st July 1871.

As in certain former reports, I have the honour to adduce analyses, which express the changes in the composition of our oldest barks during the past two years. The following table expresses the amount of alkaloids in the trunk bark of the eldest trees of *C. Succirubra* in the month of May, the period of maximum yield in the respective years. The amount is expressed in per-centages of dry bark:—

	1868.	1869.	1870.	1871.
Total alkaloids - - - - - -	6·74	7·43	7·60	7·85
Total sulphates obtained - - - - -	6·0	6·43	6·00	5·45
Quinine - - - - - - - - -	2·40	1·72	1·73	1·80
Chinchonidine and chinchonine - - -	4·34	5·71	5·87	6·05
Sulphate of quinine, obtained crystallised - -	2·21	1·51	1·40	1·15
Sulphate of chinchonidine, obtained crystallised -	3·85	4·92	4·60	4·30

2. The above analyses show that up to May 1871 the total amount of alkaloids in the red bark had continued to increase. But, as I had the honour to mention in a report, dated 17th August 1868 (Proceedings Madras Government, 22nd September 1868, No. 334, Revenue Department), as being highly probable to occur, the annual increments diminish in amount, a circumstance which indicates that the bark is arriving at its maximum of yield. The numbers which approximately express the annual increments during the period of my observations are 0·75, 0·69, 0·17, 0·25. The circumstance that these numbers do not accurately express a regular diminution of increment is doubtless attributable to the difficulty which occurs in collecting in successive years a sample which shall accurately represent the mean yield of the bark of a large number of trees, together with the difficulty in collecting the samples each year under precisely comparable circumstances.

3. From certain results obtained in the comparison of the analyses of barks that have been treated with moss, with those of the natural unmossed bark, I am strongly inclined to believe that if the bark of our oldest trees has not actually reached the age of its greatest yield, it must have very nearly approached it. As this is a point of some importance, which cannot be held decided without positive proof hereafter be obtained, I here merely mention my personal opinion.

4. In a report appearing (Proceedings Madras Government, 22nd February 1870, No. 235, paragraph 4), I had occasion to mention that the amount of quinine had diminished during past years in the red barks, although that of the total alkaloids had increased

During

During the last two years it appears that the amount of quinine has remained nearly constant, and probably, in years to come, its amount will hereafter remain nearly stationary in our red bark.

5. From the above analyses it also seems probable that the amount of obtainable crystallised sulphate of chinchonidine is diminishing with the increase of age. But with the present evidence I cannot hold this yet to be quite clear, since the determination of the amount of crystallised sulphates is apt to be modified by circumstances other than the real amount of pure alkaloid, which latter it only approximately indicates.

6. The large amount of variation, according to circumstance of growth, met with in the bark of *C. officinalis* renders a precise determination of its mean quality a work of great difficulty. I here quote certain analyses of this bark calculated in per-centages of its dry state :—

CROWN BARK from DODABETTA PLANTATION.

	I. Trees of good growth, Six Years Six Months of Age.	II. Trees of good growth, Five Years Nine Months of Age.	III. Oldest Trees.	IV. Trees of fine growth.
otal alkaloids - - - - - -	5·26	3·10	6·53	6·91
Quinine - - - - - - -	3·48	1·62	4·18	4·71
Chinchonidine and chinchonine - -	1·78	1·50	2·35	2·20
Sulphate of quinine, obtained crystallised	3·25	1·64	4·17	4·80
Sulphate of chinchonidine, obtained crystallised.	2·04	1·14	1·57	1·60

CROWN BARK from NEDDIVUTTUM PLANTATION.

	Trees, Six Years Nine Months of Age.	Trees, Six Years Three Months of Age, of good growth.
Total alkaloids - - - - -	4·96	6·01
Quinine - - - - - - -	3·03	4·19
Chinchonidine and chinchonine - -	1·93	1·32
Sulphate of quinine, obtained crystallised	3·14	4·24
Sulphate of chinchonidine, obtained crystallised.	1·05	1·39

7. The above analyses, though comparatively useless to determine the alteration of the bark with age, are adduced as showing the high quality of the barks. Though it falls without my province to speak of the improvement in the growth of the *C. officinalis* trees, yet I cannot forbear to remark that a low yield is getting much less frequent in their bark than formerly. Both the crown barks of Dodabet plantation, which consists entirely of this species, and those of Neddivuttum are improving in quality. The increase in the yield of alkaloids is quite apparent, although I cannot with accuracy express its actual amount. This increase is due to quinine; and at present it actually appears probable that hereafter the total yield of alkaloids will equal that of the red bark. These two kinds divide between them nearly the whole of our plantations. For European quinine manufacture the bark of *C. officinalis* is admirably suited, as it is so rich in quinine. In addition, it is easy to work, and the sulphate of quinine crystallises with great readiness and purity. It is especially the bark for export to Europe. A small quantity is now packed for sending to England, and I trust that from time to time its export may be continued.

8. In total yield the bark of *C. Succirubra* is the richest, but in its natural state, at least, this consists mainly of chinchonidine, chinchonine, and, occasionally, quinidine, alkaloids which custom and the addition of fresh names, coincident with the first separation of these substances, have kept out of extensive therapeutical use. The medical reports of the Chinchona Commissioners of the Indian Presidencies and the report on the medical use of "amorphous quinine" appear to indicate that these alkaloids, and consequently red bark, is the kind that can be employed most usefully in India. In Europe

Europe the price of the natural red bark will hereafter sink, when it is brought into competition with crown bark. How far by careful special cultivation of the red bark it may hereafter be possible to modify this result it would at present be premature to speculate.

9. After the above kinds, the most important at present cultivated on the plantations is undoubtedly that of *C. Calisaya*. As in my former reports the trees of Calisaya were very young, it is quite natural to find the amount of alkaloids in the bark has increased. The most remarkable point about the plants of *C. Calisaya* is the great number of varieties. These display almost every habit. As it was necessary to examine the bark of the trees of most marked character, in order to determine the kind most suitable for cultivation, these varieties have taken up much time. I have the honour to quote the analyses of several of these varieties. The alkaloids are given in per-centages contained in dry bark :—

TRUNK BARK of *C. Calisaya*, grown at *Neddivuttum*.

	I.	II.	III.	IV.	V.
Total alkaloids - - - - -	3·95	3·93	5·28	4·16	5·36
Quinine - - - - - -	2·67	3·18	1·02	2·50	4·67
Chinchonidine and chinchonine -	1·28	0·75	4·26	1·66	0·69

10. These represent fairly the different yields I have met with among the kinds of *C. Calisaya* raised from seed obtained from Mr. Money. They are, as a whole, of good quality; but No. V., or the bark of a variety with broad leaves, which are red in the under-surface and of vigorous habit, is the kind which should be propagated, as it is the one whose cultivation can be most profitably extended. I have examined the bark of several other varieties besides those whose analyses are given above, but find them all inferior to No. V., and promising nothing remarkable in their qualities. The bark of our *C. Calisaya* is of excellent quality, and is better suited for quinine manufacturers' use than that of *C. Succirubra*. I regret that a larger number of the trees has not been planted; but as the yield of bark from the present plantations will shortly be so large, I cannot now recommend any considerable extension, even with this sort.

11. In a report appearing in Proceedings Madras Government, Revenue Department, No. 334, paragraphs 22 and 23, I had occasion to remark that in the barks of *C. Succirubra* and *Officinalis* a high mean temperature appeared unfavourable to the production of quinine; that alkaloid occurring more readily in the bark of trees grown at high elevations within certain limits. I have met with a remarkable illustration of this principle also in the bark of *C. Peruviana*. The bark of this tree grown at Neddivuttum generally contains no quinine whatever, and at best contains it in so small an amount that it is with difficulty it can be clearly detected. But the superintendent of the plantations has with great judgment experimentally planted several of these trees at Dodabet plantation, where they grow with much difficulty from the cold being too great for them. An analysis of the bark of one of these trees gave the following results, to which, for comparison, I attach an analysis of the bark grown at Neddivuttum :—

Dodabetta.		Neddivuttum.	
Total alkaloids - - - -	2·06	Total alkaloids - - - -	6·25
Quinine - - - - -	0·70	Soluble in ether - - - -	0·41
Chinchonidine and chinchonine -	1·27	Chinchonidine - - - -	2·00
Sulphate quinine, obtained crystallised - - - - -	0·67	Chinchonine - - - -	3·84
Sulphate chinchonidine, obtained crystallised - - - -	0·94	Sulphate chinchonidine, obtained crystallised - - - -	1·80

Though

Though the bark of *C. Peruviana* from Neddivuttum contained a small amount of alkaloid soluble in ether, it was not quinine. But by growing the same species at the higher elevation of Dodabet plantation, its bark quite alters its character, and yields in analysis an amount of pure quinine which readily crystallises as sulphate. Indeed, the bark thus grown far more resembles the bark of *C. Succirubra* than a grey bark. I cannot but consider this instance of a total change of alkaloid by increase of elevation a most interesting one.

12. The occurrence of several remarkable varieties among the trees raised from seed has directed my attention to the occurrence of hybrids among our species of chinchona. In one instance I was able, from the account given by Mr. C. Dawson, then assistant superintendent at Neddivuttum, to directly trace the origin of a very beautiful plant, which was found to be a hybrid between *C. Succirubra* and *Micrantha*. This plant was picked up a seedling under a tree of the latter. I analysed its bark, and found its yield was poor, but represented a mean between the qualities of the two species. Examination among seedling trees led to the discovery of many other examples of hybridism, especially to cross-breeds between *C. Succirubra* and *Officinalis*. In 1870 I communicated a short memoir on the subject to the Linnæan Society.* The occurrence of the dimorphic varieties, "*macho*" and "*hembra*," in each species of chinchona was shown in this communication to render cross-breeding highly probable, in the same manner as has been shown by Darwin to occur in *Primula*, *Oxalis*, and other plants. I learn, from the discussion which took place on the subject at the Society's meeting, that the fact of the tendency of chinchona to hybridism was considered proved. Since that time I have made numerous analyses of the bark of various hybrids that I have observed, but in no one instance have I found any of special excellence. In fact, it appears to me that these hybrids combine the bad qualities of both their parents. I therefore do not quote the analyses.

* Read 3rd March 1870.

13. I cannot but think that this ready hybridism between the species of chinchona affords an explanation of the occurrence of the numerous *varieties* which have been recognised by botanists. I observe, for instance, that a most recent classification gives 33 undoubted species and nearly 80 separate varieties of chinchona. On our plantations there are several plants which, though certainly hybrids, would undoubtedly be made into species by a botanist ignorant of their origin. It seems therefore not improbable that several species to which a separate name has been attributed may be only South American hybrids. It is to be hoped that in any future botanical classification of the genus this circumstance may be borne in mind.

14. This fact of the inter-breeding of the species renders the seed of a tree, surrounded with many others of a different kind, subject to considerable uncertainty of producing all plants like its parent. As a fact, the seeds of the variety I called, provisionally, "*lanceolata*" gave but few plants which resembled their parent, and consequently the *seedlings* had to be discarded. As the tree producing the seeds was surrounded on all sides by the ordinary crown barks, the variation in the seedlings becomes intelligible.

15. I observe that Dr. Weddell, in his "Notes sur les quinquinas" (Annales des Sciences naturelles, 5 e serie, tomes XI. and XII.), and at the suggestion of Mr. Howard, calls the valuable variety I called "*lanceolata*," above alluded to, "*Cinchona officinalis, Bonplandiana, Angustifolia*," remarking that *lanceolata* does not express so well as *angustifolia* the peculiar-shaped leaf. I would suggest that the name *angustifolia* be in future adopted as the name of the variety.

16. In several preceding reports I have abundantly stated my convictions, and their grounds, for considering that living chinchona-bark has its yield of alkaloids injured by exposure to sunlight. The experimental evidence of this already adduced appears to me to be quite conclusive of the fact, so that further proof is scarcely needed. Further proof appears, however, in the circumstance, of which I have been for some time aware, that the bark of opposite sides of the same tree differs in yield of alkaloids. This, of course, is only fully apparent in trees that are equally exposed to sunlight on each side, which, from the site of the plantations, does not generally occur. But the following analyses express the yields of the bark taken respectively from the north and south sides of a tree which is equally exposed on all sides. The bark was taken 25th July 1871:—

	North Side.	South Side.
Total alkaloids - - - - - - - -	3·18	3·80
Quinine - - - - - - - - -	0·62	1·40
Chinchonidine and chinchonine - - - -	2·56	2·40

17. As

17. As the sun has been on the north side of the tree for the last four months, the effect has been that the yield of alkaloids has been diminished 0·68 per cent. This decrease apparently consists of quinine, which is commercially the most valuable of the alkaloids. This effect has been produced in spite of its being the most cloudy period of the year.

ORDER of Madras Government thereon, 26th September 1871.

ORDERED, that the above paper be forwarded for the information of the Right Honourable the Secretary of State, and that copies be as usual furnished to the Governments of India and of the other Presidencies, and of Ceylon, the Straits Settlements, Batavia, and the French Settlements in India.

2. The facts noted by Mr. Broughton are of much interest, especially as regards the effect of altitude and sunlight on the production of quinine. The attention of Mr. McIvor, the superintendent of chinchona plantations, will be specially directed to the apparent ready hybridisation noticed by Mr. Broughton, in view to steps being taken to isolate plants of the more valuable kinds for the production of pure seed.

— No. 17. —

(No. 4.—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 11 January 1872.

1. MR. BROUGHTON'S Report on the examination of chinchona-barks, dated 31st July 1871, has been received, with your Excellency's Despatch, dated 7th November (No. 45) 1871, and has been under my consideration in Council.

2. Its perusal has impressed me with a sense of the value of these periodical reports by a competent quinologist. They indicate the measures which should be adopted in conducting the cultivation, and furnish your Government with accurate data respecting the tendency of the course hitherto pursued at the earliest possible moment. Thus not only is much time saved, but errors are avoided, and in the end considerable saving in actual outlay is doubtless effected.

3. The conclusion to which the present Report seems to point is, that it will be found advisable to use one set of barks for general consumption among the natives in India, and to cultivate another, having a larger yield of crystallisable sulphate of quinine for sale in the London market. The establishment of the interesting fact that hybridism readily takes place between the chinchona species is also important, and points to the necessity for keeping the species apart, in order to secure good seeds.

4. I take this opportunity of repeating the request that a complete set of the flowering and fruit-bearing branches and of the barks of each of the chinchona species now growing on the Neilgherries may be transmitted to this office.

I have, &c.
(signed) *Argyll.*

— No. 18. —

(No. 10 —Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 8 February 1872.

With reference to my previous Despatch, dated 11th January (No. 4) 1872, I transmit herewith 30 copies of some notes prepared at my request by Mr. Howard, the quinine manufacturer, after perusing Mr. Broughton's Report, dated 31st July 1871. You will perceive that Mr. Howard attaches great importance to the extension of the cultivation of the *Angustifolia* variety of crown-bark. It appears that the importation of the once famous crown-barks from South America has practically ceased, so that the world is now dependent on India for the supply of this valuable product. Mr. Howard is also of opinion that the grey barks should not be neglected, as the demand for chinchonine, which they yield so abundantly, is increasing. I desire that Mr. Broughton and Mr. M'Ivor may be furnished with copies of Mr. Howard's Report, and that they may be instructed to give their careful attention to the remarks and suggestions of this eminent quinologist.

I have, &c.
(signed) *Argyll.*

Enclosure in No. 18.

Sir, Tottenham, 16 January 1872.

In compliance with a request from the Secretary of State for India, dated the 6th instant, I beg to transmit the following remarks, which I have the more pleasure in doing, as I can now report more favourably of the results of the cultivation than at any previous period of the undertaking.

In reference to "the species which is likely to produce the most remunerative bark for sale in the London market," I will remark, in the first place, on that which has been the most largely cultivated, the red bark tree, or *Chinchona succirubra.*

Two circumstances especially recommended this sort for cultivation: its free propagation and growth, and the very high price paid for the mature bark of this sort in the London market.

I have never been favourable to the almost exclusive preference paid to this sort by many cultivators. I have shown,* in a recent examination of two trees sent me by the Indian Government, one of this sort and the other of *C. officinalis*, that the more rapid development of the former species did not secure a comparative advantage as to the production of alkaloid, since the quinine in the latter rind exists in a more abundant quantity as to the percentage in the bark, and also in a much purer state than in the former (the *C. succirubra*).

I am happy to be able, in this view of the subject, to coincide entirely with the published report of Mr. Broughton, whose more extended opportunities of observation supplement the more limited character of my own personal investigation. In reference to the price of the bark, I remarked, in my report dated 15th June 1864, that "the very high price of between 8 *s.* and 9 *s.*, which has been recently paid for red bark in this market, applies only to those pieces of bark from the trunk which possess from their age a peculiarly bright appearance.

A further recommendation of the *C. succirubra* to notice exists in the fact that it gives, on the whole, a very large product of alkaloid, and also of the chinchona red, so that it may be called the most *chinchonaceous* of all the chinchonæ. Against this must be set the fact that, in connection with the gradual oxidation of the chincho-tannic acid and the production of the chinchona-red, there is a gradual diminution and waste of the alkaloids, so that the bark does not really improve by age, but the contrary. This is the peculiar habit of the species, and it would seem, from the accompanying report of Mr. Broughton, that the effect of this idiosyncracy is already beginning to be apparent.†

It will be noticed that, whilst the *total alkaloids* have risen from 6·74 per cent. in 1868 to 7·85 in 1871, the "sulphate of quinine obtained crystallised," which, to a large extent, marks the value of the bark in the eyes of the quinine manufacturer, has steadily declined from 2·21 per cent. in 1868 to 1·15 per cent. in 1871. The sulphate of chinchonidine obtained crystallised has, in the meantime, risen from 3·85 per cent. in 1868 to 4·30 per cent. in 1871. It will immediately occur that this is, to a certain extent, a counterpoise, as no doubt it is, but to a certain extent only, as will be explained hereafter.

It is needful also to remark that the *waste* of alkaloid, which has been apparent to the writer in the examination of many specimens of South American bark of the age of perhaps one or two centuries, has not yet taken place in these still young Indian specimens, and also that it is open to question whether the apparent conversion of chinchonidine into quinine

* "Pharm. Journal," November 1871.
† *i.e.*, in the *present change*, to be followed by *future waste* in the alkaloids.

quinine is due to deoxidation,* which increases also the proportion of chinchonine, or to some other cause.

In my report, dated 1st August 1865, I remarked, in reference to the preponderating product of chinchonidine, which I could not help foreseeing: "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 Secretary of State for India (Sir Charles Wood) lost no time in acting on the first of these suggestions, and consulted Sir Ranald Martin,† who entered cordially into the subject, and approved of both ideas. The result was, through Sir Charles Wood's recommendation to the Governor General of India,‡ the appointment of a medical commission, whose labours have been most advantageous. It is not for me to speak of their value to medical science, but to show the bearing of the report of this Commission on the cultivation of the *Chinchona succirubra*, as its outcome differs somewhat from what might have been anticipated.

The Commission has shown that all the alkaloids are to be relied upon more or less in the cure of intermittent fever, or, in their own language, "that they form a very valuable class of therapeutic agents," and (taking the order of the instructions sent to medical officers) they consider them to be—

1. Febrifuges, antiperiodics, and tonics.

2. Their general effects are similar to those of quinine, though perhaps in an inferior degree.

3. As variously estimated, they possess the same effects as quinine, to the extent of one-half or two-thirds.

4. They are very efficacious in treating the common fever of the country, and disordered digestion, &c., &c.

5. Their relative value seems to be:—

1. Quinine.
2. Quinidine.
3. Chinchonidine, Chinchonine. } about equal.

6. Their proper doses are—

Quinine	- - -	From 3 to 20	grains.
Quinidine	- - -	„ 5 to 20	„
Chinchonidine	- -	„ 7 to 20	„
Chinchonine	- -	„ 7 to 20	„

It is clear that quinine keeps its long-maintained and acknowledged supremacy, and that next in order of merit we must place quinidine; but *quinidine* (except in some rare and quite exceptional cases) is what *C. succirubra* does *not* produce.

Then chinchonidine and chinchonine are looked upon as of equal efficacy, if we read the report aright.

There are other circumstances which lead to quinidine maintaining its price, and it seems to be, and probably will continue, the favourite next to quinine. But next to quinidine comes in, not chinchonidine, but chinchonine, the obvious reason being that it can be delivered at a lower price, in addition to which it is (at least in one of its combinations) a more convenient medicine to prescribe.

So we have, after all, chinchonidine rather falling behind in the race, and if the effect of this on the cultivation of *C. succirubra* be well considered, it will tend to confirm our doubts about the result.

We then come to the second of my suggestions,—Cannot the *C. succirubra* be encouraged to grow quinine, instead of chinchonidine? We have seen that its tendency is increasingly the reverse.

How can we alter this? The answer is certainly, not alone by *mossing*, as is strikingly shown by an analysis of Mr. Broughton's now before me, the unmossed bark yielding 2·18 per cent. sulph. chinchonidine, and the *old mossed* bark of the same parcel of *C. succirubra* not less than 4·66 per cent., whilst the quinine is less in this latter.

There remains the process of the re-formation of the bark over surfaces from which it had been removed. This gives rise to the production of lax cellular tissue, full of quinine (which I have described anatomically and chemically in "Quinology of the East India Plantations"). Mr. Broughton admits this fact,§ and it is doubtless familiar to Mr. M'Ivor, so that I am at a loss to understand why this plan is not pursued to a greater extent than appears to be the case. I have obtained large percentages of quinine from bark of this description, more than sufficient to repay the extra cost, unless there are circumstances

* In connection with the chincho-tannic acid taking from the alkaloids oxygen, for which it has very rong affinity. Both the alkaloids contain a smaller amount of oxygen than quinine possesses.
† "Return," 18th June 1866, p. 136.
‡ "Return," p. 316. Letter dated 30th September 1865.
§ Return of 9th August 1870, page 195.

cumstances unknown to me which tend greatly to augment the cost of the operation, or to render it, from some cause, undesirable.

I have now stated the objections to the cultivation of *C. succirubra*. On the other hand, I am bound to say that its inherent good qualities have secured it a favourable reception in the English market, and a price which may probably be found satisfactory to the producers.

At a quite recent sale of bark grown on the Government plantations at Ootacamund, the "old mossed *succirubra*" brought 2 *s.* 3 *d.* per pound, the "small mossed *succirubra*" 2 *s.* 6 *d.* per pound, the "unmossed *succirubra*" realised 2 *s.* 10 *d.* per lb. These were all sold (as far as is known) for pharmaceutical purposes, whilst one parcel of "unmossed and old mossed *succirubra*" was sold for the extraction of quinine, and obtained 2 *s.* 7 *d.* the pound.

It is a favourable feature that the attention of leading druggists in London is being aroused to the merit of the article, and that the prices above-named were the result of the competition of purchases from the Continent with these in London.

I suggested to the Government, in June 1854, that the bark of the small branches might be advantageously sold for pharmaceutical preparations, and it now seems as if the bark of the whole tree would be welcome for the purpose. On the review of all that is apparent at present, I do not think it wise to rest the success of the cultivation on this one species; it cannot be looked upon as the quinine-tree of the future.

I come next in order to the *C. officinalis* and its varieties, representing in India the "Loxa" or "crown barks," which used to be supplied from South America to the European markets.

These latter may now be looked upon as belonging to the past, as none are forwarded at present from Hoja, and it is not very probable that the inertia of the people of those parts will be overcome so far as to cultivate them, and thus replace the worked-out forests. It is therefore a most fortunate circumstance that all, or nearly all, the varieties should have found so congenial a home as India.

There have now been several importations of the "*officinalis*" barks from different plantations in the East, and I can speak well of all I have seen, and that without any of those reservations which attach themselves to the former species. I have no doubt that these barks will improve with age, and they already command a price equal in some cases to that of *Calisaya*. That of the variety *Angustifolia*, if it can be produced equal to the specimen analysed by Mr. Broughton and myself, would of course realise a much larger amount. In reference to this sort, Mr. Broughton wrote to me, in April 1869, that "the flower did not appear to differ from the other *officinalis* blossom," and in July of the same year "some further experience quite supports your views that it is a *crown bark*. I can now trace all gradations into the *Bonplandiana* type." I may add, that having received dried specimens, which were gathered in the latter part of 1868 at Ootacamund and sent home by Mr. Batcock, I sowed some of the seed remaining in the capsules of one of these, which is marked "No. 6 (?), *var. C. officinalis, var. crispa*" (the duplicate of which, as of the other numbers, is in the Royal Museum at Kew). This appears to be the same as Mr. Batcock's "No. 4, *C. officinalis* (? ?), *crispa*," but differing widely from the real *crispa* of Tafalla.

From these seeds I obtained several plants, of which two remain. One of these is more like the parent, but the other plant represents exactly the "No. 11," or *var. angustifolia*. It appears to be a freely-growing sort, being at this time five feet in height, and having nearly a dozen small branches. This, for a three years' growth (under all disadvantages of cultivation under glass) promises well. Mr. M'Ivor wrote me, under date 29th June 1869: "We are now propagating the *lanceolate officinalis* from cuttings as fast as we can. It is, I believe, only a variety, and consequently it will not come true from seeds, and therefore the only way to get up a large stock quite true is by cuttings and grafts." In confirmation of its only being a variety, Mr. Broughton sent me specimens, of which he writes, under date October 1869, "I have a set of [*crispa?*] specimens just ready to send you. Those marked A, B, C, D, E are all from *crispa* seed. You will, I think, see a gradation in all characters between two marked types. I want your opinion on these."

These very well-selected specimens nearly bridged over the interval between the *var. Bonplandiana* and the *var. angustifolia*, to which latter I should assign C, D, and E, as differing by no specific tokens from the No. 4 and No. 6 above, nor yet from No. 7, which is termed "the strong growing variety." A and B are of a separate type.

I should like to take one further step to establish the specific identity of these forms,—to sow the seed from No. 11, and see whether it would not originate the other sorts. In the meantime, it remains to propagate diligently the *var angustifolia.* by layers and cuttings, as Mr. M'Ivor was already doing in 1869. By this time the plants thus raised may have amounted to a large number, for the plant of *C. officinalis* (raised from seed from Uritusinga in 1859), which I had the honour to present to the Indian Government, gave rise, under the skilful care of Mr. M'Ivor, to many thousands in the same period; and the last I heard was that he hoped to plant 60 acres from that one tree. Now, it is easy to understand how valuable a plantation in suitable soil and climate of the *var. angustifolia* would be; but if this seems scarcely attainable it might, at all events, be easy to intersperse these among closely-set plants of the *C. officinalis* (in its other varieties), and to remove these latter year by year as required, cutting them down cleanly to

to the root, and sending in the bark to the English market. This would pay all expenses, and then the more valuable trees might in the meantime acquire a large size, whilst between them an undergrowth of offshoots from the cut-down stems would be coming on for fresh cutting. I mention this plan in connection with the *C. officinalis* especially, because in these crown-barks the very youngest shoots that could be peeled have often been sold, and even preferred by the trade.

It will be seen how this bears upon the question of quick return of capital by some such plan as the above. There is no fear that the bark of these varieties of *C. officinalis* should deteriorate with age, so that the trees left might in time rival those of the Bolivian forests; in these there have been found specimens both of *calisaya* and *lancifolia*, yielding as much as five per cent. of bark each; but it is not our own generation that will see such trees in India.

I have not much to remark in reference to the remaining varieties of *C. officinalis*. I have quite recently met* with the *Amarilla del Rey* (as well as the *Colorada del Rey*), once celebrated Loxa barks. These seem quite as good (chemically viewed) as their originals in South America, and might easily be so gathered as to please the eye of the druggists here. In the meantime I can entirely confirm the opinion expressed by Mr. Broughton, that this sort (the *officinalis* in its varieties) is "especially suited for export to Europe" for the purposes of quinine manufacture. I must also add that these barks are now required to fill up the vacancy occasioned by the cessation of the supply of the true Loxa or crown barks. The cessation, if not *absolute*, is *practically* complete, and is supplemented by the importation of miserable products *via* Guayaquil.

The species standing third in importance, according to the Report, is that of *C. calisaya*, of which the No. V. form appears to be the one to be encouraged. Considering the acknowledged superiority of these barks in South America, it must occur that there is something yet to be learned about them in India, causing them to take a higher place than the third rank. The No. V. form is not improbably the one found by Don P. Rada in the east of Bolivia, and described by me in the "Journal of Botany" in 1869. In that case it would form trees of from 120 to 150 feet in height, and still produce bark of fine quality. The analysis of Mr. Broughton shows a very promising kind.

It will be needful to guard the cultivators against the inferior sorts which (however they may be arranged botanically) will assuredly disappoint their expectations.

I am glad to notice that the grey bark trees, or the *C. micrantha* and *C. Peruviana*,† have been, to some extent, encouraged by Government, as these trees furnish chinchona in abundance and of a good quality, and this alkaloid is increasing so much in consumption that it will some day become important to have a readily available source to depend upon for its supply.

The Pitayo trees, of which there exists now a complete collection at Ootacamund (through the last mission of Cross), should, I think, be encouraged, as they not only furnish a good material for the extraction of quinine, but also of quinidine, which is coming into favour in some quarters.

In conclusion, I wish to add some remarks to dispel the fears which seem to be entertained by cultivators, that an excessive supply from India will so glut the market as to cause the prices to fall too low to be remunerative. I do not see any reason to fear this with reference to *really good barks*, which must always repay well the expense bestowed on their cultivation. There is no medicine in the world to rival quinine in its efficacy and in the extent of its consumption, and there is no probability that any artificially-formed product will ever take its place.

Then, as to the South American forests, it is clear that these cannot compete with skilfully-cultivated plantations in India. The very cost of transport, if nothing else, would hinder this.

It remains that the planters should not over-supply the demands of the world; this, indeed, is a *possibility*, but one so remote that it may be dismissed from all thought for at least the present generation; and the range of altitude above the sea-level and climate under which the chinchona can be profitably grown are at best extremely limited, as Mr. Broughton's Reports abundantly show, and it will be found eventually that the really productive plantations are not too numerous for profit.

I have, &c.

The Under Secretary of State for India. (signed) *John Eliot Howard.*

---

* In importations from India.

† Also *C. nitida*.

— No. 19. —

(No. 4—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 15 February 1872.

WE have the honour to forward, for your Grace's information, our proceedings of 12th January 1872 (with the previous papers therein referred to), containing a letter from Mr. McIvor, instituting a comparison between the growth of chinchona plants in British Sikkim and on the Nilgiris.

2. We also forward our proceedings of 11th January 1872, embodying a letter from Mr. McIvor, refuting the statement published at pages 982 and 1000 of the Supplement to the "Gazette of India," dated 8th July 1871, to the effect that the chinchona plants, when originally supplied from the Nilgiris to Darjeeling, were affected with canker. Copy of the letter which we have addressed to the Government of India on the subject is also enclosed.

We have, &c.
(signed) *Napier*, &c.

Enclosure 1, in No. 19.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 23rd October 1871.

1. WITH reference to the measurements of the chinchona plants taken by us at Neddivuttum on the 27th ultimo, in accordance with G. O. of the 26th May 1871, I have the honour to submit a comparison of the growth of chinchona plants in British Sikkim and on the Nilgiris.

2. The following Tables, on the plan adopted in my letter of 25th April last, give the result of four years' growth :—

Cinchona Succirubra.	NEDDIVUTTUM. Planted April to June 1867; Measured September 1871.								DARJEELING. Planted February and March 1867; Measured February 18...							
	Ten largest consecutive trees.				Ten smallest consecutive trees.				Ten largest consecutive trees.				Ten smallest consecutive trees.			
No.	Height.	Circumference one foot from the ground.	Yearly growth.		Height.	Circumference one foot from the ground.	Yearly growth.		Height.	Circumference one foot from the ground.	Yearly growth.		Height.	Circumference one foot from the ground.	Yearly growth.	
			Height.	Circumference.			Height.	Circumference.			Height.	Circumference.			Height.	Circumference.
	ft. in.	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*
1	14 10½	14½	3 8⅝	3⅝	11 5	10	2 10¾	2½	11 6	7	2 10½	1¾	5 10	2½	1 5½	⅜
2	15 9	15⅝	3 11¼	3 15/16	10 4	9¾	2 7	2 7/16	15 0	7¼	3 9	1 7/8	4 0	3½	1 0	¼
3	14 9	14¾	3 8¼	3 11/16	10 10	12	2 8½	3	13 2	8½	3 3½	2	3 6	1½	0 10½	⅜
4	14 0	13½	3 6	3⅜	10 9	10¼	2 8¼	2 5/16	16 4	10½	4 1	2⅝	3 6	1¾	0 10½	⅜
5	12 5	11½	3 1½	2 7/8	9 10¾	10½	2 5 11/16	2⅝	11 16	4½	2 10½	1⅛	3 2	2	0 9½	⅜
6	15 11½	14	3 11⅞	3½	11 5	11	2 10¼	2¾	12 7	7¾	3 1¾	2	4 3	2½	1 0¾	⅜
7	14 9	14½	3 8½	3⅝	11 0	8	2 9	2	17 4	11½	4 4	2 7/8	1 11	¾	0 5⅜	⅜
8	14 11	13½	3 8¾	3⅜	11 9	12	2 11¼	3	15 9	11½	3 11½	2 7/8	3 1	2¼	0 9¼	⅜
9	15 7	14½	3 10¾	3⅝	11 9	14¾	2 11¼	3 11/16	16 9	9½	4 2½	2½	2 7	1½	0 7⅛	⅜
10	13 4	12	3 4	3	11 4	13½	2 10	3⅜	15 8	12½	3 11	3⅛	2 4	2	0 7	⅛
Average	14 7½	13¾	3 8	3⅜	11 0½	11¼	2 9⅛	2 11/16	14 6¾	9	3 7⅞	2¼	3 5	2	0 10½	⅛
Average of both finest and worst grown trees					12 10	12½	3 2⅝	3 1/16	–	–	–	–	9 0	5½	2 2⅞	1⅛

3. The above results show that on the Nilgiris four years' growth of *Cinchona Succirubra* exceeds that of the same species in British Sikkim by 3 feet 10 inches in height and 7 inches in circumference of stem, or three times the bark-producing surface. When the greater thickness of bark of the Nilgiri plants is taken into consideration, the yield may be estimated at about four times the quantity of bark produced during the same period of growth by plants of this species in Sikkim.

4. Our largest red-bark tree, planted in July 1864, measured 28 feet 5 inches in height and 24½ inches in circumference at one foot above the ground. The largest tree, planted in October 1865, measured 24 feet 4 inches in height and 18½ inches in circumference. These plants were the finest that could be found, and were considerably above the average. The largest tree found in the Sikkim plantations, planted in 1864, measured 24 feet in height and 17½ inches in circumference.

5. The following are the measurements of 10 consecutive plants of *Cinchona Calisaya* at Neddivuttum and Rungbee :—

Cinchona Calisaya.	NEDDIVUTTUM. Planted October, November, and December 1867; Measured September 1871.				DARJEELING. Planted June 1867; Measured February 1871.			
	Ten largest consecutive plants.				Ten largest consecutive plants.			
No.	Height.	Circumference one foot from the ground.	Average yearly growth.		Height.	Circumference one foot above ground.	Average yearly growth.	
			Height.	Circumference.			Height.	Circumference.
	ft. in.	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*	*ft. in.*	*in.*
1	9 1	7½	2 3¾	1¾	15 –	9	3 9	2¼
2	8 9	7⅜	2 2¼	1 1/16	12 4	8¾	3 1	3¼
3	12 3	9	3 0¾	2¼	14 3	9½	3 6⅜	2⅜
4	8 6	9¾	2 1½	2 7/16	13 3¼	7	3 3¼	1¾
5	8 2	6½	2 0½	1⅜	12 7½	6½	3 1¾	1⅜
6	9 2	9	2 3½	2¼	14 9	10¾	3 8¼	2⅜
7	7 10	6¾	1 11½	1 11/16	15 6	7	3 10½	1¾
8	8 6	10	2 1½	2½	14 –	6½	3 6	1½
9	11 7	10½	2 10⅜	2 9/16	14 8¾	7¼	3 8¼	1¾
10	9 9½	8½	2 5⅜	2⅛	15 –	7½	3 9	1⅞
Average	9 4½	8½	2 4½	2⅛	14 1⅝	7⅞	3 6½	2

giving an annual average growth of 1 foot 2⅜ inches less than the growth of this species on the Sikkim plantations, but the circumference of stem is in favour of the Nilgiri plants; the bark-producing surface of the main stem of the plants being nearly one-half more than those on the Nilgiris. When the additional thickness of bark is taken into account, the produce of *Cinchona Calisaya* on the Nilgiris will be about equal to that of the Bengal plantations.

6. Of all the species of chinchona cultivated on the Nilgiris, *Cinchona Calisaya* has made the most unsatisfactory growth, and consequently has not been cultivated to so great an extent as the *Cinchona Officinalis*, which grows freely, and yields a superior bark for the manufacture of quinine.

Enclosure 2, in No. 19.

From the Commissioner of the Nilgiris, to the Acting Secretary to Government, Revenue Department, Fort Saint George; dated Ootacamund, 1st May 1871.

I HAVE the honour to forward Mr. McIvor's report upon the Bengal chinchona plantations.

2. The report seems carefully drawn up, and conveys valuable information. Mr. McIvor has purposely abstained from drawing any contrast between the Nilgiri plantations and those he visited, as he considers that any such comparison coming from him might appear invidious and uncalled for.

3. I quite

3. I quite enter into Mr. McIvor's feelings, and respect the principle which has guided him in framing his report; but I am led to take a different view of the necessities of the case. It is so easy to make plausible assertions as to the general condition of an extensive plantation that such statements are of little practical value. But where, as in the present case, with the plantations reported on, we have certain facts recorded, the result of actual measurement and observation of which we cannot doubt the accuracy, I submit that we ought to put the Nilgiri plantations to the same test, and contrast the results. In my judgment such a comparison is called for in the general interests of the State, and as having an important bearing on the inquiries made by the Secretary of State in his Chinchona Despatch, dated 19th May 1870, No. 13.

4. For example, in paragraph 6 of his report, Mr. McIvor has given the average yearly growth on the Bengal plantations of the *finest* ten consecutive plants selected by the head-gardener from among 256,000 four-year-old *succirubras*, and the average yearly growth of ten consecutive *badly*-grown plants of the same age. In paragraph 7 Mr. McIvor has given the dimensions of the largest *succirubra* tree to be found of those planted in 1864 and 1867. Why should we not, as a matter of fact and for purpose of contrast, have on record the average yearly growth of our ten *best* and *worst* four-year-old *succirubras*, and the dimensions of our largest 1864 and 1867 *succirubra*?

5. In like manner I would deal with the *calisaya* variety, as described in paragraphs 8 and 9 of the report.

6. If Government approve, I shall call upon Mr. McIvor to be good enough to carry out this comparison on the points referred to; and for Mr. McIvor's satisfaction, I shall be glad to be present when he measures our trees.

From the Superintendent of the Government Chinchona Plantations, to the Acting Secretary to Government, Revenue Department, Fort Saint George; dated Ootacamund, 25th April 1871, No. 9.

WITH reference to the Order of Government, No. 1,998, dated 10th December 1870, authorising me to visit the chinchona plantations of the Bengal Government in British Sikkim, I have the honour to submit the following observations on the condition and prospects of those plantations as a source of supply of chinchona-bark.

2. I would respectfully call attention to the fact that I visited the Himalayan plantations at a season of the year when the plants are in the worst condition. My observations were made during a short stay, and at an unfavourable time; and my impressions, as to the condition of chinchona cultivation in the North of India, might have been somewhat modified had my visit been made at a more favourable season.

3. The quinine plantations in Bengal are situated in the Valley of Rungbee, on the Himalayas, about 13 miles from Darjeeling. This valley opens on the plains to the south-east, is entirely sheltered by surrounding hills, and its general appearance is strongly marked by indications of a locality possessing every requirement for the successful growth of chinchona. The natural forest-trees are overgrown with moss, and the undergrowth is ferns. The climate is very moist, especially in the higher portions where the ridges attract the clouds, and an almost perpetual drizzle or mist prevails, except during two months of the year, when the weather is comparatively fine, with occasional showers.

4. At one time the Valley of the Rungbee must have been covered with heavy virgin forest, which has long ago fallen under the axe of the native cultivator, and the land has for years been cropped with raggy, Indian corn, and wheat. The ground not being capable of producing a succession of these crops is, on its becoming exhausted, abandoned, and after a few years the surface gets covered with a growth of scrubs and long grass. This has been cleared, and the chinchona plantations formed on the land. The general lie of the ground is steep and rugged, with here and there marks of ancient and modern landslips of formidable proportions. There is very little surface-soil. It has apparently been exhausted by previous cropping, or washed away by the heavy rains when the land was under native cultivation.

5. The plantations in British Sikkim, both public and private, are, as a whole, in an unsatisfactory condition. They are exceedingly patchy and irregular, not one-third of the extent of land under cultivation having produced plants of fair growth, while large patches exist in which the plants have died out altogether. There are, however, here and there a few fine patches, and some exceptional plants have made extraordinary vertical growth, much exceeding that on the Nilgiris; but even these plants have not the robust habit and luxuriant foliage which characterise the plants of Southern India. The whole of the plants which I saw in British Sikkim are sparsely-leaved and long-jointed, and have attained little more than half the circumference of stem which plants of the same height have on the Nilgiris.

6. In the Sikkim plantations the plants are placed close together—*C. Succirubra* and *Calisaya*, at 6×6 feet, or 1,210 plants to the acre; *C. Officinalis* and *Pahudiana*, about 4,500 plants to the acre. The number of acres of plants on the Bengal plantations in September last was 1·134. The total number of plants planted out at the end of each year on the plantations from 1864, the date on which the permanent plantations were formed, to September 1870, was as follows :—

TABLE

TABLE showing Total Number of PLANTS and Acreage at the end of each year.

Total number planted in	C. Succirubra.		C. Calisaya.		C. Micrantha.		C. Officinalis.		C. Pahudiana.		TOTAL.	
	Number of Plants.	Acres of 1,210 Plants.	Number of Plants.	Acres of 1,210 Plants.	Number of Plants.	Acres of 4,500 Plants.	Number of Plants.	Acres of 4,500 Plants.	Number of Plants.	Acres of 4,500 Plants.	Number of Plants	Acres.
1864 - -	389	0·32	–	–	15	–	270	0·06	92	0·02	766	0·40
1865 - -	389	0·32	–	–	15	–	870	0·19	2,162	0·48	3,436	0 99
1866 - -	31,387	25·93	3	0 02	158	0·04	30,640	6·81	5,092	1·13	67,280	33·93
1867 - -	256,143	211·69	150	0.12	5,558	1·24	130,919	29·09	5,092	1·13	397,862	243·27
1868 - -	576,618	476·54	220	0·18	29,667	6·59	312,719	69·49	5,092	1·13	924,316	553·93
1869 - -	1,002,100	828·18	2,330	1·03	29,667	6·59	406,899	90·43	5,092	1·13	1,446,088	928·26
30th Sept. 1870 -	1,219,715	1,008·03	24,860	20·54	29,667	6·59	440,000	97·78	5,092	1·13	1,719,334	1,134·07

Of the above, the *C. Succirubra* (red bark) has made the most satisfactory growth. The finest 10 consecutive plants of this species which could be selected, by Mr. Grammie, out of 256,000 planted in February and March 1867, measured on the 25th February 1871—

	Height.	Circumference One Foot from Ground.	AVERAGE YEARLY GROWTH.	
			Height.	Circumference.
	Ft. In.	*In.*	*Ft. In.*	*In.*
Number 1 - - - - -	11 6	7	2 10½	1¾
„ 2 - - - - -	15 0	7¼	3 9	1⅞
„ 3 - - - - -	13 2	8¼	3 3½	2
„ 4 - - - - -	16 4	10⅛	4 1	2⅝
„ 5 - - - - -	11 6	4⅛	2 10⅛	1⅛
„ 6 - - - - -	12 7	7¾	3 1¾	2
„ 7 - - - - -	17 4	11⅛	4 4	2⅞
„ 8 - - - - -	15 9	11⅛	3 11⅛	2⅞
„ 9 - - - - -	16 9	9¼	4 2¼	2¼
„ 10 - - - - -	15 8	12⅛	3 11	3⅛

giving an average vertical growth of 3 feet 7⅜ inches per annum, and an average increase of circumference of stem, at one foot from the ground, of 2¼ inches per annum. Ten consecutive badly-grown plants of the same age, selected for measurement on the same patch, gave the following :—

	Height.	Circumference One Foot from Ground.	AVERAGE YEARLY GROWTH.	
			Height.	Circumference.
	Ft. In.	*In.*	*Ft. In.*	*In.*
Number 1 - - - - -	5 10	2⅛	1 5⅛	⅝
„ 2 - - - - -	4 0	3⅛	1 0	⅞
„ 3 - - - - -	3 6	1⅛	0 10⅜	⅜
„ 4 - - - - -	3 6	1⅜	0 10⅜	⅜
„ 5 - - - - -	3 2	2	0 9½	½
„ 6 - - - - -	4 3	2⅛	1 0¾	⅝
„ 7 - - - - -	1 11	¾	0 5¾	¼
„ 8 - - - - -	3 1	2¼	0 9¼	⅝
„ 9 - - - - -	2 7	1⅛	0 7¾	⅜
„ 10 - - - - -	2 4	2	0 7	½

or an average vertical growth of 8¾ inches, and an increase in circumference of half an inch. The mean of the two measurements gives the vertical annual growth of this species at 2 feet 2¼ inches, and an increase of circumference of 1⅜ inches. But this estimate affords too high an average, as the plants have grown badly on considerably more than one-half of the plantations.

7. The largest plant of *C. Succirubra*, planted in 1864, is 24 feet high, and the stem 17¼ inches in circumference at a foot from the ground. Only a few plants of that season's planting remained at the date of my visit, many having died of canker. The largest plant of this species planted in 1867 also measured 24 feet in height, with a circumference of stem of 13 inches.

8. The cultivation of *C. Calisaya* (yellow bark) in British Sikkim may be said to have just begun, as only three plants of this species were planted in 1866, 150 in 1867, and 220 in 1868. These latter plants are of a very valuable description, and were raised from the seeds imported by Mr. J. W. B. Money. The growth of the *Calisaya* is equal to that of the *C. Succirubra*, while the bark produced by this species is very superior for the manufacture of quinine. Ten consecutive plants of *C. Calisaya*, the finest that could be selected by Mr. Grammie, and planted on the 29th June 1867, gave the following measurements :—

	Height.	Circumference One Foot from Ground.	Average Yearly Growth.	
			Height.	Circumference.
	Ft. *In.*	*In.*	*Ft.* *In.*	*In.*
Number 1 - - - - -	15 0	9	3 9	2¼
„ 2 - - - - -	12 4	8¾	3 1	2¼
„ 3 - - - - -	14 3	9⅛	3 6¾	2⅜
„ 4 - - - - -	13 3½	7	3 3¾	1⅝
„ 5 - - - - -	12 7⅛	6⅜	3 1⅞	1⅝
„ 6 - - - - -	14 0	10¼	3 8¼	2⅝
„ 7 - - - - -	15 6	7	3 10½	1¾
„ 8 - - - - -	14 0	6¼	3 6	1⅛
„ 9 - - - - -	14 8¾	7⅛	3 8½	1¾
„ 10 - - - - -	15 0	7⅛	3 9	1⅞

or an average vertical growth, annually, of 3 feet 6½ inches, with an increase of circumference of stem of two inches. These plants were growing on the finest land on the Rungbee plantation.

9. The best plant of *C. Calisaya* measured 18 feet 2 inches in height, with a stem of 9 inches in circumference at a foot above the ground, a growth which is extraordinary, and would promise the best results, were it not that canker has already made its appearance among these plants, not only in the older plants, but to some extent in the plants of 1869. At the date of my visit small patches had begun to die. The growth of the *Calisaya* in British Sikkim appears in every respect equal, but in no way superior to that of the red bark.

10. *Cinchona Micrantha* (grey bark) cannot, in my opinion, be grown successfully on the Himalayas. The plantations of this species are very patchy. The plants appear to make satisfactory growth for about two years only, while the red and yellow barks on good ground grow well for three years. Upwards of one-half of the entire number of plants of *C. Micrantha* are already dead, and a few only are free from canker.

11. *Cinchona Officinalis* (crown-bark), which is, perhaps, the most valuable of all the species grown in India, has not succeeded in Bengal. Of the plants of this species at least three-fourths are already dead, and I believe that there is not a plant on the whole of the Government plantations free from canker, and this to such an extent as to stop the growth of the plants.

12. *Cinchona Pahudiana* is a species of comparatively little value; this, also, has not been successfully cultivated on the Himalayas, the plants being much in the same condition as the *C. Officinalis*.

13. The few plants of *C. Pitayensis* in British Sikkim have not as yet been placed in permanent plantations; it was therefore impossible to form any opinion of the success which may attend the cultivation of this sort.

14. From what has preceded, it would appear that if a supply of quinine-bark is to be produced in British Sikkim, it can only be obtained from *C. Succirubra* and *Calisaya*,

and that the cultivation of *C. Micrantha*, *Officinalis* and *Pahudiana* must be abandoned. The *C. Succirubra* is undoubtedly the best species for the supply of mixed alkaloids, such as have been successfully used in the hospitals of India. The *C. Calisaya* is one of the best species for the production of pure quinine. If, therefore, from these two species an ample supply of bark can be produced, it will meet all requirements of the Indian Government and the home manufacturer.

15. It is, therefore, with the deepest regret I have to inform the Government that, in my opinion, permanent plantations of these species cannot be formed in British Sikkim. The disease, which has rendered impossible the successful cultivation of *C. Micrantha*, *Officinalis*, and *Pahudiana*, has also made very serious inroads on, and threatens ultimately to destroy, the plantations of *C. Succirubra* and *Calisaya* also.

16. The disease known as canker generally arises from excessive damp, or a damp subsoil: and this would appear to be the cause of disease in the Sikkim plantations. All species seem to thrive in good land for one or two years after being permanently planted out, and the *Calisaya* and *Succirubra* for three years. At this age it appears to me the disease begins to make rapid progress among the red-bark plants. I must state, however, that I am informed by Mr. Clarke, the superintendent of the plantations, and by all his assistants, that the canker, especially among the *C. Succirubra* or red-bark plants, was decidedly on the decrease. These gentlemen have local experience and extensive observations of the plantations, and their opinions are therefore entitled to greater weight than mine; nevertheless, I am constrained to state that I cannot coincide in their opinion, and my impression is that the disease is on the increase. This impression is forced on my mind by the fact that the disease shows itself on numerous spots, here and there, throughout the plantation, wherever the soil is thin or the land damp. The plants on these spots made little or no growth; the leaves become yellow and unhealthy. The bark of the stems cracks, becomes rugged and knotty, and in the centre of these knots, or protuberances on the bark, a dark spot of decay appears. This spot penetrates the bark and wood of the stem of the plant, and extends sometimes horizontally and sometimes perpendicularly, destroying the tissues of the bark and wood, which becomes perfectly dead and dry. That this dead and dry portion of the stem can ever be renewed by any process in the action of the plant appears to me impossible, nor did I observe in any one instance, although I examined thousands of plants, any appearance of the healthy wood throwing a fresh deposit of bark over the decayed part; but in all instances the decay was encroaching rapidly on the living part of the plant. This also appears clearly established by the fact that the canker continuously spreads from the small points on which it originates, until, in the plantations of three and four years of age, the disease has so encroached on the fine patches that only a few healthy plants remain to the acre, while acres together have entirely died out from the progress of the disease. The young portions of the plantations are almost free from the disease, except in such spots where the soil is thin and the damp is near the surface. The steady spread of the disease from such points is so marked and visible that I believe so soon as the roots of the plants that now appear healthy penetrate into the subsoil, the disease will show itself more or less in these also. Of course the greater the depth of the surface-soil, the greater will be the growth, and the longer will the disease be in making its appearance. This is clearly illustrated by a general view of the plantations. The plants upon rich deep bamboo-land have made very satisfactory growth, and in some parts have attained four years' growth before they have become seriously affected with canker. A tract of this description of land of about 30 acres, adjoining the bungalow on the Rishap plantation, must have been for the first three years of its growth as fine a piece of chinchona-planting as could be found in any part of the world, but unfortunately at the time of my visit canker had made its appearance to a large extent in this also.

17. In some parts a great addition has been made to the depth of the surface-soil by the earth excavated from the road being thrown on the lower side. The plants on these parts have for the first three or four years made vigorous and satisfactory growth, but after this time canker has appeared here also. Here and there very large pits have been made by the natives in excavating the roots of the wild yam. These pits have in course of time been filled in by the wash of rich surface-soil, and the plants accidentally placed in these pits have made wonderful vertical growth; and although the older plants are not so luxuriant as the younger ones, still I did not observe any appearance of disease; I am therefore impressed that had the plantations been formed on rich virgin forest-land, the success would have been much greater, although it is probable that even under such circumstances the plantations, after a lapse of eight to ten years, would become diseased in consequence of the roots penetrating into the damp subsoil.

18. The private plantations in British Sikkim are in much the same condition as those of the Government. That of the Darjeeling Chinchona Association is, perhaps, on the whole better, while the *C. Officinalis* on the Tukvur plantation is decidedly in much better condition than this species on the Government plantations. Tukvur is a much drier climate than Rungbee, and it is strange that here the red-bark plants are in the same condition as on the Government plantations.

19. The cost at which chinchona-bark can be grown in British Sikkim cannot at present be estimated with any degree of certainty. Trees of equal height do not produce so much bark as in the South of India. This arises from the more slender growth and thinner

thinner bark of the plants in British Sikkim. Three selected red-bark trees above the average of the best on the Rishap plantation gave 6 seers or 12 lbs. of fresh bark. Only the stem and best branch bark was taken, the yield of dry bark being about 3¼ lbs. These trees were nearly four years old when cut down. On the 185 acres planted in 1867, taking the whole extent together, there were not on an average more than 70 such trees to the acre.

20. On the 30 acres of red bark near the Rishap bungalow, already mentioned as being the finest and most uniform on the Sikkim plantations, each alternate row of plants was cut down when 3½ years old. The produce obtained from these plants was 40 maunds of dry stem and branch bark. The quantity of bark in the trees left standing on the ground would thus be 40 maunds also. Previous to the alternate line of trees being removed, about 20 maunds of bark from thinnings had been obtained from the same piece of ground. I thus estimate that if these 30 acres had been entirely cut down, it would have yielded a total produce of 100 maunds, or 8,200 lbs. of dried stem and branch bark, or 273 lbs. per acre. This bark would be worth in London, at present market rates, from 7 *d.* to 2 *s.* per lb., or would have realised an average of 1 *s.* 3½ *d.*, giving a total sum of 5,296 rupees, or *Rs.* 175. 12 *a.* per acre.

21. If the cost of collecting the bark, drying, packing, carriage, freight, insurance, agency, brokerage, &c., amounted in all to 53 rupees per acre, a sum will be left of *Rs.* 122. 12 *a.* per acre as the entire return of the finest acres of *C. Succirubra* in British Sikkim when 3½ years old.

22. The patchy and irregular growth of the plantations, however, renders the result given above far too high as an average. From a careful examination of the 185 acres planted in 1867, of which the above 30 acres form a portion, I was strongly impressed that the 30 acres would produce more bark than the remaining 155 acres; but supposing the 155 acres capable of yielding double the amount of the 30 acres, or 16,400 lbs., the average return per acre would be reduced to about 60 rupees, instead of *Rs.* 122. 12 *a.*

23. In the fourth year of the age of the plants at Rungbee, it appears desirable that they should be cut down for the bark, this being the best time to secure vigorous shoots from the stumps; because, if a longer time for the growth of the plants is allowed, the disease makes such progress that the stumps will not throw shoots. The fresh shoots throw new surface-roots from beneath the points from which they spring from the old stools. I am, therefore, of opinion that the suckers thus treated would grow well for three or four years before they are seriously affected by canker. In this way, for a time at least, a crop might be obtained every third or fourth year from the best parts of the plantation, but more than half of the land already planted will never produce trees of sufficient size to give bark of any commercial value. The close planting practised in the Rungbee plantations is admirably adapted for this system of treating the plants.

24. The rough system of cultivation adopted in the Sikkim plantations is well described in the report of Mr. Clarke, the acting superintendent of the plantations, dated 10th July 1870, paragraph 28. The climate and local circumstances render this sort of cultivation necessary at Rungbee, as to cultivate and dig up the land in such a wet climate and on steep slopes would cause much of the soil to be washed away; but it is a system that cannot be practised on the Nilgiris, as under it our plants make slender and unsatisfactory growth, and many would die during our dry weather; moreover, the plantations would be liable to entire destruction by fire, and this is a danger from which they are not entirely free even in the moist region of Rungbee. The examination of the Sikkim plantations strongly impresses me with the desirableness of maintaining a high system of cultivation with all plants under six years of age on the Nilgiri plantations. After the plants attain this age they can be safely left without cultivation.

25. On the Himalayas they possess many advantages which at first sight would indicate that locality to be the best suited for the production of quinine-bark. They have an unlimited extent of land perfectly sheltered and free from heavy storms, which occasionally do so much harm to the plantation on the Nilgiris; they have an abundant and good supply of cheap labour; they are free from the severe and continuous drought to which we are subjected: against these advantages are to be placed what, in my opinion, forms an insuperable obstacle to the successful growth of chinchona, namely, the cold damp subsoil, an excessively moist climate, with extremes of temperature during the winter and summer months.

26. On the Sikkim plantations I did not observe any seedlings springing spontaneously from the seed which had fallen from the older trees. On the Nilgiri plantations thousands of such seedlings spring up yearly, and many have attained a height of from 8 to 10 feet. The manner in which self-sown plants establish themselves on the Nilgiris indicates a climate which cannot be otherwise than suited to the growth of the plants.

ORDER of the Madras Government thereon, 26th May 1871.

THE Government consider that such a comparison as Mr. Breeks proposes would be both interesting and useful. He will associate himself with Mr. McIvor as sugge

---

Enclosure 3, in No. 19.

From the Commissioner of the Nilgiris, to the Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 13th December 1871

IN accordance with the Under Secretary's letter of the 27th October 1871, I drew, Mr. McIvor's attention to the statement made by Mr. Munro at page 982 of the Supplement to the "Gazette of India," dated 8th July 1871, namely: "We received our first (chinchona) cuttings from the Nilgiris, and these were extensively affected with canker;" and to the remark in paragraph 4 of Mr. Secretary Hume's letter (page 1,000 of Supplement), to the effect that the canker, which has attacked the plants at Rungbee, "is shown to have existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations."

2. As directed, I forward Mr. McIvor's remarks, which are pertinent, and, to my mind, conclusive.

The weight due to Mr. Munro's statement is not difficult to determine with the aid of Mr. McIvor's explanation, that the Darjeeling Association never received any cuttings from the Nilgiris in Mr. Munro's time, and that Mr. Munro did not arrive at Pomong until the Nilgiri plants originally supplied had been nearly two years, and the last supply fully ten months, in Beng l.

It was not the object of the Chinchona Commission to discover whether the disease came from this or that district, and, therefore, Mr. Munro's statement passed unchallenged; nor is it worth while now, I apprehend, to ask him to refresh his memory by the light of Mr. McIvor's letter.

3. There remains Mr. Hume's statement.

I have read the Chinchona Commissioners' Report, and am at a loss to understand how Mr. Hume arrives at the conclusion that the disease "is shown to have existed in the plants originally sent up from the Nilgiris."

Mr. Munro's random assertion is the only evidence that the Nilgiri plants were cankered; yet this single unexamined statement, made seven or eight years after the last supply of Nilgiri plants to Bengal, by a witness who could not speak from his own experience, is accepted by Mr. Hume as conclusive, and is made public, with the authority of the Government of India, in the face of Dr. Anderson's testimony at the time to the "vigorous growth and excellent condition" of the Nilgiri plants imported by him.

4. Such a hasty statement is hardly creditable to a department lately created, in order that "special attention might be devoted to many branches of administration now unavoidably more or less neglected, or but imperfectly dealt with."

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 6th December 1871.

I HAVE the honour to acknowledge your letter of the 31st ultimo, calling my attention to pages 982 and 1,000 of the Supplement to the "Gazette of India" of 8th July 1871, in which is published the Report of the Bengal Chinchona Commission, and asking me for an explanation of the evidence given by Mr. Munro, namely, that "we received our first cuttings from the Nilgiris, and these were extensively affected with canker;" and to paragraph 4 of the Proceedings of the Governor General in Council, where the canker in the chinchona plants in Sikkim is said to be "a disease which is shown to have existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations."

2. In reply, I beg to state that I am not aware of the facts on which the Government of India have come to the above conclusion, but if the original 204 plants of chinchona, selected by Dr. Anderson in December 1861 from our stock on the Nilgiris, and conveyed by that gentleman to Bengal, were really cankered plants, it is remarkable that

there should have been no mention of this fact until 1871. The reports by the gentlemen in charge of the Bengal plantations describe the plants to be in the "highest health" and "growing most vigorously." It appears impossible that responsible, scientific, and practical gentlemen should have continued for years to furnish such favourable reports on plants which were affected with disease from the first.

3. When viewed in connection with recorded facts many of the statements made before the Chinchona Commission appear contradictory and impossible. This is especially the case with reference to the evidence of Mr. Munro. It is, therefore, to be regretted that that gentleman was not asked to explain the facts on which he made the statement above quoted. It is quite certain, from a careful examination of the records, that Mr. Munro never received any cuttings from the Nilgiris. In fact, Mr. Munro did not arrive at Pomong until December 1863, or when the original plants sent from the Nilgiris as stock for the Sikkim plantations had been nearly two years, and the last supply fully ten months, in Bengal. Thus it was impossible for him to know whether such plants were healthy or otherwise when they left the Nilgiris.

4. At page 981, in reply to Question No. 2, Mr. Munro states: "But my present plantation of 500,000 (*C. Succirubra*) plants have been raised by cuttings from 92 plants." This is an error, as I supplied a quantity of excellent seeds to the proprietors of the Pomong plantations, Mr. Lloyd and Colonel Angus. These seeds germinated freely, and probably produced from 50,000 to 100,000 seedlings. The seeds were gathered from plants which never had an indication of disease, and at the present moment are fine forest trees.

5. Another instance of the manner in which the evidence given before the Chinchona Commission is ill-considered, and likely to mislead, occurs at page 985, where Mr. Mann, in referring to the plants planted out in Sikkim in 1864, says: "Ten per cent. were old exhausted stock plants from the Nilgiris." Mr. Mann did not arrive in India till the 14th March 1864, or one year and two months after the last supply of Nilgiri plants arrived in Bengal.

6. It appears to be assumed that the Sikkim plantations were stocked with plants from the Nilgiris only. But the records show that the stock was obtained as follows:—Dr. Anderson raised in April and May 1861 in the Calcutta Botanic Gardens 120 seedlings* from seeds of *C. Micrantha*, *C. Succirubra*, and *C. Peruviana*, obtained by Mr. Markham from South America. Of *C. Pahudiana*, 548 seedlings were raised in Calcutta in December 1861, and the early part of January 1862 from Java seeds. Two hundred and four plants reached Calcutta from the Nilgiris on the 13th January 1862, and the second and last supply of 350 plants from the Nilgiris† arrived in Calcutta on the 30th January 1863. Of *C. Officinalis*, 11 plants‡ were received from Ceylon on the 28th January 1863, and 1,373 additional plants of *C. Pahudiana* from Java seed had germinated on 1st April 1863. In March 1866 Dr. Anderson raised 3,100 seedlings§ of *C. Officinalis* from seeds received in January 1866 from Mr. Thwaites, Ceylon, and 8,000 seedlings‖ from seeds received from the same source in March 1866. During 1866-67, 38,500 seedlings, and in 1867-68, 101,175 seedlings were raised in the Sikkim plantations.

7. Thus the Sikkim plantations received large supplies of seeds and plants from other sources than the Nilgiris; the Nilgiris merely furnishing the principal stock of *C. Calisaya* and *C. Succirubra*. The Sikkim stock of *C. Officinalis* was raised principally from seeds from Ceylon, and it is worthy of note that the entire stock of this species has been so seriously affected with canker as to cause the cultivation to be abandoned. The Sikkim stock of *C. Pahudiana* raised solely from Java plants and seeds has also been destroyed by canker. The Java variety of *C. Calisaya* (*C. Josephiana*) has been so affected by canker that only one plant existed on the Sikkim plantations at the date of my visit in February 1871 out of all the plants received of this variety. It is thus a matter of record that disease in the Sikkim plantations has not been confined to plants produced from the Nilgiri stock; disease, in fact, having made even more serious inroads on the plants and seedlings from South America, Ceylon, and Java. The *C. Succirubra* and *C. Calisaya*, the principal stock of which were supplied from the Nilgiris, are the only species which give a hope of successful culture in Sikkim. It, therefore, may be fairly assumed that the stocks of these plants were at least as healthy as any procured elsewhere.

8. I shall now notice what Dr. Anderson states to have been the condition of our plants. That gentleman visited the Nilgiris on the 17th December 1861, and that he was not favourably impressed with anything we had done is abundantly illustrated in his Report to the Secretary to the Government of India of 14th February 1862. In this Report Dr. Anderson condemns all the sites on the Nilgiris as unsuited to the growth of chinchona.

* Report of Botanical Gardens, Calcutta, from April 1861 to April 1862, by T. Anderson, Esq.
† Annual Report of Chinchona cultivation in British Sikkim, dated 30th April 1863.
‡ T. Anderson, Esq., to Junior Secretary to Government of Bengal, 1st May 1866.
§ Report of the Sikkim plantations from 1st April 1865 to 31st March 1866, by T. Anderson, Esq.
‖ Report on the cultivation of Chinchona in Bengal for the year 1867-68.

chona. He asserts that the plants require "dense shade," and that our attempt to grow a "shade-loving tree" in such "unnatural places as cleared gardens" will end in "complete failure." This depreciation also extends to our plants, as Dr. Anderson, in the same Report, at paragraph 8, states, "The season is now too far advanced for the despatch of plants to Java, and the plants at the Nilgiris are not at all adapted for transmission to a distance, as plants artificially propagated, as they have been, cannot bear the risk of a long journey without a few months' preparation. Of those I brought, the short journey from the Nilgiris to this, I lost nearly 10 per cent., while the plants from Java, which were seedlings, can hardly be said to have suffered at all." Again, at paragraph 6, Dr. Anderson, referring to the Nilgiri plants, says, "These arrived in tolerable order, considering the loose manner in which Mr. McIvor, from want of time, was obliged to pack them. About 13 plants out of 204, the entire number received, have been seriously damaged; the remainder, in the present genial climate of Calcutta, have quite recovered, and are as healthy as at Ootacamund." Again, at paragraph 20, Dr. Anderson states that "193 plants" out of the 204 were "growing most vigorously" in the Calcutta Botanical Gardens on 19th January 1862. This reduces the loss to less than 5½ per cent.

9. The whole of the above gives a most erroneous impression, as the loss of the plants was neither owing to artificial propagation, or to being carelessly packed, but was wholly caused by an accident which Dr. Anderson describes in his Report on the Botanical Gardens, Calcutta, from April 1861 to April 1862, in these words: "While I was at Ootacamund I procured 204 plants belonging to four other species of chinchona, besides those I obtained in Java. Several of these plants were destroyed between the foot of the Nilgiris and the railway station by the upsetting of one of the carts on which the Wardian cases were carried."

10. The last batch of plants forwarded from the Nilgiris as stock for the Sikkim plantations were prepared by me in December 1862, and are thus mentioned by Dr. Anderson in his Report on the Sikkim plantations, from 1st April 1862 to 30th April 1863: "These plants were obtained from Madras on the 31st January 1863, and of the original number, 350, obtained from Madras, only 23 had been lost between Calcutta and Darjeeling during the two months that had intervened from the date of their arrival in Calcutta and their reaching Darjeeling." Dr. Anderson speaks of the same plants in his letter to Sir William Denison, dated 9th March 1863, as follows:—"You will probably like to hear that the chinchona plants supplied to me from Ootacamund arrived here in excellent condition; they are still in the gardens, and have grown much, most of them having made three pairs of leaves since their arrival here. The weather is now getting too hot for all of them, except *C. Succirubra*."

11. On the Nilgiris we received, on the 9th April 1861, in all 463 plants of *C. Succirubra* from South America, and those plants had been about eight months on these hills at the time Dr. Anderson selected the plants for Bengal. Dr. Anderson thus describes our plants at the date of his visit (December 1861): "With the exception of a few plants recently placed in the open air nurseries at Neddivuttum, all the chinchona plants on the Nilgiris are growing in the conservatories in the Government Gardens at Ootacamund, where, protected from the vicissitudes of the weather, and in a recently erected house, even under the influence of artificial heat they are growing luxuriantly." Dr. Anderson selected his 204 plants from 3,500, which were prepared to be sent to the Neddivuttum Nurseries, and the whole of the remainder of these plants, namely, 3,296, were subsequently planted on the first Denison plantation, and now form a fine chinchona forest. No disease has ever appeared among any of these plants. During this year we have taken the bark from the stems of 1,000 of these trees, and they have yielded upwards of three pounds of dry bark each; the trees, notwithstanding the removal of the bark, still continue to maintain their usual health and vigour.

12. In conclusion, I would desire to bring prominently forward the following facts:—First, for many years, subsequent to the receipt of the Nilgiri plants, Dr. Anderson and the other gentlemen in charge of the plantations speak of them as in the "highest health" and "growing most vigorously," &c.;* second, the plants and seedlings received from other

* From the Officiating Superintendent, Royal Botanic Gardens, to the Secretary to the Government of India, 11th February 1862.

20. * * "The plants are in very good health, and *C. Succirubra*, *C. Calisaya*, and *C. Pahudiana* are growing most vigorously, and seeds *C. Pahudiana* are coming up daily."

* * * * *

First Annual Report on Chinchona Cultivation in *British Sikkim* from 1st April 1862 to 30th April 1863, by the Officiating Superintendent of the Botanic Gardens, *Calcutta*.

* * * * *

"I am glad to be able to report that on my visiting the Chinchona Nursery at Lebong in the end of May I found all the plants in the highest health, and that the propagation of all the species, except *C. Pahudiana*, was advancing rapidly."

* * * * *

other places than the Nilgiris, are, if anything, more extensively diseased than those raised from the Nilgiri stock; third, that Dr. Anderson selected his own plants (204) out of 3,500; the remaining 3,296 were planted out on the Nilgiris. No trace of disease has ever shown itself in these plants, and they are at the present time as fine trees for their age as any in the world; fourth, the loss of the 11 plants mentioned by Dr. Anderson was owing to an accident, and not to artificial propagation or loose packing.

— No. 20. —

(No. 7—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 29 February 1872.

In continuation of our Despatch, dated 21st September 1871, No. 41, we have the honour to forward, for your Grace's information, the accompanying tabular report on the progress and condition of the Chinchona plantations on the Nilgiris for the half-year ending 31st January, 1872.

We have, &c.,
(signed) *A. J. Arbuthnot*, &c.

Report on Chinchona Cultivation, at *Darjeeling*, from 1st April 1863 to 15th July 1864, by the Superintendent, Botanic Gardens, *Calcutta*.

* * * * *

"It is, however, deserving of notice, as showing the great suitability of the climate of Darjeeling for the species *C. Officinalis* (var. Bonplandiana), that the rate of increase of that species has been nearly 2,000 per cent. during the same period. The rate of increase is now most satisfactory, and the cuttings obtained monthly are large and healthy."

From the Superintendent of the Botanic Gardens, *Calcutta*, to the Junior Secretary to the Government of Bengal, 13th February 1865.

* * * * *

"The condition of the plants is in the highest degree satisfactory, considering the removal of almost all from Lebong to Rungbee, a distance of about 20 miles."

* * * * *

Report on the Cultivation of Chinchona at *Darjeeling* during the Month of April 1865.

* * * * *

2. "The growth of the plants has everywhere been most satisfactory, and especially at the lowest plantation the condition of the plants of all species could hardly be surpassed."

* * * * *

Report on the Cultivation of Chinchona at *Darjeeling*, from the 1st April 1865 to 31st March 1866, by the Superintendent, Royal Botanic Gardens, *Calcutta*.

"I am glad to be able to report that the cultivation of chinchona at Darjeeling has, during the past year, been attended with the greatest success."

* * * * *

"The stock plants of all the species are in the finest condition, and the 37,000 plants of *C. Succirubra* and *C. Officinalis* intended for the permanent plantations to be commenced in April, are strong and healthy."

* * * * *

Report on the Cultivation of Chinchona in *Bengal* for the Year 1867–68.

"The cultivation of chinchona has been most successfully carried on during the year. The number of plants propagated has far exceeded the amount added to the chinchonas during any previous year."

* * * * *

From the Officiating Superintendent, Botanic Gardens, and in charge of Chinchona Cultivation in *Bengal*, to the Secretary to the Government of Bengal (Botanic Gardens, 27th May 1869).

* * * * *

7. * * "The growth made by the plants in the Rungbee and Rishap plantations during the year has far exceeded that during the preceding year."

* * * * *

Enclosure in No. 20.

Report on the Number, Distribution, and Condition of Chinchona Plants on the Nilgiris for the half-year ending 31st January 1872.

Species.	Botanical Names.	Commercial Names.	Number of Plants.	Value per lb. of dry Bark in the London Market.
				s. d. *s. d.*
1	C. Succirubra	Red bark	1,215,963	2 6 to 8 9
2	C. Calisaya C. „ Vera C. „ Frutex	Yellow bark	54,881	2 10 to 7 –
3	C. Officinalis	—	—	—
	C. var Condamenia	Original loxa bark	1,183,159	2 10 to 7 –
	C. „ Bonplandiana	Select crown bark	87,509	2 10 to 7 –
	C. „ Crispa	Fine crown bark	4,355	2 10 to 6 –
4	C. Lancifolia	Pitayo bark	279	1 8 to 2 10
5	C. Nitida	Genuine grey bark	2,786	1 8 to 2 9
6	C. Species without name	Fine grey bark	8,500	1 8 to 2 10
7	C. Micrantha	Grey bark	46,730	1 8 to 2 9
8	C. Peruviana	Finest grey bark	3,389	1 8 to 2 10
9	C. Pahudiana	Unknown	425	Unknown.
10	C. Lanceolata-leaved variety of C. Officinalis.	-	6,319	- ditto.
11	C. Pitayo, raised from imported seeds	-	12,155	- ditto.
12	C. Pitayo plants brought out by Dr. Simpson.	-	76	- ditto.
	Total number of plants		2,626,526	

Table showing the Growth of the different Species of Plants planted out in the Plantation for the half-year ending 31st January 1872.

Number of Plants.	Species.	Where planted.	When planted.	Maximum Growth.	Average Growth.	Height of the tallest Tree.	Girth near the Ground.
				inches.	*inches.*	*feet.*	*inches.*
12	C. Succirubra	Nedivuttum	30 Sept. 1862	11	7¼	28⅓	27½
12	C. Micrantha	- ditto	30 „ „	12	5⅓	27½	31½
12	C. Officinalis	Dodabetta	30 „ 1863	39	18	22	16½

Table showing the Propagation, Distribution, &c., of Plants and Seeds during the hal year ending 31st January 1872.

DATE.	Total Number of Plants Propagated.	Total Plants permanently planted out.	Total Plants distributed to Private Individuals.	Total Quantity of Seeds gratuitously distributed.
				ozs.
August 1871	1,881	1,200	- -	8
September „	2,349	1,000	5,000	—
October „	1,708	- -	- -	14
November „	1,652	- -	- -	5
December „	1,507	—	—	—
January 1872	1,651	- -	- -	4
	10,748	2,200	5,000	31
Previously	2,615,778	1,153,974	179,267	342
Grand Total	2,626,526	1,156,174	184,267	373

Remarks.—1,500 Chinchona Calisaya and 700 C. Lanceolata plants were permanently planted out in the plantations at Neddivuttum, making the total 1,156,174.

Seven thousand eight hundred and sixteen C. Pitayo and 2,932 C. Lanceolata plants were propagated, making the total 2,626,526.

The number of plants distributed to private individuals is 5,000, making the total 184,267.

Thirty-one ounces of Chinchona seeds have been gratuitously distributed, making the total 373 ounces.

The circumference of the stems of the succirubra trees are given at a foot above the ground instead of at the surface, as in former reports.

Ootacamund, 7 February 1872.

—No. 21.—

(No. 11 Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 7 March 1872.

In continuation of our Despatch, dated 21st August 1871, No. 36, Miscellaneous, we have the honour to advise your Grace of the transmission to the India Office by steamer, *vid* the Suez Canal, of 12 cases received from the Commissioner of the Nilgiris, containing 4,106 lbs. of Chinchona bark for sale in the English market.

2. The Commissioner's letter on the subject, with its enclosure, and one from the Government Quinologist, reporting the results of the analysis of the bark in question, are herewith forwarded.

We have, &c.,
(signed) *A. J. Arbuthnot.*

Enclosure 1, in No. 21.

From the Government Quinologist, to the Officiating Chief Secretary to Government, Fort St. George, dated Ootacamund, 26th February 1872:—

A considerable amount (4,106 lbs.) of red and crown bark is being sent to England for sale by the Superintendent of the Chinchona Plantations according to the following invoice:—

No. of Boxes.	Description of Bark.	Weight of Bark.	Weight of Boxes.	Total Weight.
		lbs.	*lbs.*	
1	Red Bark, Mossed - - - -	182	55	
2	„ „ - - - -	190	61	
3	„ „ - - - -	252	84	
4	„ „ - - - -	229	73	
5	„ „ - - - -	326	90	
6	„ „ - - - -	116	41	
7	Crown Bark „ - - - -	430	108	
8	„ - - - - -	400	103	
9	„ - - - - -	658	139	
10	„ - - - - -	368	84	
11	„ - - - - -	676	145	
12	Red Bark, Unmossed - - - -	279	59	
	TOTAL - - -	4,106	1,062	5,148

2. The

2. The barks on an average contain 10 per cent. of water, although air-dried bark. The amount of alkaloid contained in the average specimen of each bark is as follows when expressed in percentages of quite dry bark:—

——	Crown Bark.	Unmossed Red Bark.	Mossed Red Bark.
Total Alkaloids - - - - - - -	4·02	6·60	7·80
Quinine - - - - - - - - -	2·43	1·49	1·64
Chinchonidine and Chinchonine - - -	1·59	5·11	6·16
Pure Sulphate of Quinine obtained crystallized	2·43	0·84	0·92
Other Sulphates obtained crystallized - -	1·10	4·45	4·74

3. The mossed red bark is from the oldest trees and has been long under moss. The unmossed red bark is from the upper part of the trunks of some trees. The crown bark is from the Neddivuttum plantations, and consequently though good not of our best quality.

Enclosure 2, in No. 21.

From the Commissioner of the Nilgiris, to the Officiating Chief Secretary to Government, Fort St. George, dated Ootacamund, 1st March 1872.

With reference to Order of Government, Revenue Department, No. 2,048, dated 5th December 1871, I have the honour to forward, herewith, a letter from Mr. MeIvor, with its Enclosure, No. 148, dated 29th ultimo, advising despatch to Madras, through the Carrying Company, of 12 boxes, containing Cinchona bark.

2. I beg to invite your attention to paragraph 3 of the above letter, regarding protection of the boxes from salt water, while in transit from the beach to the shipping.

From the Superintendent, Government Cinchona Plantations, to the Commissioner of the Nilgiris, dated Ootacamund, 29th February 1872.

I have the honour to enclose the Madras Carrying Company's receipt for 12 boxes, containing Cinchona bark, forwarded to the Revenue Secretary to Government, Madras, for the Secretary of State for India, in accordance with Government Order, No. 1,339, dated 4th August 1871, and Government Order, No. 2,048, dated 5th December 1871.

2. The boxes contain 1,295 lbs. of Mossed Red Bark.
279 „ of Unmossed „
2,532 „ of Crown Bark, as noted at foot.

3. I beg you will be good enough to request that the boxes may be protected from salt water while conveying them from the beach to the ship.

— No. 22. —

(No. 18—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 9 May 1872.

I HEREWITH transmit five copies of a work entitled "*Nouvelles Études sur les Quinquinas, &c., par J. Triana,*" for presentation to public libraries, and for the use of officers who are in charge of, or connected with Chinchona cultivation in the Madras Presidency.

I have, &c.,
(signed) *Argyll.*

— No. 23. —

(No. 21—Revenue.)

From the Government of Madras to the Secretary of State for India, Fort St. George, 4 June 1872.

My Lord Duke,

Proceedings of Government, 10 April 1872. Proceedings of Government, 1 June 1872.

WITH reference to paragraph 2 of Sir Stafford Northcote's Despatch, dated 30th November 1868, No. 47, we have the honour to forward, for your Grace's information, our proceedings marginally noted, containing a letter from the Government Quinologist, reporting the results obtained by the action of certain manures on Chinchonas.

2. Mr. Broughton's experiments in the matter are very instructive and important; and it seems desirable that they should, as proposed by him, be continued on an extended scale. We accordingly enclose an indent for the English manures required for the plantations, namely, one ton of sulphate of ammonia and one ton of Peruvian guano, and request that your Grace will cause the same to be supplied to us as early as practicable.

3. It will be seen that we have arranged for ordinary farmyard manure having also a trial.

We have, &c.,
(signed) *Hobart*, &c.

Enclosure 1 in No. 23.

From the Government Quinologist, Ootacamund, to the Officiating Chief Secretary to Government, Fort St. George, dated 7 March 1872.

I HAVE the honour, in the following pages, to communicate the results at present obtained by the action of certain manures on the trees of *Chinchona succirubra* and *officinalis*, growing on the Government plantations.

Origin and objects of experiments with manures. * Government Order, Revenue Department, 22 September 1868.

2. The Government, in consequence of my suggestion,* ordered that experiments should be tried with certain nitrogenous artificial manures, in order to determine whether their action would increase the amount of alkaloid in the bark of the Chinchona trees to which they were applied.

3. In consequence, 10 casks of manures were ordered from England, consisting of 12 cwt. of ammonic sulphate, as prepared from English "gas-liquor," and 9 cwt. of "Peruvian guano," both being of good commercial quality. These manures were applied to several plots of trees at the Dodabet and Neddivuttum plantations in October 1869, the trees being of various ages, and the quantities applied varying from 4 oz. to 1 lb.

Proceedings.

4. Some

Proceedings and consequences with *C. Succirubra.*

4. Some fine young plants of *C. Succirubra* at Neddivuttum, three years of age, were treated in November 1869 in plots of 50 each, with 1 lb. of ammonic sulphate and the same amount of guano. There were but few showers after October, and no surprise was felt at the circumstance that the trees did not in the least differ in appearance from the ordinary unmanured trees. But after the succeeding south-west monsoon, it appeared somewhat strange that no greater luxuriance of growth was apparent. The trees, even during the rains of 1871, preserved still their ordinary appearance, and I thought it remarkable that these ordinarily stimulating manures should so entirely fail in their effect on the Chinchona trees. It was not until the autumn of 1871 that any change was perceptible; but at that time it appeared to me that an increase in the depth of tint of the leaves and a somewhat greater luxuriance was apparent among the trees, manured with ammonic sulphate. The difference, however, was slight, and I was informed by Mr. McIvor that no difference was perceptible to him. I certainly perceived no change in the growth whatever in those trees which had received less than 1 lb. of the manure.

Results with ammonic sulphate

5. In January last, the time appeared to have arrived at which it was desirable to examine analytically the quality of the barks. The following statement gives the amounts of alkaloid obtained, calculated in per-centages of dry bark; compared with a sample of bark taken from trees of same age, growing near, under conditions which only differed by the absence of manure.

	Manured.	Unmanured.
Total alkaloids - - - - - - -	7·25	4·89
Quinine - - - - - - - -	2·45	1·78
Chinchonidine and Chinchonine - - -	4·80	3·11

I thus found, somewhat to my surprise, that the manure had caused an increase in the alkaloids to the amount 2·36 per cent., of which 0·67 consisted of quinine.

Results with Guano.

6. A similar examination was conducted with the trunk bark of the trees which had received 1 lb. of guano. The comparative results are expressed in the same manner as the above:—

	Manured.	Unmanured.
Total alkaloids - - - - - - -	5·29	4·76
Quinine - - - - - - - -	0·91	1·04
Chinchonidine - - - - - - -	4·38	3·72

Consequences.

7. From these analyses it is evident that the guano had produced an increase of but 0·53 per cent. of total alkaloids, and that the manured bark contained 0·13 per cent. less quinine than the unmanured. The loss of guano, when compared with that of ammonic sulphate, is contrary to what would be expected *à priori*. The conclusion I derive from these experiments with *C. Succirubra* is, that as the gain in the most successful case consists mainly of alkaloids other than quinine, it will not be profitable henceforward to manure this species, even with ammonic sulphate, as the cost of such manure may be as great as the increase in the commercial value of the bark. The fact of the gain in alkaloids is, however, a result of much interest.

Proceedings, Madras Government, 22 February 1870, No. 235, paragraphs 5 and 6. Sensitiveness of *C. officinalis.*

8. I have had occasion in the report noted in the margin and in many subsequent reports to mention the great sensitiveness with which the crown bark trees are effected by situation, sunlight, and character of soil; and have taken the opportunity of expressing my conviction that *C. officinalis* was the best adapted for high cultivation. Hence I naturally anticipated that the influence of manures on this species would be marked, and would result in a considerable increase in the amount of alkaloids contained in the bark. The considerable variations which occur in the bark of this species from apparently slight causes necessitated much care in experiments in which the influence of manures was to be investigated. Hence in an apparently homogeneous plot of *C. officinalis* long double rows were selected in which to try the effect of the manures, while the trees between these double rows were left unmanured.

Proceedings and consequences with *C. officinalis.*

9. In October 1869 the manure was applied in amounts of 1 lb. and ½ lb. of each to a tree. Smaller amounts were also used, but were applied to younger trees. The trees to which the larger quantities of manures were applied were of the same age as the trees of

C. Succirubra

C. succirubra at Neddivuttum, or were, in 1869, of three years old. Several heavy showers fell after the manuring took place, and it was with much surprise that I could perceive no change had taken place in the growth of the tree. Since the above date no improvement whatever has been perceptible in the manured trees over the immediately adjoining trees which have been unmanured. As the trees of *C. officinalis*, which yield the finer barks, are nearly always of more vigorous and luxuriant growth, I for a long time concluded that the views I formerly held were wrong, and that the experiments with manures would yield negative results only. In February 1872 no difference was to be distinguished between the manured and unmanured trees, and they were only to be recognised by the postal labels which marked them. The trees which had received 1 lb.

Results with guano.

of guano gave the following per-centages of alkaloid in the dry bark. The analysis of the unmanured bark is also attached for comparison, a mean specimen of each being carefully collected for that purpose :—

	Manured.	Unmanured.
Total alkaloids	6·51	3·98
Pure Quinine	4·41	2·40
Chinchonidine and Chinchonine	2·10	1·58

Hence it appears that the 1 lb. of guano had increased the total alkaloids in the bark by 2·53 per cent., of which increase 2·01 was quinine.

Results with ammonic sulphate.

10. It was with great vexation that I found that the stake, which carried the label which marked the trees that had received the 1 lb. of ammonic sulphate, had been taken away during the last three months of 1871, and that no mark remained by which the trees could be distinguished. Hence, to ascertain the effect of this ammonic salt, I had to take trees which had received but ¾ lb. of the manure. The content of the dry trunk-bark in alkaloids is expressed as follows :—

	Manured.	Unmanured.
Total alkaloids	5·76	4·54
Pure Quinine	3·11	2·54
Chinchonidine and Chinchonine	2·65	2·00

The addition as manure of ¾ lb. of ammonic sulphate had thus produced an increase o 1·22 of total alkaloids, and 0·57 of quinine.

Application of farm-yard manure.

11. In 1857, during the absence of the Superintendent of the plantations in England, requested the acting superintendent, Mr. Batcock, to apply stable manure to six averag trees of *C. officinalis*. On the return of the Superintendent, Mr. McIvor continued th application of a barrow load of pig-litter or bullock manure every six months, as com menced by Mr. Batcock. More lately, owing doubtless to the frequent changes made i the subordinate superintendence of the plantations, this manuring has been carried out wit great irregularity. On the whole, each tree has probably had three applications, and a the most but four. As no improvement was perceptible in the appearance of the tree none has been applied during the last 18 months. In February 1872 specimens of bar have been taken from four trees, and at the same time the bark was taken from severe unmanured trees growing under the same conditions and immediately adjoining. Th analyses are as follow :—

	Manured.	Unmanured.
Total alkaloids	7·49	4·68
Pure Quinine	7·15	2·40
Chinchonidine and Chinchonine	0·34	2·28

Hence there has been a singular improvement in the quality of the bark. The total increase in alkaloids has been 2·81 per cent., but the manure has also had the singular effect in causing the alkaloids to be *quinine*, instead of cinchonidine and cinchonine. Hence

Hence the total increase in pure quinine is no less than 4·75 per cent. Hence the bark has been at least doubled in value in the English market, and the gain or difference in value in English money may be estimated at the present time to be 2 *s.* 6 *d.* per pound of trunk-bark. This estimate does not take into account the fact that this manured bark yields quinine sulphate sufficiently pure without the cost of the separation from the cinchonidine sulphate; and hence is of less expense in quinine manufacture.

Results and gain.

12. In nearly every case in which the action of farm-yard manure has been compared with the more artificial manures, it has been found to have somewhat the superiority. Although in the above experiments it has had the advantage of a longer time of action, this superiority still is evident.

General superiority of farm-yard manure.

13. The only perceptible change which appears in the crown bark trees by these nitrogenous manures consists in the increased yield of alkaloids. There is no greater luxuriance of growth apparent, and it is only by analysis that a change is detectable in the bark. This result appears to me strongly to corroborate the hypothesis that it is by supplying the elements of the alkaloids in an appropriate form that the increased yield is produced. I have long been of opinion that the alkaloids in the bark of the trees are not specially active constituents in the processes connected with the life and growth of the plant, and this supposition is supported by the circumstance that the increased amount of alkaloid produced by the manure causes no change in the appearance and rate of growth of the tree.* It is thus to be remarked that the action of manures on Chinchona is peculiar and specially supports the above hypothesis. It would be quite intelligible from the well-known action of manures upon growing plants that an increased growth of bark would be obtained. But this is not the result with Chinchona; a larger yield is not obtained; but certain constituents of the bark are increased in quantity. That there is a certain similarity in composition between some constituents of the manure and the alkaloids appears thus a fair conclusion.

Corroboration of hypothesis formerly mentioned.

14. The addition as manure of 1 lb. of guano to a tree of *C. officinalis*, as reported above, has caused an increase in the value of a pound of bark that may be moderately estimated at the present time to increase its market value by 1 *s.* 6 *d.* per lb. The cost of the guano bought in England, with that of freight, insurance, agent's commission, and carriage to the hills, cost 2½ *d.* per lb. It thus is evident that even employing guano, obtained at by no means the lowest cost, as manure to *C. officinalis*, the profit is certain and considerable. It is furthermore probable that the maximum effect of the manure has not been arrived at in the foregoing experiments, since it is unlikely that the period of greatest yield would be hit upon by chance in the first trial.

Discussion of gain.

15. It thus appears to me that the action of manures promises a new direction in which the cultivation of the Chinchona alkaloids can be still further improved.

16. I should mention that the quinine obtained from the manured trees readily yields its normal, or nearly theoretical amount of crystallized sulphate. As the analyses were not made for a commercial purpose, the amount of crystalline sulphates has not in every case been determined.

Quinine readily crystallizes as sulphate.

17. There are some plots of younger trees whose treatment with manure has hitherto purposely been in smaller amount than those whose examination forms the subject of the foregoing. I am of opinion that a further small quantity of manure should be obtained from England for the further treatment of these young trees and for certain experiments suggested by the foregoing. The manure can be procured out of savings in my next year's budget. Whether the application of manures should be carried out to a greater extent than these experimental plots Government will decide. I would recommend that *C. officinalis* be the species to which it should be applied; and that if stable manure, as is probable, cannot be obtained in sufficient quantity, guano should be the manure used.

Projected proceedings.

ORDER of Madras Government thereon, 10 April 1872.

IN this letter the Government quinologist reports the results obtained by the action of certain manures on Chinchonas.

2. Mr. Broughton's experiments in the matter are very instructive and important; and it seems desirable that they should, as proposed by him (paragraph 17), be continued on an extended scale. The Government will be prepared to apply to the Secretary of State for a supply of the English manures on being furnished with an indent of the quantity required. They think it will be well that the indent should provide for double the quantity stated in paragraph 3 of the report to have been obtained in 1869, so as to admit of the experiments being made under greater diversity of circumstances. Ordinary farm-yard manure should also have a competitive trial; cattle and pigs being purchased to form this manure if it is not otherwise procurable. The Commissioner of the Nilgiris will instruct Mr. McIvor to arrange for having this done.

* Mr. McIvor informs me that he has greatly stimulated the growth of young plants on poor soil by manuring them with cow-dung. No stimulus was, however, as has been stated, apparent in the cases to which this report refers.

— No. 24. —

(No. 28—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 8 August 1872.

1. I HAVE received and considered in Council your Excellency's Despatches, dated February 29th (No. 7), March 7th (No. 11), and June 11th (No. 21), 1872, on the subject of Chinchona cultivation.

2. With reference to the cases of Chinchona bark, the transmission of which was announced in your Despatch of the 7th of March (No. 11), I have now to inform you that the *C. officinalis* bark was sold direct to Messrs. Howard at 2 *s.* 4 *d.* the lb., and that the red bark, in the open market, fetched prices from 3 *s.* 1 *d.* to 2 *s.* 1 *d.* the lb. The amount, 429 *l.* 13 *s.* 5 *d.*, will be placed to the credit of Revenue in the Home Account. Messrs. Howard, after receiving the analysis, were only able to offer 2 *s.* 4 *d.* per lb. for the *C. officinalis* kind. Yet I have been given to understand that *C. officinalis* bark, on a private plantation in the Nilgiris, growing under the same conditions, has been sold at 3 *s.* 6 *d.* per lb. There can be no reason why the Government bark should not be as good as that grown, under the same conditions, by private speculators, and I desire that the Commissioner of the Nilgiris may be instructed to make inquiries on the subject. The chief object of your Government, in forwarding bark for sale in the London market, should be to make its great superiority over all other barks well known throughout the world, and care should therefore be taken that it is equal to any bark that is grown, under the same conditions, on private plantations.

3. The experimental application of manure to Chinchona trees has been attended with interesting and important results, and I have given order for the prompt supply of the manure for which you have indented.

I have, &c.
(signed) *Argyll.*

— No. 25. —

(No. 28—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 13 September 1872.

Proceedings of Government, 15th March 1872, Nos. 182, 183.
Proceedings of Government, 20th August 1872, Nos. 184, 185.
Proceedings of Government, 8th June 1871, Nos. 84-86.

WE have the honour to forward the Reports on the Government Chinchona Plantations on the Nilgiris for the years 1870-71 and 1871-72, together with our Proceedings thereon, dated 15th March and 20th August 1872, Nos. 456 and 1,237. The information conveyed by the former Report will have already reached your Grace in the Administration Report for the year.

2. The G. O. of 8th June 1871, No. 1011, quoted in paragraph 3 of our Proceedings of 20th August 1872, is forwarded.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 25.

From the Commissioner of the Nilgiris, to the Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 9th June 1871.

I HAVE the honour to submit the report on the Government Chinchona plantations for 1870-71.

2. Two acres of the new varieties of *C. Calisaya* were planted during the year, and this was the only extension made. The other planting operations were confined to filling up vacancies, planting the edges of roads and spaces by the side of ravines. 602 plants and 45 oz. of seeds were distributed to the public; 51,352 lbs. of fresh bark were supplied to the Government Quinologist for the manufacture of his "amorphous quinine."

3. The Superintendent reports that the trees manured with guano, sulphate of ammonia, and stable manure in 1870, have not yet shown any marked improvement in growth.

4. The Superintendent's calculation of the yield in the eighth year of an acre of Chinchona holds out a favourable prospect to Chinchona growers on the Nilgiris. There is, however, much force in his remarks on the length of time the grower has to wait for a return for his outlay; eight or nine years with red barks, and 12 or 14 with crown barks. This seems to me to tell with great force in favour of the cowle-system of land tenure, if Government are desirous to see their waste land taken up for Chinchona cultivation. In connection with this I take leave to refer to my letter to the Board, dated 26th October 1869, No. 149.

5. I need not here discuss the mossing and coppicing processes alluded to in paragraphs 10, 11, 12, 13, and 14 of Mr. McIvor's report. As stated in my letter of the 15th March last, No. 20, the value of mossed as compared with unmossed barks, and the best mode of harvesting the bark, are now being tested.

6. During the year under review Mr. McIvor, with the sanction of Government, paid a visit to the Bengal plantations, and has submitted an interesting report on their condition. I would suggest here that he be permitted in like manner to pay a visit to the Java plantations at a time of year when his services can be spared, in order to make himself acquainted with the system of Chinchona cultivation in force, and the result obtained there.

7. I have visited the various Nilgiri plantations several times in the year under report, and am well pleased with all I have seen, except at Mailkoondah, regarding which plantation the Government are in possession of my opinion. I regret that Mr. Dawson has left the department; his practical knowledge of the state of our plantations, and of the various experiments that were being carried on rendered his services of especial value in the absence of Mr. McIvor.

8. In the course of a month or so, I hope to be able to submit to Government detailed survey plans of all the Government Chinchona estates.

REPORT on the Government Chinchona Plantations, Ootacamund, Nilgiris, for the Official Year 1870-71.

Plants grown well.

THE growth of the Chinchona plants during the past year has been very satisfactory. The older plants of the different varieties of *C. officinalis* have formed fine leading shoots, and entirely thrown off the shrubby habit, and assumed a tree-like appearance. The largest plants of *C. officinalis* vary from 22 to 23 feet in height, with a circumference of stem of from 18 to 21 inches. The finest plants of *C. Succirubra* are now 30 feet high, with a circumference of stem of 3 feet.

C. officinalis assumed a tree-like habit, and assumed a tree like appearance.

Size of largest trees

Red bark plants 30 ft. high, with ster 3 feet in circumference.

2. Three thousand five hundred plants of the new varieties of *C. Calisaya* have been permanently planted out on new land. These have been planted close, and will cover about two acres of land. This is the only extension made to our permanent plantations, our operations having been confined to filling up failures, planting along the edges of the roads and spaces by the sides of ravines.

Two acres added to permanent plantations.

3. The number of plants of the new species propagated during the year is 16,379 against 17,000, the result of last year's propagation. Only 662 plants have been distributed to the public, and 45 ounces of seed have been gratuitously issued to planters in various parts of India.

Plants propagated.

Plants and seeds distributed.

4. Among the new species recently introduced, some of the varieties of Pitayo bark promise

Increase of new and rare species.

promise to be hardy and well suited to this climate. The total number of plants of new and recently introduced varieties are as follows:—

Chinchona lancifolia (from Java) - - - - -	279
„ *officinalis* (lanceolate-leaved variety) - -	2,140
„ *Pitayensis* - - - - - - - -	1,779
„ *Calisaya* new varieties - - - -	54,881
	59,079

Calisaya yellow barks.

5. The new varieties of *C. Calisaya* having been sufficiently propagated to meet the extensions desired by Government, the propagation of these sorts has been discontinued. The important plants *C. Pitayensis*, received on the 6th December 1870, are being increased, as this imported variety is stated by Mr. Cross to be of very great value, and it may differ in quality from the seedlings raised from the imported seeds; it is, therefore, considered desirable to continue the propagation of this kind. The *C. lancifolia*, received from Java, makes slow growth in this climate, and consequently has not been extensively propagated. There are in all seven varieties of the lanceolate-leaved *Chinchona officinalis*. These differ slightly in appearance one from another, and also in the quality of bark. Nos. 1 to 3 having been found to yield the greatest quantity of quinine, these numbers only are now propagated.

Pitayo barks.

C. lancifolia.

Lanceolate-leaved variety of *C. officinalis.*

Bark supplied for the manufacture of amorphous quinine.

6. During the year 51,352 lbs. of fresh bark has been supplied to Mr. Broughton, the Government Quinologist, for the manufacture of amorphous quinine.

Effect of manure on Chinchona trees.

7. The Chinchona trees which were manured in 1870, with guano, sulphate of ammonia, and stable manure, do not show any marked difference in their growth, and probably the manure will have little or no effect upon the secretion of the alkaloids.

Collection of bark from mossed trees.

8. The bark is now being taken from the 4,000 plants of *C. Succirubra*, and 2,000 of *C. officinalis* (Condamenia), which were mossed during last year, in order "to test the value of my mossing process when applied on a large scale." The results will hereafter be reported in a separate communication. I would, however, observe that from 1,000 unselected eight-year old plants of *C. Succirubra*, 1,060 lbs. weight of dry bark has been taken; these plants will yield in October and November of this year 1,500 lbs. more of dry bark; in all 2,560 lbs. during the year, or an average of over 2½ lbs. of bark per tree. This bark will realise in the home-market from 2 *s.* 8 *d.* to 3 *s.* per lb., from which, deducting 8 *d.* per lb. as cost of collection, carriage, &c, and calculating 350 trees to the acre, a clear profit of at least 1 rupee per lb., or 875 rupees per acre will remain. Supposing the cost of Chinchona cultivation at the eighth year to be 1,000 rupees per acre, the above return will make Chinchona cultivation a very good investment, especially as the yield in the ninth year will be almost equal in value to that obtained in the eighth. In the tenth and each succeeding year, the yield will, in all probability, increase with the growth of the trees, and in consequence of the quality of the bark improving with each renewal. I make the above observations, as at the present moment, there is a strong conviction that Chinchona cultivation will not prove profitable. This conviction has caused private individuals, who have invested in the cultivation as a speculation, to withhold expenditure; consequently, private estates on the Nilgiris are generally in a neglected or abandoned condition.

Yield and value per acre.

Increase of value with growth of plants.

Impression that Chinchona cultivation will not pay.

Money withdrawn and plantations neglected.

Yield of bark from eight-year old trees in Government plantations higher than could be obtained from private plantations.

9. The above yield of bark is higher than could be expected from the average of private plantations in the eighth year. Such plantations would probably not yield more than half the quantity of bark given above, as the trees from which this bark was taken, were planted in October 1862, on the Government plantations, and from the first were well cared for. The land was thoroughly prepared and trenched before the plants were placed in it, and from that time to the present date the plants had every attention and care; consequently, their growth has been much above the average development of trees on private plantations, where a smaller expenditure of money and care has been considered sufficient.

Difficulties encountered by speculators in Chinchona cultivation.

The growth of American bark costs nothing.

In India production of bark forms a heavy charge.

Supply of bark from America abundant.

High quality of bark required to compete successfully with American bark.

Advantages of mossing process.

10. There exists, however, serious difficulties to be encountered by speculators in Chinchona cultivation. With red bark, it is necessary to wait eight to nine years, and with crown bark 12 to 14 years, before a profitable crop can be obtained. It is few who can be so long out of their money, and at the same time maintain an expensive cultivation. Apart from this, it is difficult to enter into successful competition with American-grown bark. In America, chinchona bark is a wild product, and its growth costs nothing. Here, in India, as a cultivated plant, the cost of production forms the heaviest item of charge. From the quantity of bark brought into the home-market, it appears that the supply from America, instead of decreasing as was anticipated, is yearly becoming more abundant, so that the supply from this source keeps pace with the increasing demand. It is therefore evident that, with a low quality of bark, we can never hope successfully to compete in the home-market with American bark of like quality; but with higher quality barks, I believe that a successful and profitable competition can be established. The mossing process is indispensable to obtain a bark of high quality, as by each successive renewal of bark its value increases; and this will, no doubt, continue until red bark will yield from 10 to 12 per cent. of crystallizable alkaloids, and of this from 6 to 8 per cent. of quinine sufficiently

sufficiently pure to pass the commercial tests. From crown barks, a like quantity of crystallizable alkaloids will probably be procured; of which, from 8 to 10 per cent. will be commercial quinine. Bark of this quality would defy competition, as no such bark could be procured from America. The freedom with which these high qualities of bark are worked, greatly enhances their value, while the cost of collection, preparation, and shipment, would be the same as for an inferior bark. It appears, therefore, to be an object of importance to aim at producing only the highest quality of bark.

Bark from small branches would not pay cost of collection and carriage.

Coppicing system.

11. The bark from loppings and prunings, such as we have during last year supplied to Mr. Broughton for the manufacture of amorphous quinine, if sent into the London market, would scarcely pay the cost of collection and carriage. The coppicing-system has the disadvantage of always producing a bark of ordinary quality, and only giving a crop every eighth year.

Quantity of bark and estimation of value from unmossed trees.

12. In Mr. Broughton's letter of the 31st August 1870, recorded in Proceedings of Government of the 7th February 1871, that gentleman estimates the yield of an unmossed tree at eight years of age to contain 7·55 per cent.* of alkaloids in the trunk bark and 3·2 per cent, in the branch bark, or an average of 5·375 per cent. Mr. Broughton does not say how much of this is crystallizable, or how much is quinine. When the bark is to be sold, this would be important, although it is not so when the bark is made into "amorphous quinine." In paragraph 11, Mr. Broughton says, "I assume that after a tree, aged eight years, has been cut down, that the shoots, after a lapse of eight years, will produce as much bark as the original tree; an assumption that will not, under any circumstances, entail a great error." In Appendix at paragraph 1, the yield of dry bark from a tree of eight years' growth is given at a little less than 1 lb. 5 oz. of dry trunk bark, worth from 2 *s.* 8 *d.* to 3 *s.* per lb., in the home-market, and 1 lb. 6 oz. of branch bark, worth from 1 *s.* to 1 *s.* 4 *d.* per lb., or a total value of *Rs.* 2. 10. per tree. These trees being cut down every eight years will entail the cost of keeping the land clean, otherwise weeds will spring up and choke the young shoots. This would cause considerable additional expense, perhaps equal to that of mossing and removing the bark annually from mossed trees. The commercial value of Chinchona depends on the quantity of crystallizable sulphates it contains, not on the total alkaloids.

Quality and yield of renewed mossed bark.

Crystallizable alkaloids increase with each renewal of bark, and are greatest in bark of eighteen months' growth.

13. Mr. Howard found the first crop of renewed red bark of one year and five months' growth from a plant of three years and five months old, to give 5 per cent. of crystallized sulphates and 7·70 per cent of total alkaloids.† The second crop of renewed bark of 17½ months' growth gave of crystallizable sulphates 8·45 per cent., and total alkaloids 9·79 per cent.‡ The application of moss to red bark trees does not act materially till after 12 or 14 months in increasing the crystallizable alkaloids. In the red barks it is between the 12th and the 18th month of the growth of the bark that the crystallizable alkaloids rapidly increases; therefore a harvest of bark of high value can only be obtained from mossed trees of this species every 18 months, namely, one-half of the bark being taken in May and the other half in October in each succeeding year; these being the best seasons for the removal of mossed bark.

Total alkaloids greatest in renewed bark of twelve months' growth.

14. The total quantity of alkaloids in mossed bark is as great at 12 months' growth as at 18, and for the manufacture of "amorphous quinine" the harvest of bark could be obtained annually, thus Mr. Howard, in the first renewal of bark of one year's growth from a plant of three years and five months old, found of crystallizable sulphates 2·72 per cent., of alkaloids soluble in alcohol 7·00 per cent., or a total of 9·72 per cent.§ of alkaloids. The third harvest of renewed bark of 12 months' growth from a tree of seven years old gave 6·15 per cent. of salts of quinine and 11·20 per cent. of total alkaloids.‖ From the above results it appears that the total alkaloids are greatest about the twelfth month, and increase with each renewal of bark, and that the crystallizable alkaloids reach their maximum about the 18th month of the growth of the bark; but to fix this definitely, and to insure the bark being taken at the best time for the preparation of crystallizable sulphates and for amorphous quinine, a few further experiments are necessary.

Cultivation.

15. The high system of cultivation hitherto maintained on our plantations has not been carried out during the past year, the expenses having been reduced to the lowest point possible. The result, however, of last year's cultivation makes it evident that, to secure the greatest possible benefit from our chinchona plantations, it is necessary and economical to maintain a liberal system of cultivation.

Establishme

16. The establishment in the Chinchona Department has been very materially reduced. Mr Jamieson, the deputy superintendent, was removed at the end of the year from the department

* Appendix, paragraph 1.

† Report of an analysis of the fourth remittance of the bark from India, by J. E. Howard, Esq., F.L.S., to the Under Secretary of State for India, 1st August 1865.

‡ Report of an analysis of the fifth remittance of bark from India, by J. E. Howard, Esq., F.L.S., to the Under Secretary of State for India, 4th February 1867.

§ Report of an analysis of the fourth remittance of bark from India, by J. E. Howard, Esq., F.L.S., to the Under Secretary of State for India, 1st August 1865.

‖ Report of an analysis of the eighth remittance of bark from India, by J. E. Howard, Esq., F.L.S. to the Under Secretary of State for India, 1st September 1868.

department, and placed in sole charge of the Botanical Gardens. Mr. Dawson, the assistant superintendent of Neddivuttum Plantation, has left the department and accepted employment in the Ouchterloney Valley.

17. No new buildings have been erected during the year, the principal work performed being weeding the plantations, maintaining roads, cutting drains, and filling up failures.

18. The tea plantation has not been further extended, and a considerable number of the rooted tea cuttings in the nursery at the end of autumn died during the last dry weather.

19. The acclimatization of the European fresh-water fish, introduced in December 1867, has proved most successful. The trout, rudd, carp, tench, gold and silver fish are increasing rapidly. The tench, especially, are most prolific, and grow to a large size in one year; a dozen of these fish bred here were caught, and weighed from 1½ to 2 lbs. each.

20. Appended are the meteorological tables, and table of expenditure from 1860 to 31st March 1871.

(signed) *W. G. McIvor,*
Ootacamund, 31 May 1871. Supt., Government Chinchona Plantations.

METEOROLOGICAL OBSERVATIONS, from 1st April 1870 to 31st March 1871, made on the Government Chinchona Plantations at *Neddivuttum.*

MONTHS.	DRY BULB.				WET BULB.				Minimum observed during the month.	RAINFALL.		Days with Rain.	Days without Rain.
	7 A.M.	2 P.M.	6 P.M.	Daily Mean.	7 A.M.	2 P.M.	6 P.M.	Daily Mean.		Inches.	Cents.		
April 1870 -	60·90	79·53	67·53	69·32	56·90	64·56	60·96	60·80	54·00	–	89	2	28
May „ -	60·45	74·71	61·20	65·45	57·96	65·42	58·64	60·67	54·40	2	86	7	24
June „ -	60·33	60·33	61·00	60·55	60·33	60·00	61·06	60·46	56·00	22	73	28	2
July „ -	55·13	57·10	57·26	56·50	56·00	57·32	57·26	56·86	55·03	29	86	26	5
Aug. „ -	56·32	57·48	57·06	56·95	56·13	56·81	56·32	56·42	55·61	25	24	23	8
Sept. „ -	55·86	56·33	56·13	56·11	55·83	56·13	55·96	55·97	55·40	22	39	23	7
Oct. „ -	57·19	59·36	60·93	59·16	57·16	59·10	59·10	55·12	56·77	19	44	23	8
Nov. „ -	56·27	70·23	56·80	61·10	54·13	61·43	52·50	56·02	47·23	2	67	7	23
Dec. „ -	58·55	72·16	67·16	65·96	55·39	54·71	53·71	54·60	49·61	–	39	2	29
Jan. 1871 -	65·64	70·84	65·77	63·75	67·41	65·36	64·55	65·94	56·06	–	35	1	30
Feb. „ -	65·68	68·18	61·54	65·13	61·43	67·11	64·71	64·42	55·46	–	65	3	25
March „ -	64·65	79·90	70·16	71·57	51·25	75·87	53·03	60·05	53·68	–	74	3	28
TOTAL - - -	–	–	–	–	–	–	–	–	–	128	21	148	217
Annual Mean -	59·75	67·18	61·88	62·63	57·48	61·98	58·15	58·94	54·10	–	–	–	–

Ootacamund, 1 April 1871.

W. G. McIvor,
Supt., Government Chinchona Plantations.

METEOROLOGICAL OBSERVATIONS made at the Botanical Gardens, Ootacamund, from April 1870 to March 1871.

MONTHS.	DRY BULB.				WET BULB.				Maximum in Shade.	RAINFALL.		Days with Rain.	Days without Rain.
	7 A.M.	2 P.M.	6 P.M.	Daily Mean.	7 A.M.	2 P.M.	6 P.M.	Daily Mean.		Inches.	Cents.		
April 1870 -	56·03	73·25	62·05	63·77	49·29	61·50	56·40	55·73	75·82	1	74	6	24
May „ -	57·52	70·78	61·09	63·13	53·46	62·72	57·52	57·90	73·33	4	43	14	17
June „ -	55·91	65·43	55·91	59·08	54·21	61·82	54·91	56·98	68·82	7	23	25	5
July „ -	54·93	61·74	55·77	57·48	54·00	59·38	55·45	56·27	65·16	–	95	4	22
Aug. „ -	53·77	63·12	55·03	57·30	52·96	60·29	53·29	55·51	66·74	2	58	9	22
Sept. „ -	55·46	63·00	55·71	58·05	53·50	59·96	54·28	55·91	65·50	1	04	9	26
Oct. „ -	54·78	63·00	56·28	58·02	53·35	60·42	54·92	56·23	68·35	11	73	10	21
Nov. „ -	51·48	62·82	54·20	56·16	47·27	57·72	51·34	52·11	68·62	3	00	10	21
Dec. „ -	51·44	65·96	53·79	57·06	43·89	53·36	48·82	48·85	70·48	1	50	4	27
Jan. 1871 -	54·47	65·53	56·53	58·84	49·53	58·31	52·41	53·41	70·90	3	39	8	23
Feb. „ -	54·26	69·26	62·96	62·16	49·11	59·81	50·67	55·20	72·81	1	13	2	26
March „ -	59·04	69·93	63·04	64·00	50·71	58·18	55·43	54·78	75·43	1	88	6	25
TOTAL - - -	–	–	–	–	–	–	–	–	–	40	60	107	258
Annual Mean -	54·92	66·15	57·70	59·59	50·94	59·50	54·29	54·90	70·16	–	–	–	–

Ootacamund, 1 April 1871.

(signed) *W. G. McIvor,*
Superintendent, Government Chinchona Plantations.

STATEMENT showing the Expenditure on each of the Chinchona Plantations on the Nilgiris.

PARTICULARS.	Superintendent and Office Establishment.		Propagation and Nursery Department.		Dodabetta Plantation.		Neddivuttum Plantation.		Pykara Plantation.		Malakoondah Plantation.		TOTAL.
	1860 to 1870.	1870-71.	1861 to 1870.	1870-71.	1860 to 1870.	1870-71.	1861 to 1870.	1870-71.	1862 to 1870.	1870-71.	1863 to 1870.	1870-71.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
Establishment (including salaries).	65,057	8,120	35,760	2,502	38,376	2,449	79,274	2,672	11,746	813	9,005	480	2,56,249
Buildings - - -	–	–	13,849	244	20,281	240	22,445	420	3,163	295	3,083	55	64,075
Tool and store-rooms	–	–	–	–	660	–	1,554	40	885	–	320	–	3,459
Coolies' quarters -	–	–	–	–	1,545	48	3,959	160	2,140	80	375	170	8,477
Felling - - -	–	–	–	–	4,568	–	9,227	–	7,536	–	4,952	–	26,283
Clearing and weeding	–	–	1,000	–	14,038	2,100	24,782	2,520	16,007	1,240	10,549	495	72,731
Pitting - - -	–	–	–	–	9,070	220	14,975	240	6,247	205	4,508	55	35,580
Carriage of plants -	–	–	–	–	3,315	65	4,869	105	1,664	25	781	5	10,829
Planting and shading	–	–	–	–	6,359	355	6,485	690	1,835	180	1,089	28	17,021
Trenching - -	–	–	–	–	3,759	–	6,642	–	2,065	–	575	–	13,041
Inclosing - -	–	–	548	–	5,337	–	4,467	85	1,825	20	1,080	–	13,362
Road-making - -	–	–	–	–	7,109	20	5,727	30	3,421	20	2,371	–	18,698
Tools - - -	–	–	494	–	4,984	7	5,798	29	3,800	–	1,981	–	17,093
[illegible] - -	672	59	2,323	90	5,596	115	7,610	158	1,814	19	1,066	38	19,560
[illegible] - -	–	–	–	–	1,094	–	1,195	–	–	–	–	–	2,289
[illegible] - - -	131	18	172	–	250	–	339	22	158	–	85	–	1,175
[illegible] - - -	–	–	352	–	2,210	50	2,576	86	390	70	295	8	6,037
Collection and carriage of bark.	–	–	–	–	–	–	–	1,230	–	–	–	–	1,230
TOTAL - - -	65,860	8,197	54,498	2,836	1,28,546	5,669	2,01,924	8,487	64,696	2,967	42,175	1,334	5,87,189

Ootacumund, 1 April 1871.

(signed) *W. G. McIvor,*
Superintendent Government Chinchona Plantations.

ORDER of the Madras Government thereon, 15th March 1872.

THE above paper has been in great measure incorporated in the General Administration Report for the Presidency. The Government will briefly note the leading points in it. During the year 1870-71 the Superintendent of the Government Chinchona Plantations and his staff were principally occupied with the conservancy of the existing plantations, which require a moderate annual outlay in clearing and weeding, &c. The only extension made was on the Dodabetta Estate, where three thousand five hundred plants of the new varieties of *C. Calisaya* were planted out on two acres of fresh land.

2. The total expenditure of the year appears, from the tabular statement in the Appendix, to have been *Rs.* 29,490, against *Rs.* 45,106 in 1869-70, in which year considerable additions were made to the plantations. The largest share of expenditure was incurred at Neddivuttum.

3. All the plantations, except that at Mailkoondah, are in a thriving condition. The older plants of the *C. Officinalis* variety have assumed a tree-like form, and some of the finer plants of *C. Succirubra* are 30 feet high, with a circumference of stem of from 18 to 21 inches.

4. During the year 51,352 lbs. of fresh bark were supplied to Mr. Broughton. The bark is now being taken from the plants which were subjected to the mossing process, in order to test the value of that experiment.

5. A large portion of the Report is devoted to an examination of the worth of chinchona-planting as an investment of private capital. The conclusion drawn by Mr. McIvor is, that although Indian-grown bark competes under great disadvantages in the market with the indigenous American bark, success may be reasonably looked for in the cultivation of chinchona in this country, if it is confined to the growth of the barks of higher quality.

Enclosure 2, in No. 25.

From the Commissioner of the Nilgiris to the Chief Secretary to Government, Ootacamund; dated Ootacamund, 12th July 1872.

I HAVE the honour to submit Mr. McIvor's report on the administration of the Chinchona Department during the official year 1871–72.

2. It is stated that the plantations have thriven during the year, notwithstanding drought in the months of January, February, and March last.

3. Of the new varieties of chinchona, 900 of the Pitayensis, 1,000 of the Lanceolata (*C. Angustifolia*), and 2,750 of the *C. Calisaya*, have been planted out on the Dodabetta and Hooker plantations; 12,213 of *C. Pitayensis* and 4,124 of *C. Angustifolia* have been propagated, and 5,000 plants have been distributed to the public, and 44 ounces of seed.

4. Mr. McIvor contemplates planting five acres of each of the new varieties during the present monsoon, to complete the area intended to be appropriated to these varieties.

5. Mr. McIvor reports having furnished Mr. Broughton, the Government Quinologist, with 35,072 lbs. of bark during the year for the manufacture of amorphous quinine. In connection with this subject, he states "that large quantities of amorphous alkaloids are available in London at 3 *d.* per ounce in rolls," and he suggests that our barks should be bartered for them. Upon this proposition Mr. Broughton, to whom I made a reference, writes: "The preparation which, in accordance with the instructions I received from the Home Government, I have recommended for adoption in this country as an effective febrifuge is amorphous in form; but as it contains the whole alkaloids in the proportion they are contained in the bark, it is nearly entirely susceptible of crystallisation. The amorphous quinine, which Mr. McIvor states can be purchased at 3 *d.* per ounce in England, is the refuse of the manufacture of the crystalline salts of the alkaloids, and contains what refuse to crystallise. It therefore is a totally different substance to that I am manufacturing from our red barks, and is more usually called in England quinidine."

The unsaleability and the accumulation of large stocks in the hands of manufacturers is some testimony to its comparative uselessness in medicine.

Mr. Broughton proceeds to say that he understands this substance was tried some years ago in the Madras Presidency, on account of its low price, before the introduction of the chinchona-plant to India, but was found ineffectual as a febrifuge, and its use was abandoned; and remarks that our barks, containing an ounce of alkaloid in the pound, sold for 2 *s.* 10 *d.* a lb. in the London market, and hence, that the manufacturer gave that price for an ounce of unmanufactured alkaloids, and therefore could not manufacture the real alkaloids at 3 *d.* per ounce.

6. During the year under report 7,294½ lbs. of bark were shipped to England for sale, and realised excellent prices. Mr. McIvor appears not to be very sanguine as to the success

success of the chinchona plantations in a commercial point of view. He remarks that the London market for quinine is not elastic, and that the consumption averages 1,411,636 lbs. of bark per annum, while the Government and private plantations together, when at maturity, will yield yearly 3,500,000 lbs of bark.

The actual expenditure on the Chinchona Department during the year 1870-71 was 29,490 rupees, out of a Budget grant of 45,400 rupees. The expenditure in the year under report has been 30,000 rupees, against a Budget grant of 34,337 rupees. This small excess will not, it is hoped, be viewed with dissatisfaction.

REPORT on the Progress and Condition of the Government Chinchona Plantations on the Nilgiris for the Official Year 1871-72.

THE early part of this year was most favourable for the growth of all varieties of chinchona, but the drought in December, January, February, and March has been unusually severe, and had a marked effect in retarding the growth of the younger plantations, while on the older plantations the effect was not so apparent. On the whole, the growth during the year has been satisfactory. The older trees maintained during the whole period luxuriant growth, with fine leading shoots. Where the trees have completely covered the ground, excluding the light from the surface of the soil, the growth has been most rapid, as in such places a fine deposit of new soil yearly enriches the land by the fall and decay of the leaves.

2. It has been found advisable to discontinue pruning, as when branches are removed by the knife or saw they are apt to leave a scar on the stem. Our older trees have already shown that pruning is much better to be left to nature, as when the lower branches become shaded by the luxuriant lops their growth becomes weakly, and they ultimately die and break off from the tree without leaving any scar or injury on the stem of the plant.

3. The largest plants of *C. Succirubra* average about 28½ feet in height, with a circumference of stem, at one foot from the ground, of 30 inches. The largest plants of *C. Officinalis* average 22 feet in height, with a circumference of stem of 16½ inches at one foot from the ground.

4. Of the new varieties of *C. Pitayensis* there have been permanently planted out on the—

Dodabetta plantation	- - - - - - -	500
Hooker „	- - - - - - -	400

Of the new variety of *C. Officinalis*, termed Lanceolata, but now named Angustifolia, there has been permanently planted out on the—

Dodabetta plantation	- - - - - - -	300
Hooker „	- - - - - - -	700

and of the new varieties of Calisaya on the Neddiwattam plantations, 2,750.

5. The above forms the only new land planted during the year; other operations being confined to filling up failures, keeping the plantations clean, opening drains, maintaining roads and buildings.

6. The number of new species propagated during the year are as follow:—

C. Pitayensis - - - - - - -	12,213
C. Angustifolia (Lanceolata) - - - -	4,124

7. The number of plants distributed to the public is 5,000, and 44 ounces of seeds.

8. On the Hooker Estate a piece of fine well-sheltered land has been prepared, on which it is intended to plant five acres of each of the new varieties during this monsoon. This will complete the entire extent to be planted with the new varieties.

9. During the year 23,494 lbs. of fresh trunk-bark of the first quality and 11,578 lbs. of prunings have been supplied to Mr. Broughton, the Government Quinologist, for the manufacture of amorphous quinine.

10. In July 1871, 3,188½ lbs., and in January 1872, 4,106 lbs. of dry bark were forwarded to England for sale. Advice has been received of the sale of the first consignment, from which we learn that "old mossed succirubra bark" brought 2 *s.* 3 *d.* per lb. for pharmaceutical preparations, and 2 *s.* 7 *d.* per lb. for the extraction of quinine; while "small mossed bark" brought 2 *s.* 6 *d.*, and "unmossed" 2 *s.* 10 *d.* per lb., both for pharmaceutical preparations. It is not stated what was realised for the bark of *C. Officinalis*. This bark, however, contains by far the largest proportion of quinine, and therefore does not appear to have realised a price proportionate to its value. Another fact worthy of remark is that the mossed barks have brought the lowest price; this is probably due to the altered appearance of the bark when subjected to the mossing process. The prices realised are, however, on the whole, most satisfactory, and leave no doubt that our Indian barks will shortly establish for themselves a position in the home market.

11. We

11. We have now taken, by the mossing process, the entire bark from the stems of 1,000 unselected *C. Succirubra* trees between eight and nine years of age, and find the yield of dry bark to be 2,988 lbs., or nearly 3 lbs. of dry bark per tree. The bark was taken at two periods; about one-third being removed in the early part of 1871, and the second portion of about two-thirds removed in October and November of the same year. The bark was removed from the stems only from the ground to a height varying from 8 to 12 feet, according to the size of the trees. Thus the produce of bark has turned out much greater than we expected, and indicates the great productive powers of our chinchona plantations. It would thus appear that chinchona cultivation, under good management, will prove a profitable investment, provided the market is not glutted by an excessive supply, so as to cause the prices to fall too low to be remunerative. On the Government chinchona plantations on the Nilgiris we may fairly estimate that we have at least one million of healthy plants which will attain maturity, and when the youngest of these plants have reached nine years' growth, we may safely calculate that the Government plantations alone will produce at least 1,500,000 lbs. of bark annually, containing on an average 6 per cent. of alkaloid, and that private plantations on the Nilgiris will produce about 2,000,000 lbs. of bark of a like quality. What effect this quantity of bark may have on the market it is impossible to conceive. At present it would appear that the quantity of bark above stated is more than sufficient to meet the demands of the whole world.

12. The exact quantities of Peruvian bark imported and exported into and from the United Kingdom is somewhat difficult to ascertain, as bark has been duty-free since 1815. Table I. in the Appendix, compiled by Mr. Money from the official returns, shows the yearly imports and exports for 30 years, or from 1841 to 1871, with the official prices of bark and quinine so far as they can be ascertained, the whole being complete from 1849 to 1871.

13. It will be observed, by a reference to this Table, that the reduction in the price of quinine does not seem to have increased the consumption, and that the total quantity of bark imported will scarcely average 1,411,636 lbs. per annum, while the average consumption of the United Kingdom may be estimated at between five and six hundred thousand pounds. The stock in hand in each year seems to have materially influenced the imports of bark, thus indicating that South America can supply any quantity of bark the market will take, provided the price is sufficiently high to be remunerative.

14. The cost of mossing, removing, and drying the bark from the 1,000 *C. Succirubra* trees above mentioned is as follows:—The first removal cost *Rs.* 41. 2 *a.*, and the second removal *Rs.* 180. 11 *a.* 4 *p.*, or making a total of *Rs.* 221. 13 *a.* 4 *p.*; the quantity of bark obtained being 2,988 lbs. will give the cost per lb. of dry bark 1 anna and 2 pies, or 3½ *d.* per lb., as the actual cost of labour of removing and drying the bark, exclusive of the cost of superintendence. The cost will be somewhat diminished in the succeeding harvest, as the same moss can be applied for an indefinite period of time, as the moss, when once put on, grows and increases as well as the trees.

15. A disadvantage of the mossing process, especially when viewed in connection with the manufacture of alkaloids here, is that it necessitates the bark being taken during the months of April and May, the early part of June, and in October and November only. This throws at one time upon the hands of the Government Quinologist a larger quantity of bark than he is able to manufacture.

16. Mr. Broughton estimates that 20,000 lbs. of dry trunk-bark, similar to that sold in England for 2 *s.* 10 *d.* per lb., will be required for the manufacture of 800 lbs. of "amorphous quinine." In Europe the value of bark is estimated by the quantity of crystallisable alkaloid it contains, as there only crystallised alkaloids command a sale, while amorphous alkaloids are of little value, and large stocks have accumulated in that country. In India, however, the amorphous alkaloids are considered to be quite as effective as crystallised alkaloids. It therefore appears desirable that we should forward our barks for sale in the London market, and with the proceeds therefrom purchase what quantity of amorphous alkaloids we may require. I learn from Messrs. Howard & Sons, quinine manufacturers, Stratford, London, that they can supply "amorphous quinine" at 3 *d.* per oz. in rolls. Thus 20,000 lbs. of bark at 2 *s.* 6 *d.* net in the London market will give a sum sufficient to purchase 12,500 lbs. of amorphous quinine; and as 800 lbs of amorphous quinine can only be produced from that quantity of bark when manufactured here, it would appear to be greatly to the benefit of the plantations to dispose of the bark in the home market, and to purchase there such quantities of amorphous alkaloid as may be required for the use of the hospitals in this country.

17. Owing to the reduction of the establishment in the Chinchona Department it was found impossible to maintain a correct meteorological register; the usual meteorological tables, therefore, are not appended to this report.

18. The tea plantation has not been further extended, but a considerable nursery of tea-cuttings of the indigenous Assam, hybrid, and Chinese varieties have been formed. During the year 300 lbs. of fresh tea-leaves have been supplied to Captain Jennings.

19. A Table of the expenditure incurred on the plantations from 1860 to 31st March 1872 is appended.

(signed) *W. G. McIvor,*
Superintendent Government Chinchona Plantation.

Coimbatore, 24 May 1872.

TABLE showing the Imports and Exports of Chinchona Bark to and from the United Kingdom from 1841 to 1871.

Years.	Price of Quinine.	Value of Bark Imported per Lb.	Value of Bark Exported per Lb.	Calculated Stock beginning of each Year, starting at two Years, average Exports.	Quantity of Imports.	Quantity of Exports.	Excess Imports.	Excess Exports.	Imports above Average by.	Imports below Average by.	Five Years' Averages of Yearly Imports and Exports and Home Consumption.	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	
	s. d.	*s. d.*	*s. d.*	£.								
1841 -	16 -	-	-	715,724	210,112	229,152	-	19,040	-	80,000		
1842 -	16 -	-	-	640,471	126,000	406,560	-	280,560	-	164,000	Imports - -	290,931
1843 -	16 -	-	-	303,698	312,928	450,688	-	137,760	22,000	-	Exports - -	357,862
1844 -	16 -	-	-	109,725	236,880	255,024	-	18,144	-	54,000	Home consumption per annum.	56,213
1845 -	12 6	-	-	35,368	568,736	447,888	120,848	-	278,000	-		
1846 -	12 6	-	-	100,000	739,312	433,888	305,424	-	-	1,000		
1847 -	12 6	-	-	296,964	768,544	781,088	-	12,544	28,000	-	Imports - -	740,409
1848 -	13 9	-	-	175,960	276,416	288,064	-	11,648	-	464,000	Exports - -	491,949
1849 -	16 -	-	-	55,852	737,744	407,568	330,176	-	-	3,000	Home consumption per annum.	108,460
1850 -	15 -	2 6	3 -	277,568	1,180,032	549,136	630,896	-	440,000	-		
1851 -	13 -	2 6	3 -	800,000	1,237,936	429,184	808,752	-	-	666,000		
1852 -	9 3	2 6	3 -	1,151,165	2,039,072	1,130,304	908,768	-	136,000	-	Imports - -	1,903,328
1853 -	8 -	2 6	3 -	1,602,346	1,542,464	1,526,672	15,792	-	-	361,000	Exports - -	1,305,741
1854 -	9 -	2 6	2 6	1,160,551	2,163,952	1,584,352	579,600	-	260,000	-	Home consumption per annum.	457,587
1855 -	8 3	2 4½	2 4½	1,282,564	2,533,216	1,858,192	675,024	-	630,000	-		
1856 -	7 2	2 -	2 -	1,500,000	3,090,976	1,097,152	1,993,824	-	1,178,000	-		
1857 -	6 2	1 10½	1 10½	2,992,842	2,380,112	1,078,000	1,302,112	-	468,000	-	Imports - -	1,912,422
1858 -	5 10	2 2½	2 2½	3,793,972	2,003,120	1,299,760	703,360	-	91,000	-	Exports - -	1,231,440
1859 -	5 10	2 3½	2 3½	3,996,350	1,067,136	1,324,176	-	257,040	-	845,000	Home consumption per annum.	500,982
1860 -	8 -	3 1	3 1	3,238,328	1,020,768	1,358,112	-	337,344	-	892,000		
1861 -	6 6	2 8	2 8	2,400,000	1,397,424	1,056,384	341,040	-	-	614,000		
1862 -	7 -	1 6	1 6	2,213,399	1,997,296	1,174,320	822,976	-	-	14,000	Imports - -	2,011,341
1863 -	6 4	1 -	1 -	2,508,734	2,641,968	1,264,704	1,377,264	-	640,000	-	Exports - -	1,283,699
1864 -	5 9	1 1¼	1 1¼	3,358,357	2,282,896	1,279,488	1,003,408	-	271,000	-	Home consumption per annum.	527,641
1865 -	5 2	1 2¼	1 2¼	3,834,124	1,737,120	1,643,600	93,520	-	-	274,000		
1866 -	5 -	1 5	1 5	3,400,000	1,545,264	1,274,672	270,592	-	-	66,000		
1867 -	4 9	1 5¾	1 5¾	3,124,874	1,005,760	1,490,270	-	484,512	-	606,000	Imports - -	1,611,389
1868 -	4 3	1 9	1 9	2,094,644	1,712,368	1,874,432	-	162,064	101,000	-	Exports - -	1,565,670
1869 -	5 9	1 8¾	1 8¾	1,386,862	1,257,984	1,757,056	-	499,072	-	354,000	Home consumption per annum.	545,718
1870 -	6 3	1 8¾	1 8¾	342,072	2,535,568	1,431,920	1,103,648	-	924,000	-		
1871 -	8 -	2 2½	2 2½	900,000	2,547,776	2,026,192	521,584	-	-	-		

Coimbatore, 24 May 1872.]

SANCTIONED ESTIMATE, Results of Expenditure, and Outturn of the Governme Chinchona Plantations, for the Year 1871-72.

PARTICULARS.	Superintendent and Office Establishment.		Propagation and Nursery Department.		Dodabetta Plantation.		Neddiwattam Plantation.		Pykara Plantation.		Mailkoondah Plantation.		Total.	Tota
	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expen ture.
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
Establishment, including salaries.	8,012	8,023	1,982	2,135	1,860	1,891	2,882	2,729	1,020	937	156	120	15,912	15,83
Buildings	–	–	250	125	300	100	350	150	100	125	–	–	1,000	50
Tool and store-rooms	–	–	–	–	15	15	25	24	15	8	–	–	55	4
Coolies' quarters	–	–	–	–	–	–	125	121	50	13	–	–	175	13
Felling	–	–	–	–	–	–	50	–	50	40	–	–	100	4
Clearing and weeding	–	–	40	–	4,000	3,461	4,000	3,099	2,000	2,190	147	147	10,187	8,89
Pitting	–	–	–	–	500	360	500	370	300	175	–	–	1,300	90
Carriage of plants	–	–	–	–	50	35	50	30	25	10	–	–	125	7
Planting and shading	–	–	–	–	200	180	200	174	75	65	–	–	475	41
Road-making	–	–	–	–	50	20	50	–	50	–	–	–	150	2
Tools	–	–	–	72	100	100	200	125	100	50	–	–	400	34
Contingencies	200	100	200	10	200	186	200	61	200	40	163	–	1,163	39
Clothing	30	20	20	13	20	–	20	20	10	–	–	–	100	5
Various	–	–	25	–	500	310	500	430	300	200	–	–	1,325	94
Collection of bark	–	–	–	–	500	57	1,000	1,220	–	20	–	–	1,500	1,29
Carriage of „	–	–	–	–	–	–	150	94	–	–	–	–	150	9
Mossing trees	–	–	–	–	–	–	2,540	–	–	–	–	–	2,540	–
TOTAL – – Rs.	8,242	8,143	2,517	2,355	8,295	6,715	12,842	8,647	4,295	3,873	466	267	36,757	30,93

Estimated Outturn of 1871-72.

		Rs. a. p.
35,072 lbs.	Chinchona fresh bark supplied to Government Quinologists, at 4 annas per lb.	8,768 – –
7,294½ „	„ dry bark shipped for sale in England, at 1 rupee per lb.	7,294 8 –
44 „	„ seeds distributed gratuitously, at 4 annas per oz.	11 – –
5,000 „	„ plants, at 2 pies each	52 1 4
Sale of tools		70 – –
	TOTAL – – – – Rs.	16,195 9 4

Ootacamund, 31 March 1872.

STATEMENT of Expenditure (1871-72) of the Government Chinchona Plantations on the Nilgiris.

PARTICULARS.	Superintendent and Office Establishment.		Propagation and Nursery Department.		Dodabetta Plantation.		Neddiwattam Plantation.		Pykara Plantation.		Mailkoondah Plantation.		TOTAL.
	1860 to 1871.	1871-72.	1861 to 1870-71.	1871-72.	1860 to 1870-71.	1871-72.	1861 to 1870-71.	1871-72.	1862 to 1870-71.	1871-72.	1863 to 1870-71.	1871-72.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
Establishment, salaries, &c.	73,177	8,023	38,262	2,135	40,825	1,891	81,946	2,729	12,559	937	9,485	120	2,72,089
Buildings	–	–	14,099	125	20,521	100	22,865	150	3,458	125	3,138	–	64,575
Tool and store-rooms	–	–	–	–	660	15	1,594	24	885	8	320	–	3,506
Coolies' quarters	–	–	–	–	1,593	–	4,119	121	2,220	13	545	–	8,611
Felling	–	–	–	–	4,568	–	9,227	–	7,536	40	4,952	–	26,323
Clearing and weeding	–	–	1,000	–	16,138	3,461	27,302	3,099	17,247	2,190	11,044	147	81,628
Pitting	–	–	–	–	9,290	360	15,215	370	6,452	175	4,623	–	36,485
Carriage of plants	–	–	–	–	3,380	35	4,974	30	1,689	10	786	–	10,904
Planting and shading	–	–	–	–	6,714	180	7,175	174	2,015	65	1,117	–	17,44
Trenching	–	–	–	–	3,759	–	6,642	–	2,065	–	575	–	13,0
Inclosing	–	–	548	–	5,337	–	4,552	–	1,845	–	1,080	–	13,3
Road-making	–	–	–	–	7,129	20	5,757	–	3,441	–	2,371	–	18,7
Tools	–	–	494	72	4,991	100	5,827	125	3,800	50	1,981	–	17,44
Contingencies	731	100	2,413	10	5,711	186	7,768	61	1,833	40	1,104	–	19,9
Excavating	–	–	172	–	1,094	–	1,195	–	–	–	–	–	2,4
Clothing	149	20	352	13	250	–	361	20	158	–	85	–	1,3
Various	–	–	–	–	2,260	310	2,662	430	460	200	303	–	6,9
Collection of bark	–	–	–	–	–	57	616	1,220	–	20	–	–	1,9
Carriage of do.	–	–	–	–	–	–	614	94	–	–	–	–	7
TOTAL – – Rs.	74,057	8,143	57,334	2,355	1,34,220	6,715	2,10,411	8,647	67,663	3,873	43,509	267	6,17,194

Ootacamund, 1 April 1872.

ORDER of the Madras Government thereon, 20th August 1872.

THE above papers relate to the working of the Chinchona Department during the official year 1871-72. The unusual drought during December and three following months had the effect of retarding the growth of the young plants, but the older trees were not seriously affected, and, on the whole, the progress may be regarded as satisfactory.

2. Operations were restricted, in a great measure, to conservancy; it having been decided that attention should be directed to the propagation of new varieties exclusively, the extensions were necessarily limited. Of the new varieties of *Cinchona Pitayensis*, 900 seedlings were planted out, and 12,213 propagated. Of *C. Angustifolia* (Lanceolata), the number planted amounted to 1,000, and the number propagated to 4,124, whilst 2,750 plants of *C. Calisaya* have been added to the Neddiwattam plantation. During the present season the area allotted to each of the above three new species, namely, five acres, will be completely planted up, 15 acres of land on the Hooker Estate having been prepared for the purpose.

The number of plants distributed to the public was 5,000, against 602 in the previous year. The effect of discontinuing pruning should be carefully noted.

3. The total expenditure was slightly in excess of that for the previous year, namely, 30,000 rupees, against 29,490 rupees; but the cessation of operations on the Mailkoondah Estate having led to a reduction of expenditure on that estate to one-fifth of the sum laid out in the previous year, the working expenses of the other estates were really considerably heavier than in the preceding year. The excess appears to have been in the item "weeding and clearing" on the Dodabetta and Pykara estates. This point should have been noticed in the report. As the census of the trees will, it is presumed, be completed shortly, the superintendent will no doubt be in a position soon to submit his proposals regarding the allotment of a fixed sum per acre for working charges, as directed in paragraph 4, G. O., 8th June 1871, No. 1,011. The total expenditure on the Government chinchona plantations, from the commencement in 1860 up to the end of March last, is stated to have amounted to 617,194 rupees.

4. The value of the bark supplied to the Government Quinologist and shipped to England for sale during the year under report is estimated at a little over 16,000 rupees, or rather more than half the year's outlay.

5. A first consignment of 7,294½ lbs. of dry bark was dispatched to England for sale, and realised satisfactory prices, varying from 2 *s.* 3 *d.* per lb. to 2 *s.* 10 *d.* per lb.; it is noteworthy, however, that the "unmossed" bark, contrary to Mr. McIvor's expectations, fetched a higher price than the "mossed"—a result which is attributed by him to the altered appearance of the bark, owing to its having been subjected to the mossing process; it would, of course, be premature to pass any judgment until the qualities of each description of bark have been thoroughly tested by further experiments. The comparative advantages of the coppicing and mossing methods have still to be ascertained.

6. The Government Quinologist was supplied with 2,349 lbs. of fresh trunk-bark of the first quality and 11,578 lbs. of prunings for the manufacture of amorphous quinine. From paragraph 5 of the Commissioner's letter, it appears that Mr. McIvor is altogether mistaken in supposing that the so-called amorphous quinine, procurable in the home market at 3 *d.* per oz. in rolls, is identical with the substance which is now being manufactured by Mr. Broughton under that name, and which, as Mr. Broughton explains, is amorphous in form only, but contains the whole alkaloids in the proportion in which they exist in the bark, whilst the article to which Mr. McIvor refers is the refuse of the manufacture of the crystalline salts.

7. It is satisfactory to learn that the yield of dry bark obtained from the mossed Succirubra trees averaged about 3 lbs. per tree, or half-pound in excess of Mr. McIvor's estimate (*vide* paragraph 8 of the Report for 1870-71, wherein a special report on the subject is promised). The effects of the mossing process on the proportion of alkaloids as well as on the weight of bark yielded will be ascertained by experiments.

8. The rest of the report is devoted to an examination of the effect which will be produced upon the home market by the influx of the bark produced on the Nilgiri plantations (Government and private combined), which Mr. McIvor estimates to be capable of producing 3,500,000 lbs. of bark annually. The result at which Mr. McIvor arrives, on a consideration of the data afforded by a table, showing the imports and exports of Peruvian bark to and from the United Kingdom for a period of 30 years from 1841 to 1871, is that South America is equal to any demand that is likely to arise, provided the price is sufficiently high to be remunerative. The success of chinchona cultivation, as a commercial speculation, is, however, not a question which can influence the Government action, as their avowed object is to provide an abundant supply of the febrifuge at a rate so cheap as to be within the means of the population at large, and not to enter into competition with private growers.

9. Before sanctioning the discontinuance of the meteorological observations (which appear to have been made hitherto at Neddiwattam and the Botanical Gardens), the

Government desire to be informed, in greater detail, how the reduction of the establisl nent in the Chinchona Department renders it impossible to maintain a correct registe The rainfall should at least be registered.

10. The price at which the produce of the Government tea plantation is handed ove o Captain Jennings does not appear to have been communicated to Government.

Enclosure 3, in No. 25.

From the Commissioner of the Nilgiris to the Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 20th April 1871, No. 30.

In continuation of my letter, No. 20, in reply to G. O., 7th February 1871, No. 249 I have the honour to report that, from inquiries I have made, I see no prospect whatever of being able at present to effect a sale on reasonable terms of the Pycarah and Mail coondah chinchona plantations. I here note the receipt of Government Proceedings o 27th ultimo, No. 411, with Messrs. Money and Wauchope's proposal to lease the Pycaral plantation, which, up to the end of March 1870, had cost *Rs.* 64,696. The Mailkoondal plantation had cost *Rs.* 42,175 up to the same date.

2. Since the Government Proceedings under reply were passed, certain circumstance have come to light which induce me to urge Government to reconsider their order to sell the Pycarah plantation and the lower estate at Mailkoondah.

I. Though the survey of the Government chinchona plantations was ordered long ago, it is only lately that I have received plans of those at Pycarah and Mailkoondah, and I find the area by survey-measurement as follows:—

		Acres.
Pycarah	Wood Estate	69·65
	Hooker Estate	146·33
		215·98
Mailkoondah	Upper Estate	16·36
	Lower ditto	23.92
		40·28

Hitherto, accepting the estimate given by the superin tendent, I have considered the area to be as follows:—

		Acres.
Pycarah	Wood Estate	128
	Hooker Estate	172
		300
Mailkoondah	Upper and Lower	75

Making every allowance for the fact that the Survey Department go strictly by base-measurement, while Mr. McIvor estimates the area by the number of trees planted on the surface of the ground, which, to use a common simile, may be like the roof of a house while the survey-plan represents the floor, I was not prepared for a difference of nearly 100 per cent. in the Wood Estate. There cannot, I am assured, be any mistake in the survey-plan, and even if the slope of the ground were 1 in 2 all over (which is not so at Pycarah), Captain Sargeaunt affirms that the difference would only be 11·8 per cent. in favour of surface-measurement. There must, therefore, be some mistake in the number of the trees planted, or they must be planted at less intervals apart than 7 × 7, as I am informed. I have called upon Mr. McIvor to explain the difference and count the trees. When I get the plans of the Dodabetta* and Neddivattum plantations, there may be a considerable deficiency of area (as measured by the Survey Department) in them also, so that, even including Pycarah and the Upper and Lower estates at Mailkoondah, we may fall considerably short of 1,200 acres† of chinchona by survey-computation.

II. Since the return of Messrs. Broughton and McIvor from Bengal, I learn that whatever difference of opinion may exist as to the exact extent to which the Government chinchona plantations in Bengal are affected by canker, there can be no doubt that they

* Dodabetta area has just been furnished me by the Survey officer; it is 312·35 acres. Up to 31st March 1869 it was held to be 413 acres—*see* Superintendent's Administration Report for 1868–69, paragraph 16, Proceedings of Government, 5th August 1869, No. 68.

† The limit originally fixed by the Secretary of State for chinchona cultivation here.

they are suffering more or less from the disease, and that their condition is not entirely satisfactory.

For these two reasons, and considering that we do not yet know what amount of febrifuge the Government will require, nor even what quantity an acre of chinchona will yield, I submit that it would be improvident of Government to part either with the Pycarah plantation, or with the Lower estate at Mailkoondah.

3. I have considered the expediency of fencing the estates, as suggested by Government, and cannot recommend that course. If you will refer to Proceedings of Government, No. 265, 20th June 1867, and paragraph 22 of the Superintendent's Annual Report, you will see that the Wood estate was fenced round in 1866–67. What now remains of the fence is utterly useless against animals. The fact is, I do not believe that any permanent fence worthy of the name could be made on such ground, except with posts and wire, which would run up the cost to a sum out of all proportion to the necessities of the case.

4. The elk, no doubt, do considerable damage to condamineas until the top-shoots of the young tree get out of their reach; but as far as I can learn from a personal examination of the plantation, and from Mr. Dawson's experience, the elk do not perceptible damage to the succirubras. On the Wood estate the assistant superintendent informs me that there are only 19,000 condamineas; of the rest, 86,306 are succirubras, and 2,414 are micranthas; total, 107,720. On the Hooker estate there are 37,565 condamineas; of the rest, 96,598 are succirubras, and 10,317 are micranthas; total, 144,480.

Moreover, of these condamineas, a good number have attained a height out of reach of elk. I submit, therefore, that there is no necessity to go to the expense of a permanent fence.

5. I apprehend the Government desire to make some sensible reduction in the annual expenditure under the head of chinchona, and I think this may easily be achieved without the sale of any plantation, except the Upper estate at Mailkoondah, which is utterly worthless to Government as a chinchona plantation.*

6. You will refer to G. O., 29th November 1869, No. 3,065, and observe that on the budget estimate for 1870–71, I recommended a reduction of 10,274 rupees, and that the Government did not deem it safe to cut down the estimate to that extent, but reduced it by 6,192 rupees, leaving the total allotment for the year 45,400 rupees. When the superintendent sent in his estimate for 1871–72 for 39,100 rupees, I did not like to suggest a reduction, because the estimate so far fell in with my views as to exhibit a considerable decrease as compared with that for the previous year, and because I gathered from the Government proceedings on the 1870-71 budget, that they considered the chinchona plantations still somewhat in an experimental stage; and to ensure complete success they were disposed to have the estates managed on the "high cultivation" system, which demanded a more† than liberal grant for working charges.

7. I am, however, still of opinion, not only that the budget for 1870–71‡ could have been reduced by 10,274 rupees, as I suggested, but also that the budget for 1871–72 can be reduced to a figure below 39,100 rupees without imperilling the success of the plantations.

8. The sum assigned to the Assistant Superintendent of Neddivattum and Pycarah for last year's expenditure was as follows:—

			Rs.	*Rs.*
Neddivattum.				
1 Assistant Superintendent		150 × 12 =	1,800	
1 Overseer		50 × 12 =	600	
45 Gardeners, at 7		315 × 12 =	3,780	
				8,655
Pycarah.				
1 Overseer, at 70 × 12 =			840	
30 Gardeners, at 7, 210 × 12 =			2,520	
300 acres, at 5½ per acre			1,650	
				5,010
			Rs.	13,665

Hitherto

* It may even now or by-and-by have a certain value to somebody; in that the forest has been felled, the ground cleared, and there is a large quantity of iron roofing and building material on the premises.

† Mr. McIvor's letter, November 1869, No. 121, in Government Proceedings on the 1870-71 budget.

‡ Mr. McIvor, in his letter, dated 17th April 1871 (enclosed), says that the expenditure for 1870–71 will not, he believes, exceed 31,000 rupees; but he adds that in his anxiety to economise, the plantations have suffered.

*Pycarah - 300
Neddivattum 450
750

Hitherto, Neddivattum and Pycarah have been estimated to be 750 acres.* As Pycarah by survey-measurement, is found to be - - - - - - 215·98 acres
It is probable that Neddivattum will be found to be about - - 350
565·98
Say, in round numbers - - - - 570

am told by practical planters, that in their opinion, omitting all superintendence, of 10 rupees an acre is sufficient to keep down weeds, repair roads and drains, &c., ates on the Nilgiris. Where, therefore, a great portion of the estate is under iona-trees of five, six, and seven years of age, I infer that 10 rupees an acre is more ufficient.

ropose, therefore, a budget for 1871–72, on the principle of allotting a sum for the ng charges of each estate, calculated at the rate of 10 rupees an acre, part of such o be appropriated to the maintenance of a permanent staff of gardeners on each .

On this principle, I think the estimate for 1871–72 susceptible of reduction from 0 to 28,286 rupees, as follows:—

			Rs
1 Superintendent - - - - -	500 × 12 =	6,000	
Ditto travelling allowance, 3 rupees a day -	=	1,100	
1 Deputy Superintendent, as per contract - -	=	1,742	
1 Office Manager - - - - -	60 × 12 =	720	
2 Propagators - - - - -	10 × 2 × 12 =	240	
2 Peons for Chinchona Superintendent, at 8 - - - - - -	8 × 2 × 12 =	192	
			9,994
Neddivattum and Pycarah (*say* 570 *acres*).			
1 Assistant Superintendent - - -	175 × 12 =	2,100	
1 Overseer, Pycarah - - - -	70 × 12 =	840	
1 Overseer, Neddivattum - - -	50 × 12 =	600	
2 Peons at 7 - - - - -	7 × 2 × 12 =	168	
Working charges, at 10 rupees an acre - - -	=	5,700	
			9,408
Dodabetta (312·35 *acres*).			
1 Overseer - - - - - -	70 × 12 =	840	
2 Maistries - - - - -	12 × 2 × 12 =	288	
Working charges - - - - -	313 × 10 =	3,130	
			4,258
Saderward and contingencies	As per original estimate for 1871–72.	- 1,216	
Peons and clothing -		100	
Carriage of chinchona-bark		- 150	
Repairs of buildings -		- 1,000	
			2,466
Tea Plantation and Fish.			
5 Gardeners at - - - - - -	7 × 12 =	420	
Fish experiments - - - - - - - -		120	
			540
Botanical Gardens.			
Government donation in aid - -	100 × 12 =	1,200	
1 Apprentice - - - - -	20 × 12 =	240	
2 ditto 7½ rupees each - -	15 × 12 =	180	
			1,620
		Rs.	28,286

11. I propose

11. I propose expending no more money on the lower estate at Mailkoondah, but leaving it, by way of experiment, to grow up as a chinchona forest. I propose advertising for sale the upper estate at Mailkoondah, and parting with it for what it will fetch. As in future propagation is to be confined to new varieties, of which no more than five acres of each variety are to be planted, two propagators will, in my opinion, be sufficient. Now that Mr. McIvor has been relieved of the charge of the Botanical Gardens, and the Dodabetta plantation has been planted up, I think the services of an assistant superintendent, in addition to an overseer, unnecessary for Dodabetta.

I have struck out 1,500 rupees for collection of bark, as, in my opinion, that work can be done by the permanent staff of gardeners on the estates.

12. After coming to an independent conclusion on the estimate from a personal inspection of the plantations, and from inquiries from planters, I thought it best to send the estimate to Mr. McIvor, in order that he might go carefully into the question, and submit his views for the consideration of Government. He has kindly done so, and I enclose his letter, No. 7, of the 17th instant.

13. I should be sorry to imperil the success of our plantations, which, as I have repeatedly pointed out, do Mr. McIvor great credit. If it be thought that an allotment of 10 rupees an acre is insufficient for working charges *minus* supervision, then make it 12 rupees, or even more; but I submit that the time has arrived when the annual estimates of the superintendent should be framed on some fixed principle, in the interests of economy.

From the Superintendent of the Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 17th April 1871, No. 7.

I HAVE the honour to acknowledge the receipt of your letter, No. 21, of the 14th instant, in which you are good enough to ask my opinion on a budget estimate for the chinchona plantations for 1871-72, which you intend submitting to Government.

2. I would respectfully bring to your notice that you submitted my estimate for the chinchona plantations and Botanical Gardens on 19th October 1870, and that the Government, in their proceedings in the Revenue Department, dated 4th January 1871, No. 8, approved of that estimate.

3. The Government, in paragraph 9 of their Order of the 7th February, No. 249, to which you refer, desire the reduction of expenditure on the chinchona plantations by the sale of or, if this cannot be effected, the abandonment of the Mailkoondah and Pycarah plantations, and not, as I understand, by working the plantations the Government at present intend to retain with an insufficient sum.

4. I have not yet disbursed all charges for the past official year, but, in round numbers, the actual expenditure for 1870–71 in the chinchona department and Botanical Gardens does not exceed 31,000 rupees.

5. The financial difficulties of the State and your urgent desire to reduce the expenditure caused me, during the past year, to avoid incurring any expense but that which was indispensable for the preservation of the plantations. The report also of Mr. Clark, the acting superintendent of the Bengal Chinchona Plantations, led me to believe that great success had been attained there without the high system of cultivation which I had previously pursued. Under these circumstances, I greatly reduced the labour employed in cultivation, and the result is that the young plants suffered considerably during the dry season, and to preserve and replace them will necessitate a higher standard of cultivation, and consequently a greater expenditure during the present year. If this is not done we shall lose, during next dry season, from a quarter to a third of the entire number of plants on our plantations. The opportunity I have lately had of inspecting the Government chinchona plantations in Bengal has also considerably modified my views as to the possibility of successfully working a plantation with rough cultivation. By far the greatest number of our chinchona plants are yet young, and consequently liable to be destroyed by being overgrown by weeds. It requires a growth of from four to six years (according to the species) to place chinchona plants beyond injury, and when young chinchona plants are choked by weeds during the monsoon, many die out during the dry season, and such plants as survive make slender and unsatisfactory growth. Apart from these disadvantages a great danger exists of plantations covered with weeds being entirely destroyed by fire during the dry weather. On your estimate our plantation cannot possibly be kept clean.

6. In my estimate, as sanctioned by Government, the sum of 1,500 rupees is entered for the collection of bark; you have struck out this item; and as the present time is the most favourable for gathering bark, I will feel obliged by your being so good as to inform me if it is your intention to discontinue the collection of bark.

7. I am deeply interested in the success of the Government chinchona plantations on the Nilgiri Hills, and view with alarm the system of cultivation you advocate with reference to this national undertaking, especially now when it is so closely approaching its full

development, and all the heavy expenditure has been incurred. Nevertheless, whatever sum the Government may consider it advisable to expend on the chinchona plantations, I shall endeavour to apply to the best possible advantage. During 1872–73 a reduction in the expenditure could be made without injury to the plantations.

ORDER of the Madras Government thereon, 8th June 1871.

IN proceedings of the 7th February last the Commissioner was desired to endeavour to effect a saving in the budget of the current year, which was 39,100 rupees, the estimate of last year having been 45,400 rupees, and the actual expenditure of the preceding year (1869–70) having been 47,055 rupees. The chief means suggested were the sale of the Mailkoondah and Pycarah plantations, which, it was stated, would still leave 825 acres planted for State purposes; or, failing this, the abandonment of the upper portion of the Mailkoondah plantation, and the filling-up of the lower portion with chinchonas, fencing it and the Pycarah tract, and allowing them to grow up as natural chinchona copse or forest.

2. The present letter of the Commissioner is in reply to this reference. Mr. Breeks despairs of finding purchasers for the estates on reasonable terms, and as the lately completed survey shows that the acreage of the whole of the plantations is considerably below their hitherto supposed extent, and the accounts given by Mr. McIvor and Mr. Broughton of the condition of the Bengal plantations is very unfavourable, he deprecates parting with more than the upper portion of Mailkoondah.

3. The Governor in Council concurs in this view, which, moreover, is in general accordance with the opinion of the Secretary of State in his recent despatch, above recorded. His Excellency observes that the upper portion of Mailkoondah is altogether useless as a chinchona plantation. It should be sold if possible. Meanwhile, he would retain Pycarah on the present system, and turn the lower plantation at Mailkoondah into a wild chinchona-wood, as an experiment, making proper provision for fencing or watching.

4. Mr. Brecks, it is observed, considers that the budget estimate may be reduced to 28,286 rupees from 39,100 rupees, or by rather more than 10,000 rupees. The chief alteration whereby this result is attained is the substitution of a fixed rate (10 rupees per acre) for working expenses. Mr. Breeks has fixed this sum on the advice of "practical planters." On the other hand, the Government have the assurance of Mr. McIvor, who has managed the plantations from their commencement, and who has witnessed the results of the management of the chinchona on economical principles in Bengal, that this sum will not suffice; that even with an expenditure of 31,000 rupees last year, the plantations have suffered; and that if a higher standard of cultivation be not adopted this year, the Government may expect a loss in the dry season of from a quarter to one-third of the entire number of plants.

5. It is possible, as the Commissioner admits in the 13th paragraph of his letter, that an assignment of 10 rupees per acre for working charges, exclusive of supervision, may be too low; but the Government entirely concur in the Commissioner's opinion that the annual estimates ought to be framed on a fixed principle, and that there ought to be no difficulty in determining what fixed sum per acre is sufficient for the working charges. With this view the exact acreage should be ascertained without delay, and a careful census should be taken of all the trees in all the plantations by actual counting. The Commissioner will arrange to have this done, and will employ careful and trustworthy persons on the duty. The superintendent will then submit a proposal as to the sum to be allowed for working charges per acre, specifying in detail the data on which his proposal is framed.

6. The Government approve of the proposal to reduce the assistant superintendent at Ooty; he may be sent to Neddivattum to replace Mr. Dawson, lately resigned.

7. The charges for the Government gardens and those for the chinchona experiment must in future be kept distinct. They will be budgeted for separately, and entered separately in the general budget of the Presidency. If, in view of the removal of the superintendent of the Doddabet plantation, the Commissioner thinks it advisable that Mr. McIvor should be relieved of the charge of the gardens at Burliar and Kulhutty, the Governor in Council will be prepared to sanction that arrangement, and to place the Burliar and Kulhutty gardens under the superintendent of the Ootacamund Garden.

— No. 26. —

(No. 36—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 10 December 1872.

IN the despatch dated 8th August 1872, No. 28, your Grace, in intimating to us the results of the sale of the chinchona bark from the Nilgiri Government plantations, which was transmitted to England in March last, remarked that Messrs. Howard offered only 2 *s.* 4 *d.* per lb. for the *C. officinalis* kind, while *C. officinalis* bark from a private plantation in the same locality fetched 3 *s.* 6 *d.* per lb.

2. We referred this part of the despatch to the Commissioner of the Nilgiris for report; and we now forward, for your Grace's information, our proceedings marginally noted, embodying explanatory letters from that officer and from Mr. McIvor on the subject.

Proceedings of Government, 7 Dec. 1872, Nos. 46, 47.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 26.

From the Commissioner of the Nilgiris to the Officiating Chief Secretary to Government, Fort St. George; dated Ootacamund, 16th November 1872.

WITH reference to Government Order, Revenue Department, 16th October 1872, No. 1,429, calling attention to paragraph 3 of a despatch from the Secretary of State, dated 8th August last, in which it is intimated that Messrs. Howard were only able to offer 2 *s.* 4 *d.* per lb. for *C. officinalis* bark from the Government plantations, transmitted to England in the early part of the present year, while *C. officinalis* bark from a private plantation on the Nilgiris fetched 3 *s.* 6 *d.* per lb., and directing inquiry on the subject, I have the honour to enclose an explanatory letter from Mr. McIvor.

2. It appears that the private bark referred to was grown on the estate of Captain Jennings, at Dodabetta, at an elevation of 7,700 feet, and that the Government bark was produced at 5,600 feet. The inference follows that *C. officinalis* grown at a high elevation is richer in alkaloids than bark of that description grown lower down. Mr. McIvor, in the course of a conversation I had with him on the subject, recently informed me that *C. officinalis* produces the best bark at 7,500 to 8,000 feet, and that our main plantation of this species at Dodabetta is about this height. He stated that red bark, on the other hand, flourishes best at 6,000 feet.

3. Mr. McIvor, in his letter under reference, supports the implication of the value of the *C. officinalis* bark being dependent on the elevation at which it is grown, by the statement that bark of this description grown at the height of Captain Jennings's estate gave, on analysis, 4·46 of crystallised quinine, or nearly double the quantity afforded by the *C. officinalis* bark sold for 2 *s.* 4 *d.* per lb.

4. Mr. McIvor observes that the evidence available goes to show that the produce of the Government plantations is equal, if not superior, to the produce of private plantings.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 31st October 1872, No. 100.

WITH reference to the Secretary of State's despatch in the Revenue Department, No. 28, of 8th August 1872, and your endorsement of the 17th instant, I have the honour to inform you that the officinalis bark bought by Messrs. Howard & Sons for 2 *s.* 4 *d.* per lb. was from the Neddivattum Plantation, grown at an elevation of about 5,600 feet, and obtained entirely from thinnings and prunings. This bark, by Mr. Broughton's analysis, gave 2·43 per cent. of crystallised quinine.

2. The private bark mentioned in paragraph 3 of the Secretary of State's despatch was (108 lbs. taken in 1871, and 192 lbs. taken in 1872) officinalis bark obtained from the stems under the mossing process by Captain Jennings, on his plantation at Dodabetta, and grown at an elevation of about 7,700 feet.

3. With

3. With our last consignment no bark of *C. officinalis* was sent from the Government plantations at Dodabetta, but three cases of this bark (Nos. 17 to 19) were sent in 1871, which gave, by Mr. Broughton's analysis, 4·46 per cent. crystallised quinine, showing the bark from the Government plantations at Dodabetta to be nearly double the value of that referred to by the Secretary of State as sold to Messrs. Howard & Sons at 2*s.* 4*d.* per lb.

4. In your endorsement a reference is made to the bark from the Deva Shola estate. I would observe that the highest price yet obtained for this bark is 2*s.* 2½*d.* per lb.

5. Apparently all facts which have yet transpired indicate the produce of the Government plantations to be equal or superior in value to bark grown on private plantations under the same circumstances. It should, however, be borne in mind that the Government plantations being experimental, the various species of chinchona were necessarily planted at different altitudes, and under various conditions, as regards aspect and exposure; consequently the bark of the same species may differ in value according to the locality in which it is grown.

6. I note with satisfaction that the red bark of the present consignment realised in the open market 3*s.* 1*d.*, while bark of the same quality sold in 1871 for 2*s.* 7*d.* per lb.

— No. 27. —

(No. 18—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 11 July 1873.

WITH reference to your Grace's despatches marginally noted,* we have the honour to advise your Grace of the transmission to the India Office, by steamer, *vid* the Suez Canal, of a parcel containing a collection of specimens of the flowering and fruit-bearing branches and of the barks of some of the chinchona species now growing on the Nilgiris.

* From Secretary of State, 27 September 1869, para. 3, No. 29, Public.
From Secretary of State, 11 January 1872, para. 4, No. 4, Revenue.

2. The Commissioner's report on the subject, with a letter from the Superintendent of the Chinchona Plantations, is herewith forwarded.

We have, &c.
(signed) *Hobart*, &c.

Enclosure in No. 27.

From the Commissioner of the Nilgiris to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 23rd June 1873.

WITH reference to order of Government, No. 305, of 17th February 1872, and your Under Secretary's official memorandum, No. 84, of 18th April 1873, calling upon Mr. McIvor to furnish a complete set of the flowering and fruit-bearing branches and of the barks of the chinchona species now growing on the Nilgiris, I have the honour to forward an original letter from Mr. McIvor, explaining the cause of his inability to forward a complete set. Mr. McIvor, at the same time, transmits a collection, in triplicate, of such specimens as he has been able to obtain.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 21st May 1873.

WITH reference to your endorsement on the official memorandum, Revenue Department, No. 84, dated the 18th ultimo, I have the honour to inform you that I am still unable to forward a complete set of flowering and fruit-bearing branches and bark of the various species of chinchonas at present growing on the Nilgiris, as many of the species and varieties we have in cultivation have not yet produced flowers and fruit. I however forward a collection, in triplicate, as per list annexed, of all the species and varieties which have flowered and fruited on the Nilgiris up to the present time, and these will be added to year by year as the new varieties come into bearing.

List of the Species of Chinchona.

Crown barks	No. 1	3 specimens.	
	„ 2	3 „	
	„ 3	3 „	
	„ 4	3 „	
	„ 5	3 „	
	„ 6	3 „	
	„ 7	3 „	
	„ 8	3 „	
	„ 9	3 „	
	„ 10	3 „	
	„ 11	3 „	
	„ 12	3 „	
Yellow bark	„ 13	3 „	
Yellow bark	No. 14	3 specimens.	
	„ 15	3 „	
	„ 16	3 „	
	„ 17	3 „	
Red bark	„ 18	3 „	
	„ 19	3 „	
	„ 20	3 „	
Grey bark	„ 21	3 „	
	„ 22	3 „	
	„ 23	3 „	
Corkey bark	„ 24	3 „	
Pahudiana	„ 25	3 „	

— No. 28. —

(No. 21—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 31 July 1873.

WITH reference to paragraph 4 of your Grace's despatch, 4th April 1871 No. 7 (Public), we have the honour to forward, for your Grace's information, our proceedings marginally noted, embodying an interesting report from the Government Quinologist on the results obtained by the application of Mr. McIvor's plan of mossing to the chinchona trees of the Government Plantations; also a letter from the Commissioner of the Nilgiris on the subject.

Proceedings of Government, 29 May 1873, Nos. 221, 222.

2. Mr. Broughton expresses an opinion adverse to the mossing process as regards the red barks, and advocates the coppicing system. We, however, are not of opinion that his experiments have been sufficiently extensive to justify his condemnation of the mossing process; and the Commissioner's remarks in paragraphs 9 and 10 of his letter, if correct, would seem to show that this system is likely to be more profitable than the coppicing system.

3. We have given orders for the experiment advocated in paragraph 13 of the Commissioner's letter being at once undertaken; its final result will be duly communicated to your Grace.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 28.

From the Commissioner of the Nilgiris, to the Chief Secretary to Government, Fort St. George; dated Ootacamund, 19th April 1873.

I HAVE the honour to submit a report from Mr. Broughton on the comparative merits of the mossing system, which Mr. Broughton has, in compliance with paragraph 7 of Proceedings of Government, Revenue Department, requiring the opinion of the Commissioner, forwarded through me.

2. Mr. Broughton pronounces an opinion adverse to the mossing process in the red

barks, but states that no final conclusion can be arrived at for the next three years. In the meanwhile, he complains that the coppicing system has never had as yet a fair trial, notwithstanding experiments were ordered to be carried out.

3. With regard to Mr. Broughton's condemnation of mossing red barks, it is necessary that, in order to a complete consideration of Mr. Broughton's conclusions, I shall indicate what his statements are. They are briefly these:—

1st. That mossed bark on young *Succirubra* is enormously superior to natural bark in the proportion of contained alkaloids.

2ndly. That the superiority diminishes with the age of the tree up to eight years, and at ten years (the oldest trees the Government possess) there is an equilibrium and no differenee between the natural and renewed bark as respects alkaloids. Mr. Broughton concludes that the evidence available points to even a falling-off of the qualities of the mossed as compared with the unmossed natural bark as a tree ages, and appears to imply that coppicing will be found the best mode in the long run of taking the bark from the *C. Succirubra.*

4. I was lately at Neddiwuttum with Mr. McIvor and Mr. Broughton, when an inspection of the Neddiwuttum plantation was made. Wounding a tree was thus expounded. It was said that any incision was a blow aimed at the life of a tree, which the tree took time to recover in proportion to the extent of the wound. Thus it was said peeling the bark was wounding a tree, but coppicing a tree was inflicting a more radical wound; and the question arose whether minor wounds like peeling made at comparative frequent intervals would be most detrimental to the life of the tree, or performing radical operations at longer intervals—that is to say, coppicing a tree every seven or eight years. I understood from Mr. Broughton that his fear was that, if mossing was carried on, the mossed trees would, in course of years, die and require replanting. He inferred, on the other hand, that trees might be coppiced for hundreds of years like oaks in England, and thus the plantations would never require replenishing.

5. In order that the Government may have all the evidence which is available to enable them to test these views, I make the following remarks:—Fairly coppicing, that is to say, taking off the head of a tree completely as corn would be cut, is never, I am led to believe carried out in oak coppices in England, except in the cases where there are no shoots near the bottom of the stem, and where, therefore, there is nothing to leave; and the reason is that depriving a stem of every shoot is so radical an operation that the life of the tree receives a shock from the operation very difficult for it to recover. Accordingly coppicing, as ordinarily carried out, is the felling of the tree, say, six inches from the ground, but leaving the shoots sprouting from the stool.

6. In my letter, in Government Order No. 126, dated 30th January 1873, I stated that 100 trees were thus fairly coppiced in 1866. I took note at Neddiwuttum of the largest of these coppiced trees. The shoots look weak and sickly. Their diameter is about an inch and a quarter at the bottom. I stripped a piece of bark from one of them, and found that when dried it presented a thickness no greater than blotting-paper. Mr. Broughton saw this tree, and looked over the other *fairly coppiced trees.* He was of opinion they had not sprung up again well, and attributed their weakness to an insufficiency of light and air.

7. These coppiced trees are intermediate trees, each flanked by untouched trees at a distance of 12 feet from them. It was a matter admitting of various opinions, whether the surrounding trees kept light from the coppiced trees; but one thing was clear, shoots springing from untouched trees were numerous in the vicinity of the coppiced trees; they were obviously kept from light and air much more than the shoots on the latter, and yet their appearance indicated great succulence and vigour.

8. The healthiness of the shoots on the uncoppiced trees gave rise further to a suggestion. It indicated that the mossing process could never destroy the trees on a plantation if a shoot was left on each tree. The main stems might be stripped of bark until they died, and a strong shoot be left all the time growing to take the place of the stem on the extinction of the latter. In this manner not a single tree on a plantation would be lost. The inference was that there was no need to run the risk of coppicing, because it was apprehended removing the bark from time to time under the mossing process might eventually destroy the trees.

9. The next point was the difference in the quantity of bark that would be afforded by mossing and that afforded by coppicing. At Neddiwuttum I took from an untouched and unmossed *C. Succirubra,* six years old, 2 lbs. of wet bark; the tree was mossed on decortication. In six months the tree will have grown higher, and will then yield perhaps 3 lbs. of natural wet bark. I should observe the 2 lbs. I took was not all the tree could have afforded. The tree was 19 feet high, and I stripped it to a height of 5 feet from the ground. Twenty months from my taking, the first renewed bark will be available, and six months after that the rest of the renewed bark. The renewed bark will aggregate two-thirds of the original bark; thus, in 7½ years the tree will have given about 8 lbs. of wet bark. In a further 26 months another supply of renewed bark, equal

in quantity to the first renewed bark, will be available, and the tree will then have given 10 lbs. of bark.

10. Now, if this tree had been felled, it would have given, at the date I stripped it, 4 lbs. of bark to 4¼ lbs.; and in eight years it would perhaps have re-grown, and have yielded about two-thirds of its yield on being coppiced; thus, in 14 years the tree would afford only, say, 7 lbs. against, say, 10 lbs. of bark in less than nine years by the mossing process.

11. Then, as to the commercial value of renewed mossed bark, I understand Mr. Broughton to say that on trees at all ages it is richer in quinine than natural bark, and this is a very important point. I should observe that a difference of one per cent. in quinine makes a difference in price of $1\frac{3}{8}$ pennies in the shilling; and if quinine is selling at 8 *s.* an ounce, therefore of eight times $1\frac{3}{4}$ of a penny. Mr. Howard's analyses, in all his six reports, seem to corroborate the conclusion of the increased richness of renewed mossed bark in quinine.

12. These remarks apply entirely to the *C. Succirubra.* In his report, Mr. Broughton expressly states that in Condamineas mossing affords a fairer prospect, and his appended analyses confirm this view.

13. With regard to *C. Succirubra* the adverse evidence is not, I submit, sufficient as yet to overbalance the evidence favourable to mossing; and I would not, therefore, advocate coppicing experimentally on any large scale. Mr. Broughton, I believe, would not himself risk an extensive experiment. When we were at Neddiwuttum he pointed out four rows of *C. Succirubra* of 10 years old and upwards, which he proposes to coppice in May, leaving the shoots on the stool, and to compare these trees with four adjoining rows of trees which are to be mossed. He thinks this experiment will afford a fair test, and it will not in any way disfigure the plantation. I readily consented to this arrangement, subject to the approval of Government, which I now solicit.

14. In conclusion, I venture to remark on the complaint of Mr. Broughton that the coppicing, sanctioned in Government Order No. 1,646, dated 6th December 1872, was not carried out, that Mr. Broughton was the proper person to call attention to the neglect of the orders.

15. Mr. Broughton requests that six printed copies of his report may be furnished to him, and that he may have the privilege of revising the printer's proof of the report.

16. The delay in forwarding the report has been owing to my wish to inspect the Neddiwuttum plantation before submitting a personal opinion.

From the Government Quinologist to the Commissioner of the Nilgiris; dated Ootacamund, 11th February 1873.

Subject of Report.

I HAVE the honour to report on the results obtained by the application of Mr. McIvor's plan of mossing to the chinchona trees of the Government plantations. The report is addressed to you as Commissioner of the Nilgiris, in consequence of the order conveyed in General Order No. 249 of 7th February 1871. Though the intention with which the proposition adverted to in the General Order cannot now be entirely carried out in consequence of the death of the late Commissioner, I fulfil in this report the letter of the General Order.

Origin of the experiments.

2. The origin of the considerable experiments made in order to determine the practical value of the mossing process arose from a suggestion made in a report of mine, dated 17th August 1868, in which the physiological effect of mossing was discussed. In the General Order on this report, No. 2,453, of 22nd September 1868, and in General Orders, Nos. 3,068 and 426, of 9th December 1868, and 19th February 1869, respectively, a certain number of trees, amounting in all to 7,000, were directed to be treated by the mossing process, in order to experimentally determine its practical value.

Mr. Howard's analyses.

3. The first determinations of the value of the process has been made by Mr. J. E. Howard previous to, and shortly after, my arrival in this country. They were necessarily made on a very small scale and on very young trees, whose age in no case exceeded five years. The results were very successful, and were corroborated to a certain extent by my own more early analyses.

Reasons for further trials.

4. The reasons which induced me to suggest the further trial of the process after these reports are the following:—The experiments were made on but a few trees; an extended trial might possibly, in some respects, modify the results; that the trees of the experiments were so young that it would not be possible to deal with such small plants on a commercial scale, and plants of actual crop-bearing age might possibly give different results. When the average yield of the natural bark of *C. Succirubra* is 7·2 per cent., the yield of the

bark renewed under moss may not be so great in comparison as when the yield is but five per cent.

Experiment on 20 trees.

5. A further ground for my suggestion of an extended experiment arose from a careful trial of my own. Ten trees were barked on the 17th October 1867, being then 5¼ years of age. The bark weighed 5,692 grammes, of which an analysis was made. On 4th May 1869, the renewed bark from the same trees was taken, which weighed 3,800 grammes, and an analysis was also made. I quote the results now for the first time:—

	Natural Bark, 5¼ Years old.	Renewed Bark, under Moss, 18 Months old.
Total alkaloids	5·66	9·27
Quinine	2·15	3·43
Chinchonidine and Chinchonine	3·51	5·84
Sulphate quinine obtained crystallised	undetermined.	2·58
„ Chinchonidine obtained crystallised	„	4·88

As the renewed bark contained almost exactly the same amount of moisture as the natural bark, the trees had renewed under moss not quite two-thirds of their original weight of bark that had been taken in rather more than 18 months, though not then quite seven years old.

Deficiency of quinine in above result.

6. Though the foregoing is a successful result, the amount of quinine in the renewed bark appeared less than that apparently ascribed by Mr. Howard in certain instances on younger trees.

The amount of alkaloid in red bark has hitherto increased.

7. As many of my reports have shown, the bark of *C. Succirubra* has yielded yearly a larger amount of alkaloid, though the increment appears to be annually diminishing.

Will cessation of above increase affect the results of mossing?

8. The question naturally occurred whether on older trees than the experiments dealt with, when the percentage of alkaloids is either increasing at a small annual rate, is stationary, or possibly diminishing, the mossed or renewed bark will have the remarkable richness found by Mr. Howard on bark renewed under moss on younger trees. It thus appeared very desirable for several reasons to attempt a larger experiment with the mossing process.

Experiments have been conducted with irregularity; reasons of this.

9. It is now nearly four years since these experiments were commenced. The programme of their fulfilment has been carried out with irregularity, nor is it now complete to the end. The condition of the trees, the difficulty of applying labour at certain times, the state of the weather, &c., &c., have been the main practical reasons of the lack of precision in the carrying out of the plan determined on at the beginning. But it appears to me desirable, now that the trials have so far advanced, to communicate the results obtained, though three years more must elapse before the logical conclusion of the experiments.

Originally proposed plan of procedure.

10. The original scheme was as follows:—Trees of two ages of both red and crown barks were to have their trunks covered with moss for 18 months. A part of the original bark, assumed to be much improved by this treatment, was to be taken, analysed, and sent home for sale, and the trunks thus wounded to be quickly re-covered with moss, in order that the bark may renew in darkness. At the end of another 18 months, the bark thus renewed, which would be of fine quality, was to be again taken, analysed, and sent home for sale, the trunk being again mossed. After successive 18-month renewals, the bark of the second and third renewals was to be treated similarly.

Departures from above plan.

11. In performance, however, the Superintendent of the Plantations has considerably varied from this scheme. After six months had elapsed from the first taking the mossed original bark, a further quantity was taken, and, in some instances, the moss was extended higher up the trunks than was the case at first. The renewed bark under this treatment of the trees at the end of 18 months was too thin, or adhered too strongly to the cambium to allow of its removal; so that a longer time had to elapse before it could be taken. These changes exceedingly complicate the experiments and render the examination of the results by analysis a work of much labour. Furthermore, this treatment scarcely allows the cost to be strictly debited to the results, as would have been the case had the theoretical scheme been carried out. Unforeseen circumstances necessarily modify an experiment in India which has extended to so considerable a length of time.

12. At

Present state of the experiment.

12. At the present date the experiment has advanced so far that considerable amounts of mossed bark have been sent home for sale. At the time of present writing 600 or 700 lbs. of the renewed bark from the oldest trees is prepared for export. The renewed bark from the other trees cannot yet be removed from its slight thickness, though Mr. McIvor* and myself coincide in the opinion that its excellence is more marked at an age of 18 months; hence, the results at that age have been ascertained by analysis, although the bark cannot yet be removed for export.

Time of the beginning of the experiment.

13. The trees were first mossed between the months of May and August 1869. One thousand trees of 7 years of age, and 3,000 of 5½ years of *C. Succirubra* at Neddiwuttum, 1,000 trees of *C. officinalis* of 5 years, and 2,000 of 4 years of age, were thus treated, the age being at the time of mossing.

Mossed bark of oldest trees, results 18 months under moss.

14. In order to secure a true estimate of the mean alteration in the quality of the bark a sample of mossed bark was taken from several trees, and its analysis compared with a sample of the natural unmossed bark from several trees growing under similar circumstances, both being taken from same height of trunk. This was done in order to avoid the error that might occur from employing the bark of single trees, which might possibly possess an exceptional yield. In many cases the analyses were repeated, and samples were taken at different times. I quote the results obtained from trees of *C. Succirubra* of 8½ years of age at the time of analysis:—

	Oldest Trees of C. Succirubra.			
	Analysed, 19 December 1870.		Analysed, 17 January 1871.	
	Mossed Bark, 18 Months under Moss.	Natural Bark.	Mossed Bark, 19 Months under Moss.	Natural Bark.
Total alkaloids	6·92	7·61	7·22	7·61
Quinine	1·09	1·74	1·25	1·34
Chinchonidine and chinchonine	5·83	5·87	5·97	6·27
Quinine obtained in crystals	0·70	0·91	0·71	0·99
Other sulphates excluding chinchonine	4·56	3·18	4·76	3·29

These analyses show that in trees of this age the total yield of alkaloids is not increased by mossing their bark, nor is the yield of quinine augmented. In both analyses a slight decrease in the amount of alkaloid is apparent, but this is compensated for by an increase of chinchonidine sulphate of more than one per cent. This increases the value of the bark for sale on the Continent of Europe, but scarcely for sale in England. Though the cost of the first mossing is, I believe, but 7½ pies a tree, I am quite of opinion that, for the improvement of the bark in trees of this age the application of moss is unremunerative. Though I attach but small importance to the fact, I may mention that the mossed bark on sale in England fetched a lower price than the natural bark. The alteration in the appearance of the bark produced by mossing, the state of the market, and the fancies of the purchaser, are the reasons of the want of precision that a single sale affords of the real value of the bark.

Mossed bark of oldest trees, results 18 months under moss.

15. The 3,000 trees, aged 4½ years, were also mossed, and the bark taken for analysis in

* Mr. McIvor states (Return, East India Chinchona, 1870, page 50): "As above mentioned, by the application of moss to the exterior of the bark the process of oxidation or waste is arrested and the alkaloids increased from 2½ per cent. to 15 or 20 per cent. Moreover, mossing more than doubles the bulk of the bark; thus making the direct yield of alkaloid per acre fully 30 times the quantity that can be procured under any other treatment. But this is a small advantage compared with the great one mossing affords, by enabling us to secure a yearly harvest of bark, without damage to the plants or arrest of the quinine-producing properties. By mossing every 12 or 18 months, the entire cellular bark of the stem can be removed with facility and without injury."

in a similar manner to the foregoing after being mossed about 18 months. The analyses are as follows:—

	Bark of C. Succirubra, 6 Years old.			
	4 May 1871.		22 May 1871.	
	Mossed.	Unmossed.	Mossed.	Unmossed.
Total alkaloids	6·82	6·05	6·31	5·85
Quinine	1·88	1·53	1·61	1·60
Chinchonidine and chinchonine	4·94	4·52	4·76	4·25
Quinine sulphate obtained crystallized	1·32	1·23	1·19	1·15
Chinchonidine	3·11	2·16	2·15	2·05

Conclusions.

16. Hence, in these younger trees an increase in total alkaloids is perceptible, and also the amount of crystalline sulphates obtainable is augmented. The gain is less than was expected, and in the second set of analyses is scarcely perceptible. As the number of trees mossed was large, the two analyses express the yield of trees growing under somewhat different circumstances. As the cost of mossing these trees is nearly the same as that of the older trees, and the trees at this age are too young for their bark to be commercially cropped, I am of opinion that mossing trees of *C. Succirubra* for the improvement of their bark is unremunerative. In a footnote I quote analyses of Mr. Howard made with mossed bark supplied from younger trees.*

Mossed bark of oldest trees, results; 30 months under moss.

17. On 23rd January 1872, an analysis was made of a carefully selected mean specimen of the bark of the oldest mossed trees, which had been under moss about two years and six months. I compare it with a carefully obtained mean of two analyses of the natural bark, each derived from a specimen taken from several trees.

	C. Succirubra, about 9½ Years old.	
	Under Moss, 2½ Years.	Natural Bark.
Total alkaloids	7·80	7·67
Quinine	1·64	1·49
Chinchonidine and chinchonine	6·16	6·18
Quinine sulphate obtained crystallized	0·92	1·01
Chinchonidine	3·65	3·50

18. On

* Return, East India Chinchona cultivation, 1866, page 134, Report dated 1st August 1865.
No. I.—Bark of three years and five months growth, thickened by the application of moss.
Crystallized sulphates per 100 parts - - - - - - - - 6·00
Of alkaloid soluble in extra light ether - - - - - - - 0·94
Of alkaloid insoluble in the above: therefore chinchonine - - - 1·06

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

Return, East India Chinchona cultivation. 1870, Report dated 4th February 1867.
No. II.—Original bark, six months under moss.

Crystallized sulphates	–	4·57
Alkaloids soluble in ether (chinchonidine and quinine)	–	3·78
Insoluble in ether, chinchonine	0·80	
Chinchonicine	0·11	
	0·91	
		9·26

No. III.—*C. Succirubra*, original bark unmossed.

Crystallized sulphates	–	4·50
Alkaloids soluble in ether	–	1·71
Insoluble in ether, chinchonine crest	0·40	
Chinchonicine	0·34	
	0·74	
		6·95

Memorandum.—The sulphates as No. II.

18. On 2nd October 1872, a similar analysis was made of bark from the younger trees, which had been three years under moss; the trees being somewhat over eight years of age. I compare it with natural bark from trees growing under similar circumstances:— Mossed bark of younger trees, results; 36 month under moss. Conclusions.

	C. Succirubra somewhat over 8 Years old.	
	Bark under Moss 3 Years.	Natural Bark.
Total alkaloids	7·72	6·36
Quinine	2·02	1·36
Chinchonidine	5·70	5·00
Quinine sulphate obtained crystallized	0·82	0·80
Chinchonidine „ „	8·57	4·02

Here it is apparent that in the younger trees the amount of alkaloids is increased in the mossed bark that has been three years under moss. The increase exceeds that apparent in the mean of the analyses of the bark of trees of this age mossed for eighteen months, by 0·75 per cent. But this total gain of 1·36 per cent. by three years' mossing consists of chinchonine and uncrystallizable quinine or quinicine, and does not add perceptibly to the market value of the bark. I submit, therefore, that the two analyses last quoted corroborate the conclusion I arrived at in the early part of the experiment, and stated in paragraphs 14 and 16. This conclusion is that the gain in quality produced by the application of moss to the bark of *C. Succirubra* does not compensate for the labour and expense of mossing the trees and keeping the bark under moss. To this it may be added that the conclusion is practically true, even if the bark be kept a considerable period under moss.

Thickness of renewed bark.

19. From the oldest trees that had been experimentally treated with moss as above, about 700 lbs. of renewed bark have been taken in December and January of 1872-73. The mean age of this bark is twenty months, and has been taken from trees whose age is a few months over ten years. The reason of this renewed bark not being cropped at the end of eighteen months is that at this time it could only be separated with difficulty from the cambium, and its cropping would be consequently attended with injury to the trees. I estimate its mean thickness at slightly less than half of the natural bark. As the thickness varies considerably, it is scarcely possible to obtain a completely accurate estimate. I should state that Mr. McIvor inclines to a somewhat larger estimate of its thickness than I do, but I give the above as more coincident with my own examinations. Of course, the more accurate method of comparing the yield would be to weigh the total products, but unfortunately the state of the trees will not permit of the whole of the renewed bark being taken; a strip only being taken from the centre of the long patch of renewed bark. It is believed that in May next, when the renewed bark will be two years old, the remaining portion can be taken and an accurate estimate of the respective yields will be then possible.

Renewed bark, oldest trees; results.

20. Two careful analyses have been made of the renewed bark, and the bark of several unmossed trees growing close by and under similar circumstances was analysed for comparison:—

	C. Succirubra.			
	Renewed under Moss.	Natural Bark.	Renewed under Moss.	Natural Bark.
Total alkaloids	5·82	5·72	6·25	6·12
Quinine	3·78	1·37	3·80	1·50
Chinchonidine and Chinchonine	2·04	4·35	2·45	4·62
Quinine sulphate obtained crystallized	2 81	0·50	2·87	0·85
Chinchonidine „ „	0·80	3·38	1·00	3·41

The above analyses show that the renewed bark is of superior quality to the natural bark. The amount of quinine is considerably increased, although much of it is uncrystallisable. The amount that crystallises as sulphate does so with a readiness somewhat resembling that of the quinine from crown barks. The renewed red bark is, however,

inferior

inferior to the natural crown barks as a source of quinine. I am aware that this result differs somewhat from that of the analyses of Mr. Howard made some years since of the renewed bark from younger trees, but having no doubt of its accuracy, I communicate the fact as I find it.

Mean quality of renewed bark now exported.

21. An analysis of a carefully selected mean sample of this renewed bark now about to be sent home may be conveniently quoted here as corroborating the above results:—

	Mean Sample renewed Bark.
Total alkaloids	5·38
Quinine and quinicine	2·17
Chinchonine and Chinchonidine	3·21
Quinine sulphate obtained crystallized	1·7
Chinchonidine „ „	0·85

The bark renewed on the 3,000 trees of *C. Succirubra* of 8½ years of age had arrived at the age of eighteen months in October last. Though then at the greatest excellence of yield, it was too thin to be removed from the trees, adhering firmly to the wood below. A sample was, however, taken for analysis from three trees of average appearance, and compared with the natural bark of same age grown under similar circumstances. The renewed bark varied greatly in thickness which generally ranged from a fifth to a third of the thickness of the natural bark. The results of the analyses were as follow:—

	C. Succirubra from Trees 8½ Years of Age.	
	Renewed Bark 18 Months old.	Natural Bark.
Total alkaloids	6·39	6·36
Quinine	3·21	1 36
Chinchonidine and Chinchonine	3·18	5·00
Quinine sulphate obtained crystallized	2·30	0·90
Chinchonidine „ „	3·03	4·02

Renewed bark of younger trees; results.

22. Hence it appears that the renewed bark, though thin, had improved in quality over the natural bark. It contained almost precisely the same amount of alkaloid as the natural bark, but yielded more quinine, though much of this was uncrystallizable as sulphate. Though yielding somewhat less quinine than the renewed bark of the oldest trees, it had a certain advantage over the latter in containing more chinchonidine, giving a crystalline sulphate. From certain results I have during the last year obtained, I have come to the conclusion that as the red barks increase in age, the chinchonidine becomes partially replaced by chinchonine, and it also appears that the renewed barks considerably partake of the quality of the natural bark, as altered by increasing age.*

Results with bark three years under moss.

23. Though the above results are definite as far as they go, it appeared to me desirable that investigation should decide whether red bark renewed under moss would ever, on trees from which it could be profitably cropped, possess the high qualities that have been attributed to it. For that purpose I obtained a fresh specimen of some renewed bark that had

* Though a high quality has been ascribed to the bark of first renewal, the single analysis made by Mr. Howard scarcely confirms this opinion.

Return, East India (Chinchona Plant) 1866, page 134.

"No. 2 gave of crystallized sulphate - - - - - - - - 5·00
„ of alkaloid soluable in extra light ether - - - - 0·90
„ of alkaloid insoluable in extra light ether (chinchonine) - 1·80

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

had been three years under moss. Its analysis gave the following results, which are compared with the natural bark of trees growing near:—

	C. Succirubra Trees 10 Years old.	
	Renewed 3 Years under Moss.	Natural.
Total alkaloids	6·12	6·12
Quinine	3·37	1·50
Chinchonidine and Chinchonine	2·75	4·62
Quinine sulphate obtained crystallized	2·27	0·85
Chinchonidine „ „	2·91	3·41

It, therefore, appears that three years' mossing does not improve the renewed bark.

C. Officinalis.

24. Before discussing the general question of mossing the trees of red bark, I will first detail the results of the experiment of the application of moss to trees of *C. Officinalis* so far as it has hitherto advanced.

Results with mossed *C. Officinalis.*

25. The crown barks of two ages, numbering about 2,000, were mossed at the same time as the red barks. At the end of about 18 months samples of bark were collected for analysis with much care, from trees growing under the same conditions and having the same general habit. Bark for comparison was taken from unmossed trees, growing under as like circumstances as could be found. The reason of the special care necessary in the selection of samples is that the bark of *C. Officinalis*, as I have frequently pointed out in previous reports is especially sensitive to the external circumstances under which the tree grows. This is shown by the considerable alteration produced in the amount of alkaloid in the bark by change of aspect, climate, or soil, circumstances which produce little alteration in the bark of *C. Succirubra*. The trees at the time of mossing were respectively about five and four years of age, so that at the time of taking the mossed bark their ages were 6½ and 5½ years. In most cases the analyses have been repeated to secure as complete an accuracy as possible. The results were as follows, quoting the results of both ages in one table, with a column expressing the difference produced by mossing:—

	C. Officinalis.					
	Trees, 6½ Years old.			Trees, 5½ Years old.		
	Mossed.	Unmossed.	Difference.	Mossed.	Unmossed.	Difference
Total alkaloids	7·41	5·26	2·15	4·73	3·10	1·63
Quinine	4·57	3·48	1·09	2·96	1·62	1·34
Chinchonidine and Chinchonine	2·84	1·78	1·06	1·77	1·48	0·29
Quinine sulphate obtained crystallized	4·46	3·25	1·21	2·55	1·64	0·91
Chinchonidine „ „	1·74	2·04	0·70	0·94	1·14	0·20

Satisfactory character of results.

26. The above results appear to me to be of great importance, and show a considerable divergence in the effects of mossing between *C. Officinalis* and *C. Succirubra*. In the elder lot of trees treated, which alone are of age for chopping, the amount of total alkaloids has been increased 2·15 per cent., of which 1·09 is quinine yielding nearly its due amount of sulphate. In the younger lot the gain of total alkaloids is also marked, being 1·63 per cent., of which 1·34 is quinine, of which a certain portion (though far less than is the case in red bark) is uncrystallizable, the gain in sulphates being 0·91. In the

the case of both trees a certain amount of the chinchonidine has been replaced by chinchonine as is shown by the negative difference of crystallised chinchonidine sulphate; but as regards the commercial value of the bark this circumstance has no appreciable effect. It may be roughly estimated that at the present price of chinchona barks the actual value has been increased in the elder trees by at least 9 *d.* per pound, and in the younger by about 8 *d.* In foot-note I quote the results obtained by Mr. Howard with mossed crown barks.*

Increase in elder barks by mossing, a hopeful sign.

27. The circumstance that the elder trees show in comparison with the younger trees even a greater increase appears to me a hopeful sign. This is entirely different to the red bark, and seems to show that up to the present time the effect of mossing does not diminish with the increased age of the tree. Whether it will eventually do so, experience alone can show. The mossing has, indeed, the ill effect of altering the appearance of the bark by destroying its characteristic lichens, and may even at first prevent its fetching its true value; but such a consequence must eventually cease under the influence of its substantially better quality for the quinine manufacturer.

Bark not increased in thickness by mossing.

28. At the time of analysis, as above mentioned, the thickness of the mossed bark was carefully determined by weighing equal areas of both the red and crown barks, as well as by direct measurement. From these experiments I conclude that in neither case has the bark been thickened by the application of moss. In both cases, the amount of water present in the bark has been somewhat larger than in the natural bark, but the effect of this, I think, will in practice be found of slight consequence.

Renewed bark from older trees; results.

29. In October last, the bark had renewed under moss on the crown bark trees with much evenness, and was then two years of age, or six months older than the time ascribed as that of its best yield. But it was still found too thin for removal from the trees, and could not be cropped as intended. Notwithstanding this, it appeared to me desirable to examine it by analysis. Two specimens, each from several trees, were taken in different localities, and specimens for comparison were taken from unmossed trees growing under similar circumstances. The results obtained were as follows:—

	C. Officinalis Trees, 9 Years old.					
	Renewed Two Years old.	Natural.	Difference.	Renewed Two Years old.	Natural.	Difference.
Total alkaloids	7·03	6·04	·99	6·93	6·04	·89
Quinine	5·21	4·77	·44	5·17	4·77	·40
Chinchonidine and chinchonine	1·82	1·27	·55	1·76	1·27	·49
Quinine sulphate obtained crystallized	4·57	4·80	— ·23	4·40	4·80	— ·40
Chinchonidine	0·58	0·92	— ·34	0·60	0·92	— ·32

30. Before discussing these results, I will quote analyses of similarly collected specimens

* Return, East India (Chinchona cultivation), 1870, page 35.

No. 5, *C. Officinalis* var B. Condaminea (Bonplandiana), original bark, nine months under moss.

Crystallized sulphates	6·66
Alkaloids soluble in ether, quinine, and chinchonidine	0·56
Insoluble in ether, chinchonicine	0·15
	8·02

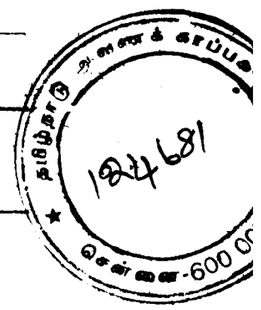
Same Return, page 134.

No. 2, Strong growing variety of *C. Officinalis*, 6½ years old.

Crystallized sulphates	2·92
Soluble in ether (chinchonidine and quinine)	0·41
Insoluble in ether (chinchonicine and chinchonine)	1·20
	4·53

mens obtained from the trees of eight years old, in which, for entirely similar reasons, the renewed bark had been allowed to attain the age of two years:—

	C. Officinalis Trees, Eight Years Old.		
	Renewed Two Years Old.	Natural.	Difference.
Total alkaloids	5·83	3·61	2·22
Quinine	3·34	2·34	1·00
Chinchonidine and chinchonine	2·49	1·27	1·22
Quinine sulphate, obtained crystallised	3·13	2·10	1·03
Chinchonidine „ „	2·60	1·44	1·16



Here, as on the trees of red bark, the yield of the renewed bark exceeds that of the natural bark, to the greatest extent on the younger trees. I cannot but consider this a discouraging indication, as it may signify that renewed crown-bark will not surpass the natural bark so greatly in after-years as when produced by young trees. But the yield of the renewed bark is absolutely greater even on the elder trees, and in this respect *C. Officinalis* considerably differs from *C. Succirubra*. In the elder trees the renewed bark is nearly equal in value to the natural bark; in the younger it exceeds the natural bark in money value by about 10 *d.* per pound. This, of course, assumes that the renewed bark could now be removed from the trees for sale, which, as before stated, is not yet the case.

Renewed bark, 28 months under moss; results.

31. As in the case of the red barks, it appeared to me to be very desirable to ascertain whether a long continuance under moss in any respect improved the quality of the renewed crown bark. I therefore, by the kindness of Mr. McIvor, obtained specimens of bark renewed under moss from the oldest *Officinalis* trees. It had been under moss two years and four months. Natural unmossed bark grown upon trees under similar circumstances was analysed for comparison. The results were as follow:—

	C. Officinalis, Nine Years of Age.		
	Renewed under Moss Two Years and Four Months.	Natural.	Difference.
Total alkaloids	5·58	5·10	0·48
Quinine	4·23	3·42	0·81
Chinchonidine and chinchonine	1·35	1·68	0·33
Quinine sulphate, obtained crystallised	4·18	3·38	0·80
Chinchonidine, „ „	1·41	1·72	0·31

Here it is evident that in this case four months' increase of age under moss has somewhat improved the quality of the bark. But in so variable a bark as *C. Officinalis* I am not inclined to place much stress on this fact, inasmuch as the alteration in quality between the natural and the renewed bark differs but slightly from the case in which the latter was two years old.

Certain consequences of mossi must be first discussed.

32. Before discussing the results of mossing the trees, certain general consequences of the application must first be stated, which appear to me considerably to influence the results.

Certain improvements perceptibl

33. The crown barks, as I have in former reports had the honour of stating, possess in the highest degree the property of forming the crystalline sulphates with facility. Hence their

in renewed bark of *C. Succirubra.*

their peculiar fitness for employment by the European quinine manufacturer. Mossing the crown-bark trees, or renewing their bark under moss, does not increase this admirable property, from the fact that it is already at a maximum. The red barks, on the contrary, have the bad quality of affording crystalline sulphates with difficulty. A covering of the bark with moss for eighteen months, however, diminishes this peculiarity, though, at the same time, it appears to increase the difficulty with which the alkaloids are obtained free from red colouring-matter. The renewed red barks, however, form crystalline sulphates with far greater ease than the natural bark, though even in this respect they do not rival the crown barks. The alkaloids of the renewed red barks, however, are contaminated with a red colouring matter in a greater degree than the natural bark, and from which there occasionally is some trouble in freeing them. This affects the value of the barks, though, I believe, in a less degree than the comparative ease of the crystallisation of sulphates. In the renewed barks it appears to me that the barks are exhausted of their alkaloids with greater ease than the natural barks.

Renewal affects growth of tree.

34. The facility with which the bark, after being cropped, renews under moss appears to me to be the most important element in the application of the process. Mr. McIvor at first stated that the taking of the bark has no effect on the growth of the tree. No doubt small experiments on a few healthy trees led to this conclusion; but, notwithstanding, I have no hesitation in stating it to be erroneous. That so important a seat of the life of the tree as the bark can be taken from it without affecting its growth appears almost an absurdity. That it is not the case experience has conclusively shown, and I do not think even the superintendent of the plantations now holds the contrary. For some months after taking of the bark, the growth of the tree ceases; it appears unhealthy; the colour of the leaves changes to yellow or red, and it has generally a more or less sickly aspect. But after a time it recovers its health; the bark that has been taken renews with variable homogeneity, and after a year it reassumes its healthy appearance and growth.

Difficulty with *C. Succirubra.*

35. As a matter of fact, the renewal of the red bark has not been entirely complete under the circumstances of the experiment. Nearly all the elder trees that I have examined had bare patches of wood, where the bark had not grown again after it had been taken. Among the younger trees there are also many trees on which the bark had not completely renewed. These trees are, of course, considerably injured by the treatment they have received, though I have not observed in any instance one that has actually died. Notwithstanding the many cases in which the bark has failed to renew, the younger red-bark trees are a mass of verdure at the present writing, the elder trees alone looking sickly. Mr. McIvor properly states that the application of the process of mossing is still an experiment, and that we have not at present the requisite experience to enable it to be performed without risk. I may mention that in consequence of Government Order, No. 1,213, of 13th July 1871, a very fine plot of 2,000 trees of *C. Succirubra* had its bark taken and the trunks mossed, the work being commenced on 15th October 1871, a time supposed to be favourable to the renewal of bark. I find by observation that 17 out of 20 trees, or 85 per cent., taken in various parts of the plot, have not renewed their bark. This plot, of course, forms no part of the experiment, though the result appears to me to be significant.

Renewal with *C. Officinalis* more certain.

36. On the other hand, the trees of *C. Officinalis* appear to me to renew their bark with far greater certainty, although the growth in thickness is slower than in the case with red bark. The quality of the renewed bark is also far finer, and is well suited for export. I am of opinion that even the renewed red bark will never be employed in English quinine manufacture as long as the market supplies sufficient crown bark, and when the good quality of the latter is thoroughly known. Notwithstanding that the cost of mossing the crown-bark trees at first has been 2 annas 11½ pies per tree, while that of the red-bark mossing has been but 7½ pies, it appears to me even now sufficiently evident that the process is more successful on the former, from the greater certainty of renewal, and the superiority of the product. It is greatly to be regretted that comparative experiments have not been carried out on coppicing the chinchona trees, in order that the most profitable means of collecting the crop might be experimentally determined.

Growth of moss little advantage.

37. In the report of the Superintendent of the Chinchona Plantations for 1870-71, attached to Government Order, No. 1,237, of 20th August 1872, paragraph 14, it is stated that the applied moss grows and increases as well as the trees. I am unable to see the advantage of this ascribed tenacity of life, since the moss must be stripped off the tree half-yearly in order to remove the bark underneath, the wound being again recovered. Another increase of labour produced by the process is that a ladder is necessary for the removal of bark at heights exceeding seven feet, from which it is found that a coolie, instead of cropping 50 lbs. of green bark per diem, only crops 20 lbs. I mention these circumstances mainly to show that the consequences of the application of the process are more complex than at first appears.

Quality of renewed bark depends on age of tree.

38. The amount of total alkaloids which red bark renewed under moss contained was, by Mr. Howard's analysis in 1865, about 6·37 per cent. In May 1869 I obtained from the same 9·27 per cent. In 1872, from a similar specimen, I obtained but 6·03 per cent. The year 1869 was the age in which the most considerable yearly increase in the amount of alkaloids that I have observed took place, as well as that in which the largest yield of alkaloid in the first renewed bark is recorded. At the present time I have some reason to

to fear that the bark of the eldest trees has arrived at, if not passed, the age of its maximum yield. It appears to me that the foregoing fact furnishes some indications that the quality of the first renewed bark is intimately connected with the changes taking place in the tree, and is highest when the natural annual increase of alkaloids is the greatest. The thickness of the renewed bark may also somewhat depend on the same causes.

Mossing applied to *C. Succirubra* less successful.

39. From the foregoing considerations I am not inclined to look sanguinely on the effects of mossing the trees of *C. Succirubra*. Had the plan of coppicing been tried, a comparative and more definite opinion could have been arrived at. I am quite of opinion that no more trees should be mossed until the results obtained from the bark of second and third renewal show the actual results they promise from Mr. Howard's reports. The grounds on which I base my opinion are—firstly, the comparative thinness of the renewed bark; secondly, its moderate quality; thirdly, the somewhat uncertainty of its renewal; fourthly, the injury to the trees produced by taking the bark.

Mossing applied to *C. Officinalis* promises success.

40. On the trees of *C. Officinalis* these objections are less patent. The renewed bark, though thin, is of fine quality, and the renewal appears to be certain. I consider the plan of mossing, as devised by Mr. McIvor, applied to this species promises success. But nearly the whole of the chinchona plantations have now been mossed, so that, unless the application be stopped, there will soon be no trees left of an age on which so necessary a plan as coppicing can be fairly tried.

Coppicing for comparison still a speculation.

41. In Government Order, No. 701, 19th April 1871, the Government assent to certain proposals of the Nilgiri Commissioner for the comparative trial of coppicing. In paragraph 3 of a letter of the same officer, attached to Government Order, No. 1,213, of 13th July 1871, he states "the same are being carried out," apparently believing it to be the case. But, with the exception of 200 trees of *C. Succirubra* which were felled in June 1871, the matter has hitherto been in abeyance.

Results appear to corroborate estimates held of the chinchona species.

42. The opinion which I hold that the success in export of the Indian chinchona plantations will, at least for the next 20 years, depend on the amount of the bark of *C. Officinalis*, *Calisaya*, and var. *Bonplandiana Angustifolia*, sent to Europe, far more than on red bark, receives hitherto, I submit, a further partial corroboration in the results detailed in the foregoing report, and the conclusions I found thereupon.

ORDER of the Madras Government thereon, 29th May 1873.

THE Government are obliged to Mr. Broughton for his interesting report. They are not, however, of opinion that his experiments have been sufficiently extensive to justify a general condemnation of the mossing process, as applied even to the old *C. Succirubra* trees, and they consider that the Commissioner's remarks in paragraphs 9 and 10 of his letter show almost conclusively (if his figures are correct) that this system is likely to be more profitable than the coppicing system which Mr. Broughton advocates.

2. Sufficient information is not, however, as yet available as to the certainty of a reproduction of bark after a tree has been stripped, and the statements made in paragraph 35 of Mr. Broughton's report, that 85 per cent. of a patch of 2,000 trees had failed in this respect, is a matter which should receive the Commissioner's and Mr. McIvor's gravest consideration.

3. The experiment advocated in paragraph 13 of the Commissioner's letter should at once be undertaken, and the number of trees which it is proposed to include in it should be reported.

4. No further mossing of the trees should be undertaken until the results of this experiment, which should be reported specially from time to time, are fully established, and the ernment desire to know whether any experiments have yet been made as to the reprotion of bark without this artificial assistance.

— No. 29. —

(No. 24—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 12 September 1873.

YOUR GRACE will have learnt from our Proceedings of 16th October 1872, 1,433, forwarded with the letter marginally noted*, that it had been arranged orward this year a large consignment of chinchona bark to England for sale in open market.

*To Under Secretary of State, 24 April 1873, No. 15.

2. We have now the honour accordingly to advise your Grace of the transmission to the India Office by screw steamer "Othello," which left the port o Madras for London, *viâ* the Suez Canal, on the 12th ultimo, of 139 cases received from the Superintendent of the Government Chinchona Plantations, containing in all 23,646 lbs. of bark.

3. The papers on the subject, subsequent to our Proceedings of 16th October 1872, are herewith forwarded for your Grace's information.

4. The invoice and bill of lading for the 139 cases in question were forwarded to the India Office with the letter marginally noted,* with a request that the freight due thereon might be paid in London after measurement of the cases on arrival there, and the detailed invoice, as prepared by the Superintendent of the Chinchona Plantations, will be found recorded in the Proceedings last above quoted.

* To Under Secretary of State, dated 19 August 1873, No. 29.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 29.

From the Commissioner of the Nilgiris to Acting Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 2nd April 1873.

GOVERNMENT, in their Order, No. 1,433, of 16th October last, approve of Mr. McIvor's proposal to consign for sale in the home market this year from 20,000 to 25,000 lbs. of chinchona bark. Mr. McIvor, in a letter, No. 161, of 24th ultimo (enclosed), reports that this quantity has already been collected, and states there is a further supply of 50,000 lbs. of bark available. He solicits permission to collect this supply and ship it.

2. It appears to me the additional available bark should be prepared and sent home. So large a quantity as 75,000 lbs. of bark thrown into the market at one time will tend to solve the question of the extent to which prices are likely to be affected by Indian bark, and it is desirable, in the interests of private owners of chinchona plantations, to obtain this information as soon as possible. A very large quantity of bark will, it is believed, be available next year.

3. Mr. McIvor brings to notice that Messrs. Stanes & Rouse have tendered to ship the bark from Calicut to London at the rate of 5 *l.* per ton of 50 cubic feet, at which computation a ton would cost in freight alone 170 rupees. On the score of economy, I would recommend that the consignment be made, as hitherto, direct to the Secretary of State.

From the Superintendent, Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 24th March 1873.

WITH reference to the Proceedings of Government, No. 1,433, under date 16th October 1872, authorising the transmission to England of from 20,000 to 25,000 lbs. of chinchona bark, I have the honour to inform you that I have collected this quantity, and not gathered more than one-third of the bark available; I would therefore feel obliged by your being so good as to obtain the sanction of Government to our collecting during this season a further supply of from 40,000 to 50,000 lbs. of bark for the home market.

2. During this official year 80,000 lbs. of fresh bark have also been supplied to Mr. Broughton, the Government Quinologist, for the manufacture of amorphous quinine.

3. Messrs. Stanes & Rouse, of Coimbatore, have tendered for the transmission of the bark we are now packing for Europe, from Calicut to London, at 5 *l.* per ton of 50 cubic feet. Chinchona bark being light, this would make the freight of a ton of 20 cwt., from Calicut to London, 170 rupees; this, together with the carriage to Calicut, will form a heavy charge against the transmission of the bark. I therefore request to be informed whether the bark is to be dispatched, as hitherto, direct to the Secretary of State for India, care of the Secretary to Government, Madras, or through Messrs. Stanes & Rouse.

ORDER of the Madras Government thereon, 22nd April 1872.

REFERRED to the Acting Collector of Sea Customs, who is requested to ascertain and report the rate of freight per ton paid on the last consignment of bark per canal steamer, and the rates now ruling at this port.

Enclosure 2, in No. 29.

From the Acting Collector of Sea Customs to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Madras, 14th May 1873.

IN reply to Government Order, Revenue Department, No. 427, of 22nd April 1873, I have the honour to inform you that I addressed the several agents to canal steamers to let me know the rate of freight per ton, and whether they would undertake the shipment of 75,000 lbs. of chinchona bark to London; they all replied in the negative, with the exception of Messrs. Binny & Co., who offer to ship the bark either on the steamer "Saltwell" or "Hindoo," leaving this on the 19th and 21st instant respectively, at the rate of 4 *l.* 10 *s.* per ton of 50 cubic feet.

2. Messrs. Binny & Co. wish to know how the bark is to be packed, and whether it is likely to damage other cargo.

3. The rate of freight paid on the last consignment of bark was 5 *l.* 15 *s.* per ton of 50 cubic feet.

ORDER of the Madras Government thereon, 28th May 1873, No. 541.

THE Government do not deem it advisable to accept Messrs. Stanes & Rouse's offer. The bark should be forwarded to the Collector of Sea Customs, who will have it shipped per canal steamer to the Secretary of State.

2. The Commissioner of the Nilgiri Hills will supply the Collector of Sea Customs with the information desired by Messrs. Binny & Co.

Enclosure 3, in No. 29.

From the Collector of Sea Customs, Madras, to the Acting Under Secretary to Government, Revenue Department, Fort St. George; dated Madras, 14th August 1873.

IN forwarding the invoice for 139 cases of chinchona-bark, together with bill of lading, in duplicate, received from Messrs. Binny & Co., the agents of the steamer "Othello," on board which the bark was shipped, I have the honour to request you will be good enough to forward them, *by the next mail*, to the Secretary of State for India, with an intimation that the freight due thereon should be paid in London after measurement of the cases on arrival there.

Enclosure 4, in No. 29.

From the Commissioner of the Nilgiris to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 12th August 1873.

IN a letter to Government in Government Order, Revenue Department, 22nd April 1873, No. 427, I requested approval to a proposal of Mr. McIvor to collect 50,000 lbs. of chinchona bark to send to England for sale, in addition to 25,000 lbs. already ordered to be collected.

2. I annex a letter from Mr. McIvor, announcing the dispatch to Madras of 23,000 lbs. of bark out of the 25,000 lbs.

3. With regard to the additional 50,000 lbs. of bark, my letter was referred to by Government to the Collector of Sea Customs for a report on the rate of freight for bark. No instructions have been issued to me to have the 50,000 lbs. collected or otherwise. I have the honour to request instructions. The bark can be harvested in October; it cannot be taken earlier, owing to the monsoon.

4. I should observe that, contrary to Mr. Broughton's statement in paragraph 40 of his report in Government Order 28th May 1873, No. 549, Revenue Department, that "nearly the whole of the plantations have now been mossed, so that, unless the application be stopped, there will soon be no trees of an age on which so necessary a plan as coppicing can be fairly tried," there are, in the Government plantations, about 6,000 red-bark trees of 11 years old, and 18,000 crown-bark trees of 10 years of age *unmossed*.

5. If an additional 50,000 lbs. of bark are to be taken this year, these 24,000 trees will have to be stripped and mossed. In this event, the Order of Government, No. 716, dated 10th July 1873, Revenue Department, stating that no more trees are to be

mossed until the merits of coppicing have been ascertained, will, *ipso facto*, modified.

6. I would venture to suggest an express modification of the order. A coppicing experiment sufficiently extensive to satisfy Mr. Broughton is now being conducted, and this experiment, or any other similar experiment, will take years to complete. In the meanwhile the unmossed trees on the plantations, if left untouched, will yield no revenue, and a serious consequence will occur besides. The bark on these trees will go on deteriorating; for Mr. Broughton, in paragraph 38 of his mossing report mentioned above, makes a remark indicating that, in his opinion (an opinion in which the information I have at my disposal leads me to coincide), the value of bark depends on the age of the bark, and not on the age of the tree, and the bark must not be beyond a limited age of a few years. He writes, speaking of certain trees: "At the present time, I have some reason to fear that the bark of the eldest trees has arrived at, if not passed, the maximum yield." I would suggest that Mr. McIvor should be at liberty to moss until the superiority of the mossing process is established. Nothing will be lost by this arrangement, because mossed trees, like unmossed trees, are capable of being felled by the axe and coppiced at any time desired.

7. In connection with the preparation of bark for shipment, I would suggest to Government the expediency of according a discretion to the Commissioner to collect bark as it becomes available, and to make arrangements for shipping it; reporting from time to time, to Government, the quantity collected and the quantity shipped, with the necessary details. In consequence of the delay in the issue of orders respecting the 50,000 lbs. of bark in question at the present moment, a favourable season for taking the bark has passed, and some months must elapse before the bark can be gathered.

From the Superintendent of the Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 31st July 1873.

WITH reference to the Proceedings of Government, Revenue Department, dated 16th October 1872 and 28th May 1873 respectively, I have the honour to inform you that I dispatched, between the 18th and 28th instant, the whole of the cases of chinchona bark, 139 in number, to the Collector of Sea Customs, Madras, to be shipped to the Secretary of State for India.

2. The invoice is enclosed. By it you will observe that 11 cases, Nos. 51 to 61, inclusive, of branch red bark has been forwarded, and 13 cases of branch crown bark, being bark rejected by Mr. Broughton as valueless for his manufactory. Mr. Broughton's process differs in some degree to that employed at home, and this bark may consequently prove of fair value in the home market, and, under any circumstances, it appears desirable to ascertain the price Nilgiri branch bark is likely to command in the home markets, and with this object these cases have been forwarded.

ORDER of the Madras Government thereon, 5th September 1873.

IT appears that, in order to carry into effect the proposal of the Commissioner, that 50,000 lbs. of bark should be collected for shipment to England, it will be necessary to moss all the unmossed trees in the plantations of 11 and 10 years of age. Relying on Mr. Broughton's statement that "nearly the whole of the chinchona plantations had been mossed," the Government, in their Order, dated 29th May 1873, No. 549, directed that no further mossing of the trees should be undertaken until the superiority of the mossing over the coppicing system had been established. Under the circumstances now stated, however, they are pleased to direct that of the 24,000 trees of 11 and 10 years old, one-fourth, or 6,000, situated in different parts of the plantation, shall be retained for coppicing, and that three-fourths, or 18,000, shall be mossed after being harvested. It is probable that this will restrict the projected harvest somewhat below the estimate of 50,000 lbs., but this is not a matter of any moment. Similarly, the application of moss will not be carried out in regard to more than three-fourths of the remaining trees of the plantations; care being taken that at least one-fourth of the trees planted in each year are reserved for experimental coppicing, in case it should be hereafter determined to carry out that system further.

2. With reference to paragraph 7 of the Commissioner's letter, the Governor in Council is pleased to authorise him to use his discretion in collecting the bark for the home market and in making arrangements for its shipment to England, submitting, from time to time, reports on his proceedings as proposed.

3. A copy of Mr. McIvor's letter, with the invoice enclosed, will be forwarded to His Grace the Secretary of State.

— No. 30. —

(No. 30—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 26 September 1873.

IN continuation of our Despatch, 12th instant, No. 24, advising your Grace of the transmission, in August last, of 23,646 lbs. of chinchona bark to England for sale, we have the honour to forward our proceedings marginally noted,* embodying a letter from the Government Quinologist, containing analyses of the several samples of the bark in question.

*Proceedings of Government, 8 September 1873.

2. We beg to invite your Grace's attention to Mr. Broughton's rema ks in paragraph 2 of his letter on the subject of putting the branch bark into the home market, and to the observations of the Commissioner of the Nilgiri Hills in paragraphs 3 to 5 of his letter of 12th August 1873.

3. With advertence to the last enclosure in our Despatch above quoted, we take this opportunity of informing your Grace that the respective merits of the "mossing" and "coppicing" system of treating the chinchona tree are now engaging our attention.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 30.

From the Government Quinologist, to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 9th August 1873.

I HAVE the honour to append analyses of the several samples of chinchona bark now being sent to England, according to the list of specified kinds furnished me by the Commissioner of the Nilgiris. The analyses are given in the following table, and are expressed in per-centages of quite dry bark:—

	Mossed Red Bark, Neddivuttum.	Renewed Red Bark, Neddivuttum.	Grey Bark.	Red Bark, Neddivuttum.	Red Bark, Pykara.	Branch Red Bark.	Crown Bark, Neddivuttum.	Crown Bark, Pykara.	Mossed Crown Bark, Dodabetta.	Crown Bark, Dodabetta.	Branch Crown Bark.
Total alkaloids	6·20	*5·82	2·75	†4·45	5·11	3·58	†4·32	†3·42	†6·60	†3·61	0·91
Quinine and quinicine	1·14	3·25	–	1·31	0·97	1·33	3·08	2·32	3·89	2·07	–
Chinchonidine and chinchonine	5·06	2·57	2·75	3·14	4·14	2·25	1·24	1·10	2·71	1·54	–
Pure sulphate of quinine, obtained crystallised.	0·74	2·62	–	0·74	0·62	0·81	3·11	2·39	3·86	2·04	–
Pure sulphate of chinchonidine, obtained crystallised.	3·47	0·88	1·00	1·61	2·22	1·14	0·85	0·67	1·00	0·99	

* Mean of three analyses. † Mean of two analyses.

2. Certain branch crown bark has been sent, contrary to my advice, given under the belief that, even if it sell for a good price, its quality will ultimately prejudice the reputation that Madras chinchona bark should seek to obtain in the market.

Enclosure 2, in No. 30.

From the Commissioner of the Nilgiris, to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 12th August 1873.

I HAVE the honour to acknowledge the receipt of a letter, in original, to your address from the Government Quinologist, dated 9th instant, forwarded for my observations.

2. The letter contains Mr. Broughton's analysis of samples from 23,000 lbs. of chinchona bark recently despatched to England for sale. With regard to this analysis I have no remark to offer at present.

3. In paragraph 2 of the letter Mr. Broughton states: "Certain branch-bark has been sent, contrary to my advice, given under the belief that, even if it sells for a good price, its quality will ultimately prejudice the reputation that Madras chinchona bark should seek to obtain in the market." Upon this point I beg to quote paragraph 4 of a despatch from the Secretary of State, printed in Government Order, Revenue Department, 11th July 1870, No. 1,022: "The plantations will require thinning from time to time, and strict injunctions should be given that no bark, not even that of the smallest twigs, should be wasted." The branch bark referred to by Mr. Broughton was bark rejected by that gentleman, in the last official year, as unfit for the use of the factory at Neddivuttum. Mr. Broughton refers to this bark in paragraph 2 of his letter in Government Order, 9th July 1873, Revenue Department, No. 714. The alternative was either to throw the bark away or to send it to England.

4. Irrespective of the instructions of the Secretary of State quoted above, it appeared to me proper that trunk and branch bark should be sent to England indiscriminately, because only by the consignments containing indifferent as well as superior parcels could there be a possibility of learning the average price of bark. Mr. Broughton appears to be of opinion that the main object is to obtain a good name for Nilgiri bark. I apprehend, on the contrary, that the object is to learn the price of all descriptions of bark, for the sufficient reason that the production of bark is undertaken by Government in part to pioneer for commerce and private parties growing chinchona, obviously must send home their bad as well as their good bark, and want to ascertain the price of both qualities as soon as possible by means of Government sales.

5. The Government will observe that Mr. Broughton seems to think it possible the branch bark will fetch a fair price.

— No. 31. —

(No. 32—Revenue.)

From the Government of Madras, to the Secretary of State for India.

Proceedings of Government, 13 September 1873.

My Lord Duke, Ootacamund, 10 October 1873.

WE have the honour to forward, for your Grace's information, the Administration Report of the Government Chinchona Plantations on the Nilgiris for the year 1872-73, together with our proceedings of 13th September 1873, No. 981, containing the observations and orders recorded by us on the subject.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 31.

From the Commissioner of the Nilgiris, to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 10th July 1873.

I HAVE the honour to submit the Administration Report of the Government Chinchona Plantations on the Nilgiris for 1872-73. I take the opportunity to reply, at the same time, to Government Order, No. 549, dated 29th May last, Revenue Department, upon the report of Mr. Broughton upon the respective merits of the mossing and coppicing systems. The

Government Order remarks upon a statement of Mr. Broughton that 85 per cent. of 2,000 trees, from which the bark was stripped in October 1871, have failed to renew their bark; that this instance of the failure of the mossing system should receive the Commissioner's and Mr. McIvor's gravest consideration.

2. Mr. Broughton's report is dated the 19th April 1873, or about 17 months after the removal of the bark. In paragraph 10 of his present report, Mr. McIvor says: "Originally it was believed that renewed bark could be taken at 18 months' growth, but now it is found that 20 months to two years' growth is necessary for the easy removal of the renewed bark."

3. Mr. McIvor informs me that the 2,000 trees referred to by Mr. Broughton are, at the present moment, in the most luxuriant possible health, and that he has already commenced to remove the renewed bark. I suspect that Mr. Broughton, in referring to these trees, intended to point out that they had been tardy in putting on the renewed bark, and not that he feared the bark would not renew. I infer this from the circumstances well known that no tree could survive if it was stripped of bark as chinchona trees are stripped, and did not at once commence a more or less rapid reparatory process.

4. The observation is made in paragraph 1 of the Government Order, that the Government consider the Commissioner's remarks, in paragraphs 9 and 10 of his covering letter to Mr. Broughton's report, "show almost conclusively (if his figures are correct) that the mossing system is likely to be more profitable than the coppicing system which Mr. Broughton advocates."

5. I beg to state that my figures were under, not over, the mark. The present report of Mr. McIvor proves this to be the case by facts. Paragraph 9 says that 200 *C. Succirubra* of 1862–63, and 40 plants of 1864–65, were coppiced in May 1871, and yielded 355 lbs. of dry bark; and paragraph 10 states that 1,000 *C. Succirubra*, of 1862–63, were stripped also in 1871, but in the month of February. These trees yielded at that time, though this information is not in the report, 1,030 lbs. of dry bark. In October last year the second harvest of natural bark was removed, amounting to 1,950 lbs. of dry bark, and recently the first harvest of renewed bark, that is to say, the renewed bark from the spaces yielding the 1,030 lbs. of natural bark, amounting to 764 lbs. of dry bark. These 1,000 trees planted in 1862-63 have, therefore, already yielded 3,744 lbs. of dry bark, and in October next the renewed bark will be taken from the spaces which yielded the 1,950 lbs. of dry bark; and this harvest will probably amount to 1,200 lbs. of dry bark, because the trees have expanded in size since the 1,950 lbs. was stripped. In my calculation I will exclude the latter renewed bark, amounting to 1,200 lbs.

6. The coppiced trees above mentioned were 240 in number, and 40 of them were, when coppiced, two years younger than the 1,000 trees. I do not know what bark the 200 trees gave, and I shall, therefore, consider the 240 trees as equal to one-fourth of the 1,000 trees, and all as of the same age. The calculation is not fair to the coppiced trees, but it is not so unfair as to vitiate altogether the argument I found on the calculation; because the comparison is so immensely in favour of the mossing process that small errors are unimportant. The 240 trees then yielded 355 lbs. of dry bark, and the trees, though in *selected* localities, that is to say, selected in order that the results might be favourable to coppicing, have as yet, as I am personally aware, only thrown up shoots as thick as a walking-stick covered with bark which when dry curls, and is no thicker than blotting paper. I saw these shoots early in the year. Mr. McIvor, in his present report, says that the south-west monsoon has rendered them more vigorous; but he does not mean to say that the growth hitherto arrested has suddenly become luxuriant. He uses the modified paragraph 9 of his report, the shoots are "becoming more healthy." These coppiced trees, at all events, will not be fit for a harvest of bark to be taken for a long term of years.

7. I put, then, the hitherto yield of the 240 coppiced trees against the hitherto yield of one-fourth of the 1,000 mossed trees. The result is that the former yield is 355 lbs. against 936 lbs. in the latter case. The figures speak for themselves, and yet there are other considerations favourable to mossing. They are, first, that mossed bark is richer in quinine than natural bark; second, that the 1,000 mossed trees will shortly give a further harvest, whereas the 240 coppiced trees will not give an additional harvest for a very long time.

8. I desire to call attention to the support the views I expressed on the coppicing system received from Mr. McIvor's present report. At paragraph 12 Mr. McIvor, referring to the trees already coppiced, and speaking of them as in selected sites, states: "A large extent of land coppiced without selection could not but add fresh testimony to the already unsatisfactory results obtained by this system."

9. With regard to the coppicing directed in the Government Order under reference, I believe it has already been done; but I shall report specifically on this subject, and

submit some remarks on the last paragraph of the Government Order when I hear from Mr. McIvor.

10. In paragraph 4 of the report, it will be observed by Government that Mr. McIvor has furnished 83,894 lbs. of wet bark, equal to 33,000 lbs. of dry bark, to Mr. Broughton during the past year, and that he has collected 25,000 lbs. of dry bark for sale in the home market, and proposed to collect 50,000 lbs. more. Upon the latter point the instructions of Government have not yet been received. In all, then, the harvest of bark for the past year, if all taken, amounted to 108,000 lbs. of dry bark, worth, at 2*s.* a pound nett all round, and this is a low price, 1,08,000 rupees. Further on, in his report, Mr. McIvor refers to the number of trees on the Government properties capable of yielding commercial bark, and shows that not one-twentieth of the trees are fit to be cropped. Mr. McIvor, however, tells me that, notwithstanding, he expects a crop of dry bark in the current year, amounting to the crop available in the past year, and in 1874-75 a crop of double the quantity. After that Mr. McIvor expects the annual yield will be very large.

11. The Government will observe that Mr. McIvor is not of opinion that manure will increase the alkaloids in the barks of chinchona trees. He is, however, experimenting with manure, and will report upon the subject in due time.

12. Mr. McIvor, under the head "Cultivation" in his report, urges that the amount at present allowed is not sufficient for the proper up-keep of the chinchona plantations. I have conferred with Mr. McIvor on the subject, and suggested his placing his views in detail on paper, when the matter can be considered. This he will do. He tells me that he is of opinion a staff of gardeners is urgently necessary to take, under the mossing system, the large harvests of bark available and expected. He declares that, had it not been for the unskilled manner in which the bark was removed from the 2,000 trees referred to by Mr. Broughton in paragraph 35 of his mossing report, there would have been no room for Mr. Broughton's strictures. Had the bark been skilfully removed, he believes the fresh bark would have appeared long ago. His general assertion is that clumsy removal of bark by untrained men causes great injury to the chinchona trees.

Enclosure 2, in No. 31.

REPORT on the Government Chinchona Plantations on the Nilgiris for 1872-73.

IN submitting this report I have much satisfaction in being able to state that the season has been favourable for the growth of all the species of chinchona. The health and vigour of the plants have never been finer than they are at present. The *C. officinalis*, as it attains age, assumes a fine tree-like habit, with increased growth; the bark also continuously increases in thickness, and improves in appearance.

2. Our propagating operations are now entirely confined to the new species and varieties of Pitayo barks and *C. angustifolia*; the average monthly increase of these varieties during the year being 1,050; the total number of plants propagated being 12,602. The number of plants in permanent plantations, including the young plants in the nurseries and propagating houses on 1st April 1873, was 2,640,081. The number of plants issued to the public during the year is 9,200; the quantity of seed issued gratuitously being 25¾ oz., making a gross total of 407½ oz., or seeds sufficient to raise 8,150,000 seedlings. The number of plants permanently planted out during the year is 13,885; there being planted on the Hooker Plantation at Pykara 4,961 plants of *C. angustifolia* and 7,394 of *C. Pitayo*, and on the Dodabetta Plantation 1,000 *C. angustifolia* and 500 *C. Pitayo*: making the total number of plants in permanent plantations 1,170,029 on 30th April 1873.

3. Among the oldest plants which were planted in permanent plantations in the autumn of 1862, a small block of 58 plants selected by Mr. Broughton for the coppicing experiment were cut down. Among these was a plant 36 feet in height. The largest of the 12 measured plants of *C. succirubra* planted out at the same time measure 30½ feet in height, with a circumference of stem of 28 inches. The largest of the 12 measured plants of *C. officinalis* planted on the Dodabetta Plantation in September 1863 measure 23 feet in height, with a circumference of stem of 7½ inches.

4. The quantity of green bark supplied to Mr. Broughton during the year for the manufacture of amorphous quinine is 83,894 lbs. in all, viz., 33,391 lbs. stem-bark and 50,503 lbs. of branch-bark. During the official year 2,072¼ lbs. of green tea-leaf has been supplied to Captain Jennings from the Governmental Experimental Tea Plantation at Dodabetta.

5. In the autumn and spring 25,000 lbs. of dry bark was collected for sale in the European

European market in compliance with Government Order, No. 1,433, dated 16th October 1872. On completing this quantity of bark, it was found that not more than one-third of the whole quantity of bark available had been taken; I therefore, in my letter No. 161, dated 14th March 1873, recommended that a further supply of from 40,000 to 50,000 should be collected and despatched to Europe for sale in the home market. The whole of the stem-bark collected during the last official year has been taken by the mossing process. A large supply of bark is now available for the local manufactory.

Recorded in Government Order, No. 427, dated 22 April 1873

6. In June 1871 the cultivation of the Malakoondah Plantation was abandoned or "converted into a wild chinchona wood," in compliance with Government Orders, No. 1,011, of 8th June 1871, and No 1 193 of 11th July 1871. No expense has been incurred on this plantation since July 1871. Notwithstanding the fact that this plantation has not been cultivated for nearly two years, the stronger plants have maintained a fair growth, but the smaller plants have been overgrown and smothered by the weeds and growth of jungle-trees. In many instances, the jungle growth is now beginning to overtop the larger plants, and, if not removed, will, I fear, shortly destroy many of them. The result of the experiment of leaving chinchona to develope themselves into a forest does not promise to be successful, at least at Malakoondah. It is quite evident on the Nilgiris that true economy demands an expenditure sufficient to keep down weeds and undergrowth until the chinchona plants have attained a growth of eight or 10 years, or until they so entirely cover the ground that their shade destroys the natural vegetation under them.

7. In previous reports I have observed that red bark plants do not become productive until their eighth or 10th year of growth, and that from the 10th to the 12th year, according to situation and exposure, the crown-barks become productive. To remove bark from young trees, except in very favourable situation, is no doubt injurious.

8. It is not generally understood that at present there is not 1-20th part of the plants on the Government Plantations on the Nilgiris which have attained sufficient age to produce bark. The number of red bark plants planted in 1862-63 was 12,500; in 1863-64, 7,700; in 1864-65, 38,500. It will thus be seen that we have now only 58,700 red bark plants old enough to be productive, while the present year is the first that the crown-barks are capable of yielding bark in any considerable quantity. I append a table to this report, showing the number of plants in permanent plantations and the dates on which they were planted. This table gives a fair idea of the quantity of bark we may expect from the Government Plantations year by year; but in forming an estimate it is necessary to take into consideration the various circumstances affecting the yield of the trees. Plants placed in rich soil and sheltered situations will produce three or four times as much bark as plants of the same age planted on poor land and in exposed places. It is also necessary to make a deduction from the total number of plants planted out in any given year of about 30 per cent. for failures subsequently filled in.

9. In May 1871 a block of 200 *C. Succirubra* trees of the planting of 1862-63, also a block of 40 plants of the planting of 1864-65, were selected by Mr. Broughton and coppiced. These blocks were on some of the best land and in sheltered localities. The total yield of bark from these plants was 720 lbs. of green stem-bark and 324 lbs. of green branch-bark, or in all a total of 1,044 lbs. green bark, equal to about 255 lbs. dry stem bark and 100 lbs. of dry branch-bark; in all 355 lbs. The shoots from the roots of these coppiced plants made unsatisfactory growth for the first two years. Now, however, they are becoming more healthy.

10. In my report of last year I informed the Government that from the 1,000 experimental *C. Succirubra* trees, planted in 1862-63, 2,980 lbs. of *dry bark* had been taken by the mossing process. We have now taken the first strip of renewed bark from these trees, and find it to be 764 lbs. of dry bark; the original bark from the same spaces having weighed 1,030 lbs. In the autumn and spring of next year the entire quantity of renewed bark will be removed from these trees. When this is completed the cost of removal per pound of dry renewed bark will be given. Originally it was believed that renewed bark could be taken at 18 months' growth, but now it is found that 20 months to two years' growth is necessary for the easy removal of the renewed bark.

11. As before noticed the whole of the barks produced this year has been taken by the mossing process only. The experience gained by Mr. Broughton has led that gentleman to consider that mossing is not the most profitable way of harvesting red bark.

12. In my letter, No. 48, of the 26th June 1871, to the late Commissioner of the Nilgiris, I recommended that, while this matter was undecided one-half of the bark collected from the plantations be procured by mossing, and the other half by coppicing. In compliance with Government Order, No. 1,213, dated 13th July 1871, the whole of the stem-bark, both for England and the supply of the Mr. Broughton's manufactory, was procured by the mossing process alone. Mr. Broughton complains that all the trees of an age to produce bark have been mossed, and few remain on which the coppicing experiment can be fairly tested. This is an error, as, in fact, of our oldest red bark trees (12,500 of the planting of 1862-63), there are fully one-half unmossed. Should the Government consider it desirable, in order to test the value of the two systems, and to arrive at definite conclusions, an extensive experiment can be carried out by coppicing on this portion of the

plantation that half of the trees which has not been mossed. These trees are now in their eleventh year of growth, and of an age most favourable for the coppicing experiment. Mr. Broughton also represents that the coppicing process has not had a sufficiently extensive trial fairly to test its value. This is no doubt correct: the few trees coppiced have been selected in favourable situations, and consequently do not give any idea of the result which would be obtained from a large extent of land coppiced without selection. Were such an extent of land coppiced, the yield of bark per tree would turn out to be from one-half to two-thirds less than that obtained from the patches already coppiced. In fact, a large extent of land coppiced without selection could not but add fresh testimony to the already unsatisfactory results obtained by this system.

13. In compliance with Government Order, No. 584, 10th April 1872, on Mr. Broughton's report on the effects of manure in increasing the production of alkaloids in chinchona barks, arrangements have been made during the year for the extensive application of manure to our plants especially to the crown-barks. I however consider it necessary to bring to the notice of Government that there are certain circumstances connected with the production of alkaloids especially in the various varieties of crown-barks which tend to deprive the results obtained by Mr. Broughton of much of their value. The best results obtained by manure in increasing the alkaloids was when applied to *C. officinalis* and Mr. Broughton attributes the effects produced on this species to a sensitiveness to the effects of manure. There are other causes which Mr. Broughton slightly notices which, to some degree, explains the results he obtained. The *C. officinalis* is the richest of all the species in quinine. Mr. Broughton has explained that it is very variable in its yield of alkaloids. In order that we may not be disappointed in the results likely to be produced by manure, I beg to draw attention to the fact that the variability in the bark of the different varieties of this species is almost beyond belief. On the first Dodabetta plantation, consisting entirely of plants raised from imported seeds of *C. officinalis*, may be taken samples of bark identical in appearance from similar trees growing under equal conditions. One sample of which will, on analysis, yield the extraordinary quantity of 11·4 per cent. crystallised sulphate of quinine, and the other yield not a trace.

14. Varieties are found varying in every degree between these extremes. Such being the fact, it will be easily understood that samples of bark gathered from the manured and unmanured rows of trees might, on analysis, have pointed to any conclusion, and it would be equally possible to show results proving the application of manure to be highly injurious instead of beneficial. In short, with plants varying in their alkaloids as crown-barks do, unless the selection of bark be made with very careful reference to the different varieties, any result may be obtained and proved by a perfectly accurate investigation and analysis. I may mention that the red barks do not vary so much in the yield of quinine as the crown-barks do; and this may account for Mr. Broughton having found that the manure applied to these plants produced comparatively insignificant results. The variation in the yield of alkaloids, especially quinine, in the red barks is from half to 2 per cent. according to the variety. The red flower and large-leaved variety produces most, the white flower variety less, and the small leaf variety in some situations contains no quinine or merely a trace. Not only does the variety of the plant vary in its yield of quinine, but these also again vary according to the situation in which they are grown.

Government Order, No. 1,428, dated 16 October 1872.

15. Our manuring operations have been pressed forward as rapidly as possible. Five thousand trees of *C. officinalis* have been manured at Neddiwuttum, and 458 of the same species at Dodabetta with farmyard manure. The artificial manure so kindly supplied for trial by Messrs. J. MacMeikan & Co., Melbourne, has been applied to 355 plants of *C. officinalis* on the Dodabetta Plantation. The artificial manure indented for, and sanctioned in Government Order No. 858, dated 1st June 1872, has not been received.

Cultivation.—During the preceding and the present official year, the expenditure having been reduced to the lowest possible point, the high system of cultivation previously maintained in our plantations has not been carried out. I would, however, again bring to the notice of Government that the results of the last two years' cultivation makes it evident beyond doubt that, if the plantations are to be fully developed, it is indispensable that a more liberal system of cultivation be maintained, at least for three or four years, on the younger portions of the plantations.

16. Appended is a table giving the rainfall at Neddiwuttum, and a table of expenditure from 1860 to the 31st March 1873; also a table showing the number and date of the plants placed in permanent plantations.

Government Order, 1 June 1871.

Establishment.—Up to the end of March 1871, the chinchona plantations were worked by a permanent establishment of well-trained gardeners, additional hands being merely called in to perform rough work. For objects of economy the late Commissioner recommended that the plantations should be worked on an estimate of 10 rupees per acre, exclusive of superintendence. The Government approved of this system being adopted, and sanctioned 12½ rupees per acre per annum. In consequence of this, it was impossible to maintain permanently our trained establishment, and the men not having constant employment sought other situations; and we have since been obliged to work our plantations with such coolies as we are able to engage at the seasons when their labour can be applied

applied to the greatest advantage. This system has been in operation for two years, and it has been found impossible to perform with accuracy any operation requiring care and attention by the untrained and inexperienced men we are obliged to employ. This system has no doubt reduced expenditure, but the absolute loss and injury done to the plants greatly exceeds any saving which has been effected. Experience has convinced me that whatever may be the sum sanctioned for the working of the chinchona plantations, it would be very beneficial to maintain a fixed establishment of well-trained gardeners, their number being limited to the expenditure proposed to be incurred. The establishments on the plantations have now been reduced to one assistant superintendent, three overseers, and three maistries. Even in the higher grades all of our experienced men have left the department, with the exception of Narrainsawmy Naidu, who joined at the commencent of the undertaking. With the zeal, application, and energy displayed by the assistant superintendent, overseers, and office manager, I have every reason to be well satisfied.

STATEMENT of EXPENDITURE, 1872-1873, of the Government Chinchona Plantations on the Nilgiris.

PARTICULARS.	Superintendent and Office Establishment.		Propagation and Nursery Department.		Dodabetta Plantation.		Neddiwuttum Plantation.		Pykara Plantations.		Malakoondah Plantation.		TOTAL.
	1860 to 1871-72.	1872-73.	1861 to 1871-72.	1872-73.	1860 to 1871-72.	1872-73.	1861 to 1871-72.	1872-73.	1862 to 1871-72.	1872-73.	1863 to 1871-72.	1872-73.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
Establishment, salaries, etc.	81,200	8,127	40,397	240	42,716	1,620	84,675	3,132	13,496	1,020	9,605	–	2,86,228
Buildings	–	185	14,218	43	20,621	195	23,015	330	3,583	53	3,138	–	65,381
Tool and storerooms	–	–	–	–	675	–	1,618	–	893	–	320	–	3,506
Coolies' quarters	–	–	–	–	1,593	150	4,240	58	2,233	24	545	–	8,843
Felling	–	–	–	–	4,568	–	9,227	–	7,576	–	4,952	–	26,323
Clearing and weeding	–	–	1,000	459	19,599	2,420	30,401	2,712	14,437	1,960	11,191	–	89,179
Pitting	–	–	–	–	9,650	70	15,585	140	6,627	199	4,623	–	36,894
Carriage of plants	–	–	–	–	3,415	12	5,004	44	1,699	124	786	–	11,084
Planting and shading	–	–	–	–	6,894	40	7,349	70	2,080	142	1,117	–	17,692
Trenching	–	–	–	–	3,759	–	6,642	–	2,065	–	575	–	13,041
Enclosing	–	–	548	–	5,337	–	4,552	–	1,845	–	1,080	–	13,362
Road-making	–	–	–	–	7,149	100	5,757	198	3,441	100	2,371	–	19,116
Tools	–	–	566	193	5,091	210	5,952	340	3,850	255	1,981	–	18,438
Contingencies	831	195	2,428	137	5,897	155	7,829	160	1,873	143	1,104	–	20,747
Excavating	–	–	172	–	1,094	–	1,195	24	–	–	–	–	2,289
Clothing	169	32	365	–	250	–	381	–	158	–	85	–	1,284
Various	–	–	–	–	2,570	225	3,092	416	660	180	303	–	7,798
Collection of bark and mossing.	–	–	–	–	57	215	1,836	1,624	20	1,005	–	–	4,757
Carriage of ditto	–	–	–	–	–	–	708	54	–	49	–	–	811
Manure and manuring trees.	–	–	–	–	–	40	–	28	–	3	–	–	71
TOTAL	82,200	8,539	9,689	1,072	1,40,935	5,452	2,19,056	9,330	71,536	5,257	43,776	–	6,46,844

SANCTIONED ESTIMATE, Results of Expenditure, and Out-turn of the Government Chinchona Plantat for the Year 1872-73.

PARTICULARS.	Superintendent and Office Establishment.		Propagation and Nursery Department.		Dodabetta Plantation.		Neddiwuttum Plantation.		Pykara Plantation.		TOTAL	Expe
	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	Expenditure.	Estimate.	
	Rs.	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	Rs
Establishment, including salaries	8,012	8,127	210	240	1,620	1,620	3,132	3,132	1,020	1,020	14,024	14,1
Buildings	–	185	200	43	300	195	300	330	200	53	1,000	8
Tool and store-rooms	–	–	–	–	–	–	–	–	–	–	–	–
Coolies' quarters	–	–	–	–	50	150	200	58	100	24	350	2
Felling	–	–	–	–	–	–	–	–	300	–	300	–
Clearing and weeding	–	–	–	459	2,500	2,420	3,811	2,712	2,500	1,960	7,811	7,5
Pitting	–	–	–	–	50	70	50	140	100	199	200	4
Carriage of plants	–	–	–	–	25	12	25	44	50	124	100	1
Planting and shading	–	–	–	–	10	40	10	70	25	142	45	2
Road-making	–	–	–	–	50	100	50	198	50	100	150	3
Tools	–	–	–	193	100	210	150	340	100	255	350	2
Contingencies	150	195	50	137	250	155	450	160	250	143	1,150	7
Clothing	30	32	30	–	10	–	20	24	10	–	100	
Various	–	–	–	–	100	225	150	416	100	180	1,350	8
Collecting bark and mossing trees	–	–	–	–	500	215	1,500	1,624	500	1,005	2,500	2,8
Carriage of ditto	–	–	–	–	50	–	150	54	50	49	250	1
Manure and manuring trees	–	–	–	–	–	40	–	28	–	3	–	
TOTAL - - - *Rs.*	8,192	8,539	520	1,072	5,615	5,452	9,998	9,330	5,355	5,257	29,680	29,6

	Rs.	*a.*	*p.*		£.
83,894 lbs. chinchona fresh bark supplied to Government Quinologist, at	–	–	4	– per lb.	20,973
25,000 „ „ dry bark for sale in England at	–	1	–	– „	25,000
2,3 6¼ „ green tea-leaf distributed to the public at	–	–	1	4 „	194 1
9,200 chinchona plants „ „ at	–	–	–	2 each	95 1
25¼ ounces chinchona seeds „ „ gratuitously at	–	–	4	– per oz.	6
				TOTAL - - - £.	46,270

CHINCHONA PLANTS permanently planted out, Dates of Planting, and Number of Acres by Base and Sur Measurement under Cultivation on the Government Plantations on the Nilgiris.

DATE.	Total Number of the Species of Chinchona Plants Planted.							Denison, Kilgraston, and Napier Estates, Neddiwuttum.						A E
	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	TOTAL.	Acres.	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	Acres, Surface.	
1862-63 -	18,550	12,500	500	3,100	350	35,000	63	4,200	12,000	500	3,000	300	–	
1863-64 -	20,432	7,700	1,000	2,500	–	31,632	55	16,000	4,700	1,000	1,500	–	–	
1864-65 -	56,700	38,500	–	3,519	–	98,719	99	10,000	23,500	–	2,500	–	–	
1865-66 -	45,500	34,020	–	–	–	79,520	80	2,000	22,720	–	–	–	–	
1866-67 -	67,000	77,000	9,200	3,140	–	156,340	156	5,000	49,000	8,000	1,140	–	–	
1867-68 -	150,701	163,800	9,600	14,000	1,600	339,701	340	15,000	94,800	6,200	9,000	–	–	
1868-69 -	65,000	77,945	7,700	2,500	–	153,145	153	20,000	72,000	7,700	2,500	–	–	
1869-70 -	84,995	168,473	–	–	899	254,367	254	3,550	70,680	–	–	–	–	
1870-71 -	–	–	3,500	–	–	3,500	2	–	–	3,500	–	–	–	
1871-72 -	–	–	2,350	–	1,900	4,250	5	–	–	2,350	–	–	–	
1872-73 -	5,961	–	–	–	7,894	13,855	15	–	–	–	–	–	–	
TOTAL - -	514,839	579,938	33,850	28,759	12,643	1,170,029	1,222	75,750	349,400	29,250	19,640	300	455	3
									474,340					

CHINCHONA PLANTS permanently planted out, Dates of Planting, and Number of Acres by Base and Surface Measurement under Cultivation on the Government Plantations on the Nilgiris.

Date.	Dodabetta.							Wood and Hooker Estates, Pykara.						Stanley Estates, Malakoondah.				
	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	Acres, Surface.	Acres, Base.	Crown Barks.	Red Barks.	Grey Barks.	Other Species.	Acres, Surface.	Acres, Base.	Crown Barks.	Red Barks.	Other Species.	Acres, Surface.	Acres, Base.
1862-63 -	14,350	500	–	100	50	–	–	–	–	–	–	–	–	–	–	–	–	–
1863-64 -	2,432	–	–	–	–	–	–	2,000	3,000	1,000	–	–	–	–	–	–	–	–
1864-65 -	32,000	–	–	–	–	–	–	14,700	15,000	1,019	–	–	–	–	–	–	–	–
1865-66 -	39,000	–	–	–	–	–	–	4,500	11,300	–	–	–	–	–	–	–	–	–
1866-67 -	55,000	–	1,200	–	–	–	–	7,000	28,000	2,000	–	–	–	–	–	–	–	–
1867-68 -	105,000	–	3,400	–	1,600	–	–	25,701	54,000	5,000	–	–	–	5,000	15,000	–	–	–
1868-69 -	40,000	–	–	–	–	–	–	–	–	–	–	–	–	5,000	5,945	–	–	–
1869-70 -	49,048	–	–	–	–	–	–	18,297	78,483	–	–	–	–	14,100	19,310	899	–	–
1870-71 -	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1871-72 -	–	–	–	–	800	–	–	–	–	–	1,100	–	–	–	–	–	–	–
1872-73 -	1,000	–	–	–	500	–	–	4,961	–	–	7,394	–	–	–	–	–	–	–
TOTAL -	337,830	500	4,600	100	2,950	378	287·25	77,159	189,783	9,019	8,494	314	226·50	24,100	40,255	899	75	40·28
		345,980							284,455						65,254			

REGISTER of the Rainfall on the Government Chinchona Plantations at Nuddiwuttum for the Official Year 1872-73.

DATE.	Rainfall.	
	Inches.	*Cents.*
April 1872	1	67
May „	3	39
June „	20	12
July „	31	71
August „	19	34
September „	13	2
October „	5	31
November „	3	71
December „	2	19
January 1873	0	0
February „	0	72
March „	0	40
TOTAL - - -	101	58

ORDER of the Madras Government thereon, 13 September 1873.

WITH the foregoing letter the Commissioner of the Nilgiri Hills submits the annual report of the Superintendent of the Government Chinchona Plantations. During the year 15 acres seem to have been planted out with 13,855 plants, making up the total number of trees in the plantations to 1,170,029. A large quantity of bark has been supplied to the Government Quinologist for the manufacture of amorphous quinine, and 25,000 lbs. have been forwarded to England for sale.

2. From the statements attached to the report, it appears that the total expenditure on the plantations up to the close of the past official year was a little under 65,000*l.*, and that the gross returns during the year under report are valued at a little over 4,600*l.*, which must be viewed as a fairly satisfactory result, considering the age of the trees.

3. The experimental abandonment of all expenditure on the Malakoondah Plantation does not promise to be successful, from Mr. McIvor's report of the state of the trees. The Commissioner will be good enough to take the matter into his consideration, and to report whether he would propose to incur a small annual outlay in order to clear the undergrowth.

4. It appears that the mossing process has not been carried out to the extent supposed, and that fully half of the oldest red-bark trees are unmossed. The remarks of the Superintendent and of the Commissioner on the superiority of the system are, however, out of place in an annual report of progress, and should be submitted in a separate communication.

5. The application of manure to the plants has been extensively carried out. As observed by Mr. McIvor, however, it will be difficult to arrive at accurate results, owing to the great variation in the samples of bark taken from trees apparently under precisely the same circumstances, but the experiment must be continued, and results carefully observed and recorded.

6. The cessation of high cultivation and the reduction of establishment, though resulting in a considerable diminution of expenditure, is stated to involve a sacrifice of efficiency. This matter should be specially brought forward for consideration as proposed by the Commissioner without delay.

— No. 32. —

(No. 34.—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Ootacamund, 10 October 1873.

* *See* Page 54.

WITH our Despatch, 15th February 1872, No. 4,* paragraph 2, we forwarded a letter from Mr. McIvor, refuting the statement which was published in the Supplement to the "Gazette of India," dated 8th July 1871, to the effect that the chinchona plants, when originally supplied from the Nilgiris to Darjeeling, were affected with canker. Copy of our letter to the Government of India, asking that the same publicity might be given to Mr. McIvor's statement as was given to the unfavourable report above alluded to, was also sent with the same Despatch.

Proceedings of Government, 14 October 1872. Proceedings of Government, 12 September 1873.

2. We now forward, for your Grace's information, our further proceedings on the subject, dated 14th October 1872, No. 1,418, and 12th September 1873, No. 978. The former embody a letter from the Government of India with papers from the Government of Bengal, maintaining the correctness of the assertion as to the existence of canker in the plants in question; and the latter contain letters from the Commissioner of the Nilgiris and from Mr. McIvor, being replies to the papers from the Government of India just referred to.

3. It appears to us that Mr. McIvor has shown that it is extremely improbable that canker existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations, though it is possible that the disease may have been generated on the journey.

Proceedings of Government, 2 October 1873.

4. The letters from the Commissioner and from Mr. McIvor, referred to above in paragraph 2, have been forwarded to the Government of India, with the request that they may be published in the "Gazette of India" in continuation of previous correspondence.

We have, &c.
(signed) *Hobart*, &c.

B

Enclosure 1, in No. 32.

From the Secretary to the Government of India, Department of Agriculture, Revenue, and Commerce (Agriculture and Horticulture), to the Secretary to the Government of Madras; dated Simla, 1st October 1872.

I AM directed to acknowledge the receipt of your letter No. 73, dated 11th January 1872, and in reply to forward, for the information of his Excellency the Governor in Council, copy of a letter* from the Government of Bengal (with enclosures), which, in the opinion of the Government of India, leaves little doubt of the correctness of the assertion that canker "is shown to have existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations."

* No. 3,096, dated 6th ultimo.

2. Your letter, together with the reply of the Government of Bengal, with the enclosures of both, will now be published in the Supplement to the "Gazette of India." Paragraphs 3 and 4 of the late Mr. Breeks's letter to your address, No. 91, dated 13th December 1871, will however be omitted, as they appear to the Governor General in Council to be objectionable, as embodying a personal attack upon a Secretary to Government, based on a statement contained in a letter signed by him in his official capacity.

From the Superintendent, Botanic Garden, and in charge of Chinchona cultivation in Bengal, to the Officiating Under Secretary to the Government of Bengal; dated Royal Botanic Garden, 12th July 1872.

12 April 1872, with enclosures.

WITH reference to your memorandum marginally noted, calling for a report on the statements made by Mr. McIvor impugning the correctness of the evidence given by Mr. Munro as to the importation of cankered chinchona plants from the Nilgiris, I have the honour to state that I have collected fresh evidence on the point from all the persons known to me now in India who were connected with the first chinchona experiments in Sikkim.

2. I have now the honour herewith to forward, for the information of Government, copies of the statements of the following gentlemen:—

(I.)—Dr. B. Simpson, Civil Surgeon of Patna, and formerly of Darjeeling. Dr. Simpson was interested in the Pomong plantation on its first being started, and consequently writes from personal knowledge.

(II.)—Mr. Munro, manager of the Pomong plantation.

(III.)—Mr. Jaffrey, of the Government Chinchona plantation. Mr. Jaffrey has been continuously on the Government plantation since its commencement until now.

(IV.)—Mr. Gammie, resident manager, Government Chinchona plantation.

(. .)—Mr. Scott, curator, Botanic Garden. Mr. Scott originally served on the the Government Chinchona plantation, but was subsequently transferred to his present appointment.

From J. Geoghegan, Esq., to H. Plowden, Esq., dated 6th April 1872.

3. In compliance with Mr. Geoghegan's letter marginally noted, I have the honour to submit some remarks on the several matters touched upon in Mr. McIvor's letter to Commissioner of Nilgiris, dated 6th December 1871.

Report of the Chinchona Commission, dated 30 March 1871.

4. In the evidence taken by the Chinchona Commission during March 1871 no particulars are recorded in regard to the introduction of canker to the Government plantation, none of the witnesses apparently having been questioned on the point. Mr. Munro's statement (page 21, paragraph 41, 4th clause), that his Association received its first cuttings from the Nilgiris, and that "these were extensively affected with canker," is the only one in which the importation of the disease into Sikkim is specially referred to. From his letter above quoted, it appears Mr. McIvor is not inclined to admit that any plants sent by him from the Nilgiri plantations to Sikkim for either the Government plantation or that of the Chinchona Association could, on arrival in Sikkim, have been affected with the disease which he calls "canker."

5. As regards the Government Sikkim plantations, Mr. McIvor thinks it improbable (paragraph 2 of his letter) that if cankered plants were received the fact should not have been mentioned until the year 1871. Mr. McIvor's argument is a negative one, and his numerous extracts from the reports of the late Dr. Anderson, while proving that in Dr. Anderson's opinion the success of the Chinchona cultivation under him had been great, do not prove that it had been attended by [illegible] drawbacks whatever. Had Dr. Anderson considered

considered the so-called canker such a formidable affection as Mr. McIvor does, he would have doubtless referred to it in his reports. From his not having done so, the natural inference is that he did not think it worth mentioning, and that, on the whole, he considered himself warranted in regarding the Chinchona experiment in Sikkim as a success —a view which is, I believe, shared by most people who have seen the plantations there. Now, however, that the question as to the introduction of canker has been definitely raised, the evidence goes to show that, as a fact, the plants brought from the Nilgiris were on arrival, or very soon thereafter, found to be affected with it. Mr. Jaffrey (in paragraph 2 of his evidence) positively states that the 327 plants received by Government in April 1863 from the Nilgiris were cankered (these are the plants referred to in Mr. McIvor's paragraph 10), and that those received by him in August 1862 were also diseased. Dr. Simpson corroborates Mr. Jaffrey's statement in so far when he says that he saw the disease in the plants in pots under glass at Lebong before a single one had been planted out. Messrs. Scott and Gammie, who joined the Chinchona establishment subsequently to the importation from the Nilgiris, bear testimony to the fact that prior to their arrival canker had been established among the plants. It is therefore quite clear that it did not appear suddenly and for the first time as a widespread epidemic shortly anterior to the visit of the Commission in February 1871.

6. As regards the private plantations in Sikkim, Mr. Munro states that his association got its first cuttings from the Nilgiris, and that these were "extensively affected with canker." Mr. McIvor argues that Mr. Munro's evidence is inadmissible, because he says "it is quite certain from a careful examination of the records that Mr. Munro never received any cuttings from the Nilgiris." Mr. Munro, on the contrary, states (paragraph 3 of his memorandum) that early in 1864, and a few months after his own arrival in Sikkim, four wardian cases of chinchona plants were received from the Nilgiris, and that these were the plants described by him in his evidence before the Commission as "extensively affected with canker." Mr. Lloyd, who succeeded Dr. Bourne as secretary to the association, of which Mr. Munro is the manager, corroborates this by explaining how much these plants cost. The evidence concerning this importation is very clear, dates of dispatch and arrival of the cases and of the remittance of the money in payment being given. Mr. Lloyd further shows that prior to this payment 500 rupees had been remitted to Mr. McIvor for plants, of which Mr. Munro says (paragraph 4) only seven were survivors at the date of his arrival in Sikkim. Dr. Simpson bears testimony to Mr. Munro's general accuracy, and himself describes the condition of the first importation from the Nilgiris; while, in paragraph 3 of his memorandum, Mr. Jaffrey states that he was consulted during the year 1863 by Mr. Barnes, one of the original partners in the Chinchona Association, as to the diseased condition of some plants received from the Nilgiris.

7. In paragraph 4 of his letter Mr. McIvor points out an "error" of omission into which, he says, Mr. Munro has fallen in his evidence before the Commission, and, by way of rectifying Mr. Munro's omission, states that the Chinchona Association was supplied by him with seeds enough of Chinchona to have produced "probably from 50,000 to 100,000 seedlings." Mr. Munro, in paragraph 5 of his memorandum, states that the amount of seed (a quarter of an ounce) was sufficient on McIvor's own showing to have produced only from 5,000 to 6,250 plants. Mr. Munro has thus, I think, very conclusively disproved both the charges of inaccurary brought against him by Mr. McIvor.

See McIvor on Propagation of Medicinal Chinchonas, page 6, paragraph 12.

8. A few statements in Mr. McIvor's letter which bear, not on the introduction of canker, but on its effects in Sikkim, remain to be noticed. In paragraph 7 of his letter he says, "the entire stock of this species (*Cinchona Officinalis*) has been so seriously affected with canker as to cause its cultivation to be abandoned." I have elsewhere stated at length the causes of the abandonment of the cultivation of *Cinchona Officinalis*, and would here only draw attention to paragraph 4 of Mr. Gammie's, to paragraph 5 of Mr. Jaffrey's, and to paragraph 7 of Mr. Munro's memoranda, in which these gentlemen distinctly state that canker was *not* the cause of its failure.

Report on Chinchona Plantations, Sikkim, for year [illegible] March [illegible]

9. In the paragraph of his letter just referred to Mr. McIvor goes on to say that "the Sikkim stock of *C. Pahudiana* raised solely from Java plants has also been destroyed by canker." I am rather surprised to find this statement made by Mr. McIvor, for everybody interested in Chinchona cultivation ought to know that this species, after having been extensively cultivated in Java, was discovered to yield *no quinine*, and that for this reason its cultivation was everywhere abandoned. Messrs. Munro and Jaffrey note this fact in their memoranda.

10. A third mistake into which Mr. McIvor has fallen in this same paragraph 7 is that of saying that "the Java variety of *C. Calisaya* (*C. Josephiana*) has been so affected by canker that only one plant existed on the Sikkim plantation at the date of my visit in February 1871 out of all the plants received of this variety;" whereas Mr. Gammie, in the concluding paragraph of his memorandum, estimates the number at 8,000.

11. In my last annual report I have given my own opinions on the disease existing in the Sikkim plantations, and have distinguished two forms of it, one general and one local. The latter I regard as anything but fatal, and I would here merely allude to the instructive instance of recovery mentioned by Mr. Gammie in the concluding part of paragraph

graph 1 of his statement. I may mention that I saw examples of both forms of the disease in the Chinchona plantations on the Nilgiris during my recent visit to them, although neither is common there.

I.—Dr. SIMPSON.

My dear King, Bankipore, 25 June 1872.

Mr. McIvor is wrong in stating that Mr. Munro received no cuttings from the Nilgiris. It is quite true that the first instalment of plants were sent long before his arrival, but when they were opened in my presence at Lebong only one plant in the box was alive, and even this subsequently died. I also corroborate Mr. Munro's statement regarding the disease in the plants. Moreover, before Mr. Munro arrived in the country at all, and before a single plant belonging to Government was planted out, I saw the disease at Lebong in the glass-house, while the plants were in pots (I allude here to the Government plants). Mr. Jaffrey, who was then in charge, can bear enough testimony to this. From my personal knowledge of Mr. Munro, even were I unacquainted myself with the actual state of matters, I would place the fullest confidence in any statement put forth by him.

Yours, &c.
(signed) *B. Simpson.*

II.—Mr. MUNRO.

Memorandum by *J. Munro*, Esq., Manager, Darjeeling Chinchona Association, Pomong.

Referring to letter No. 115, of the 6th December 1871, from Mr. McIvor, Superintendent, Government Chinchona Plantation, to the Commissioner of the Nilgiris, with enclosures.

1. From Mr. McIvor's letter I see that he calls in question the statements made by me before the Bengal Chinchona Commission at Rungbee in February 1871, and flatly denies that the Darjeeling Chinchona Association received any plants from the Nilgiris in my time, and asserts that the last supply of plants from the Nilgiris was ten months in Bengal before my arrival there.

2. My reply will be as short as possible.

3. At paragraph 3 of his letter Mr. McIvor says:—"It is quite certain from a careful examination of the records that Mr. Munro never received any cuttings from the Nilgiris. In fact, Mr. Munro did not arrive at Pomong until December 1863, or when the original plants sent from the Nilgiris as stock for the Sikkim plantations had been nearly two years, and the last supply fully ten months, in Bengal." Mr. McIvor is quite correct as to the time of my arrival. I arrived in Darjeeling on the 11th of December 1863. I do not know what records Mr. McIvor had examined so carefully, but I would respectfully suggest that he examine his own account-books (I presume he keeps books), and if he does not find there that he despatched four wardian cases of Chinchona plants to Bengal in the beginning of 1864, and that he was paid for the same in June 1864, all I can say is that such entries ought to be there.

For it is quite certain that the Darjeeling Chinchona Association did get four wardian cases containing Chinchona plants, *labelled C. Succirubra*, *C. Micrantha*, and *C. Condaminea*, from the Nilgiris, and that they arrived in Darjeeling on the 3rd of March 1864, or two months and a half after my arrival there. I also got four wardian cases from Ceylon at the same time, containing principally *C. Succirubra* and a few plants of *C. Officinalis*, very different plants from the Madras plants. As Mr. McIvor might again call in question my unsupported evidence, I enclose herewith a note from our present Secretary* of the different payments made to Mr. McIvor for plants, which speaks for itself. Those plants which arrived in Darjeeling on the 3rd of March, and for which Mr. McIvor was paid 256 rupees on the 30th June 1864, were the plants referred to by me in my evidence before the Chinchona Commission, quoted by Mr. McIvor in paragraph 1 of his letter.

4. That statement, I repeat, is substantially correct, and was made by me in support of my views on canker, and not with any view or intention of detracting anything from the glories of the Nilgiris or their able superintendent; nor was I aware (until Mr. Broughton, a member of the Commission, indignantly denied it) that the existence of canker there was denied. Indeed, I was then, as I still am, under the impression that Mr. McIvor, during his short visit to Pomong, and in answer to a direct question from me, admitted that they had canker to a limited extent. I am also under the impression that it occurs

in their native country; but, be that as it may, certain it is that the Madras plants which reached me on the 3rd March 1864 (of the first consignments I know nothing, having only arrived in time to see the death of the last of them, seven plants), and which were very stunted, having been used as *stock plants* before they were despatched, as the frequent marks of the knife on them fully testified, showed symptoms of the disease we have since learned to call canker, as soon as it could be distinguished from injuries received on the journey. The Ceylon plants were long succulent shoots that had never been topped.

I do not affirm that they were afterwards free of canker.

5. At paragraph 4, Mr. McIvor quotes another statement made by me before the Chinchona Commission, namely, "that my present plantation of 500,000 plants of *C. Succirubra* were raised by cuttings from 92 plants," and says "this is an error, as I supplied a quantity of excellent seeds to the proprietors of the Pomong plantations, Mr. Lloyd and Colonel Angus. These seeds germinated freely, and probably produced 50,000 to 100,000 plants."

This statement, which I have no doubt is quoted correctly, is not very happy in its wording, and ought to be "at least 500,000 plants of *C. Succirubra* now in permanent plantations were raised by cuttings (including layers, eyes, &c., &c.) from 96 (not 92) plants." But this does not alter its meaning in the least for the purpose for which it was made, namely, to point out to the Commission the effect such treatment must of necessity have on weakening the constitution of a forest tree—an effect from which they very soon recover, however, when placed in a favourable situation.

6. The above would scarcely be worth noticing, but that Mr. McIvor tries to damage the whole of my evidence by making some of my statements appear false. My monthly returns will show any whom it may concern the number of plants, cuttings, &c. from the beginning to date.

My return for December 1870, or previous to the sitting of the Commission, shows as follows:—

C. Succirubra plants in permanent plantations - -	867,400
Ditto - - ditto in nursery beds for ditto - -	667,331
Ditto - - ditto in stock - - - - - - -	15,000
Total - - -	1,549,731

So that my statement in round numbers of 500,000 was considerably within the mark, and left ample room for a good deal more than Mr. McIvor's seeds, even at his own estimate of them. The produce of his seeds, as soon as they were ready, were planted out with others in 1870. And I hope Mr. McIvor will not doubt my word when I say that I tried to the utmost of my poor abilities and the rude means at my disposal to make the most of them, but I think he is rather hard on me in his estimate of the number of plants I ought to have raised from them. He takes care not to mention the quantity of seeds sent; I will do so for him: it was of *C. Succirubra* ¼ oz.; and Mr. McIvor, in his "Notes on the Propagation and Cultivation of the Medicinal Chinchonas," published in 1867, page 6, paragraph 12, says "one ounce of clean seeds produce on an average from 20,000 to 25,000 plants," so that "instead of from 50,000 to 100,000" his ¼ oz. would produce from 5,000 to 6,250 plants only.

7. The remainder of Mr. McIvor's letter refers principally to the Government plantations, and does not concern me much; but as I have a few plants here of *C. Officinalis* and its varieties, and of *C. Pahudiana*, I may remark with reference to Mr. McIvor's statements at paragraph 7 of his letter. After stating that the principal stock of *C. Officinalis* had been raised from seeds from Ceylon, he says: "And it is worthy of note that the entire stock of this species has been so seriously affected with canker as to cause the cultivation to be abandoned. The Sikkim stock of *C. Pahudiana*, raised solely from Java plants and seeds, has also been destroyed by canker." This is a bold assertion, and it is certainly new information to me that the one was abandoned *through*, or the other destroyed *by*, canker; but as I presume he refers to the Government plants, I leave the gentleman in charge of them to digest it. We have a small patch of each species here, as also of *C. Micrantha*, the latter raised solely from Madras plants; we discontinued propagating the whole of them from a very early stage, not because of *canker* (which is only a mare's-nest discovered by Mr. McIvor), or because of any other disease, but simply because of their prospects from a commercial point of view. They are not destroyed, but are not worth wasting money on, and the climate of Sikkim does not appear to be very suitable to either of them. They are not the only species, however, that Mr. McIvor has forbidden to grow in Sikkim; if I am rightly informed (I write from hearsay), he in one sublime sentence pronounced the whole of our *Succirubra* to be dying out also, and gave them three years to take themselves out of existence, Pomong I suppose included. Such a statement made by any man after seeing the *Succirubra* plantations here simply deserves contempt.

8. To prevent any confusion between the Government and private plantations by the term

term "the Sikkim plantations" used by Mr. McIvor, I beg to say that my remarks in the foregoing, as well as before the Chinchona Commission, refer to the plants under my own charge only. The Government officers are perfectly competent to answer for themselves and their plants.

9. In conclusion, I would most respectfully observe that I make no claim or pretension to Mr. McIvor's ability or experience. He has more experience in his profession in general, considerably more so in India, and three years more in Chinchona cultivation than I have.

All I contend for is the truth of my statements, which I think I have sufficiently proved; and as Mr. McIvor's statement at paragraph 3 of his letter is calculated to do me injury, I will consider it only an act of justice on the part of Government to give the same publicity to this as they did to Mr. McIvor's statements, and I consider myself entitled to an apology from that gentleman for his rash and unwarranted statements.

Darjeeling Chinchona Association,
3 July 1872.

Dear Sir,

You ask me if there are no entries of money paid to Mr. McIvor for Chinchona plants. I have looked, and find the following:—

30th June 1864.

To Mr. McIvor of Madras.	*Rs.*	*a.*	*p.*
Purchase of plants - - - - - - -	256	–	–
Inland carriage - - - - - - - -	8	12	–
Freight - - - - - - - - -	40	–	–
Total - - -	304	12	–

30th April 1863.

To amount remitted to Mr. McIvor for plants - 100 – –

31st May 1863.

To amount remitted to Mr. McIvor for plants - 200 – –

30th June 1862.

To amount remitted to Mr. McIvor for plants - 200 – –

There are also references in the minutes and other proceedings and complaints against Mr. McIvor for the bad plants he had sent from Ooty.

Yours, &c.
(signed) *W. Lloyd,*
Darjeeling Chinchona Association.

J. Munro, Esq., Superintendent.

III.—Mr. JAFFREY.

Memorandum on Chinchona Canker in British Sikkim.

I took charge of the Government *Chinchona* at Sinchul in August 1862. Found a disease in *Cinchona Succirubra*, but from its peculiar type was some time before coming to the conclusion that it was canker.

2. I received during April 1863, 327 plants, consisting of various species of Chinchona from the Nilgiris, amongst which canker was fully developed.

3. Was, during 1863 consulted by the late Charles Barnes, Esq., of the Darjeeling Chinchona Association, with reference to a consignment of Chinchonas received from the Nilgiris. Observed in the wardian cases seven or eight sickly specimens; attributed the destruction of the plants at the time to their weakness, and the wretched soil in which they had been transmitted.

4. *Chinchona Pahudiana.*—Cultivation was stopped by order of Government, it being considered a useless species; 1,000 plants were killed, on the morning of the 16th January 1864, by frost. A small plantation of this species has been retained, so that it should not be lost. The plants are from 15 to 19 feet in height at this time (1st July 1872); canker has nothing to do with the disappearance of this species.

5. *Chinchona Officinalis.*—Cultivation has been held in check in consequence of the climate of Rungbee having been found unsuitable to their wants; canker in this species has been the exception, not the rule.

6. *Chinchona Calisaya, var. Josephiana.*—I am not aware of having received by name at any time this variety of chinchona. I received eight plants of *C. Calisaya* at Sinchul in 1862, and named as such. I recollect pointing out to the late Dr. Anderson a few strong plants amongst the seedlings of *Java C. Pahudiana* as being botanically like the variety *Josephiana.*

Government Chinchona Cultivation.

A. T. Jaffrey.

IV.—Mr. GAMMIE.

From the Resident Manager, Government Chinchona Plantation, Rungbee, to the Superintendent, Botanical Gardens, and in charge of Chinchona Cultivation in Bengal; dated Mongpoo, 5th July 1872.

In forwarding the remarks of Messrs. Jaffrey and Munro on the introduction of canker to British Sikkim, I beg to state that I can say nothing on the subject from personal experience, as I did not arrive in India till December 1865. I have every reason to believe that canker showed itself in the plants immediately after their arrival from Madras, but at the same time I think that, even had quite healthy plants been received, there would have been more or less canker in the Sikkim plantations, but that it is not a disease to cause alarm, for it very seldom kills the plants. As a case in point, I may mention that Mr. McIvor, when at Rungbee, wished to pull up a plant of *C. Calisaya*, which he said had been killed by canker, for the purpose of showing the Chinchona Commission the deadly effects of the disease as had been previously expounded by him. Mr. Clarke, the Officiating Superintendent, would not allow him to do so, as he denied it was dead, and wished to see whether he or Mr. McIvor was right. Mr. Clarke gave him permission to pull up any other canker-stricken plant he chose, but, to the best of my recollection, Mr. McIvor did not act on the permission. This particular plant is alive to this day, and will probably live for many years to come.

2. As Mr. Mann is absent on leave, and has not the opportunity of defending himself, I beg leave to state that Mr. McIvor has, in my opinion, misunderstood the statement made by Mr. Mann, that "ten per cent. were old exhausted plants from the Nilgiris." Mr. Mann, in my opinion, meant that they had been exhausted by constantly being cut for propagation here, and not that exhausted plants had been sent from the Nilgiris.

3. I am surprised at Mr. McIvor coming to the conclusion that "it appears to be assumed that the Sikkim plantations were stocked with plants from the Nilgiris only," for the receipt of seeds (from whatever source) and the results were generally published in the Chinchona reports, as he himself partly shows.

4. Mr. McIvor is quite mistaken in his conclusion that the cultivation of *C. Officinalis* was abandoned on account of canker, and that *C. Pahudiana* was destroyed by the same disease. *C. Officinalis* certainly died out, but from the root, and not from what I understand to be canker, which affects the bark and not the root.

5. I am not aware where Mr. McIvor got his information "that only one plant of the Java stock of *Calisaya* was in existence at the time of his visit to Sikkim in 1871," but certainly it was not from a reliable source, for the original Java stock was not kept separate from the stock received from other places, and it is quite impossible for any one to tell with certainty the origin of all the plants. However, at the time of Mr. McIvor's visit, there were in permanent plantations not fewer than 8,000 plants raised from Java seeds.

V.—Mr. SCOTT.

Memorandum by *J. Scott,* Esq., Curator, Royal Botanical Garden, Calcutta.

I only joined the Government Chinchona nurseries in Sikkim, then at Lebong, about the end of December 1864. The so-called canker had infected the plants ere that, and was indeed equally as prevalent as I ever after saw it amongst the plants in the frames or nurseries at Rungbee. I am thus unable to say whether or not the plants originally received from the Nilgiris were infected with that disease. Even supposing, however, that the plants were perfectly free from the disease when lifted and dispatched in the wardian cases from the Nilgiris for Sikkim, I am quite of opinion that it might have originated during the journey if the plants were kept in a wet soil, and a close, hot, and moist atmosphere. I do not think that the disease is at all infectious, or has any fungoid origin, but I consider it simply due to excess of moisture in the soil and atmosphere.

From the Officiating Superintendent, Botanical Garden, and in charge of Chinchona Cultivation in Bengal, to the Officiating Secretary to the Government of Bengal, General Department; dated Royal Botanical Garden, 8th August 1872, No. 363.

With reference to Dr. King's report, No. 360, of the 12th July 1872, on the introduction of the Chinchona bark disease, I have the honour to inform you that subsequent to the submission of that report, Mr. Davidson (lately an assistant to Mr. Broughton, Quinologist to the Madras Government), called on Dr. King, and in the course of conversation he incidentally noticed the occurrence of canker on the Nilgiri Chinchonas. Dr. King was thus induced to ask Mr. Davidson for a memorandum on the condition of the Government Chinchona plantations there as regards that disease. I now beg to submit a copy of Mr. Davidson's memorandum (received this day), which I may remark is strongly confirmative of Mr. Munro's statement to the Chinchona Commission, "that canker was imported into the Chinchona plantations, Sikkim, from those on the Nilgiris."

2. "With reference to canker," says Mr. Davidson, "in the Government Chinchona estates at Neddiwuttum, I may state that I have never paid very close attention to the subject, so my information may be rather scanty; but what I can give I believe to be strictly correct. One form of disease that I have observed seems to be confined to the lower portion of the tree; the bark just above the surface of the soil cracks, the cracks, I think, generally radiating from a common centre; the wood under the cracked part rots, the rotting going deeper until it reaches the pith; if the rotten wood is closely examined, it will be found to contain a minute fungi, similar in appearance to ordinary mould. The second form is when the bark dries (but does not crack); sometimes in patches along the trunk, sometimes up one entire side of the tree. I believe Mr. McIvor always makes it a point to have all trees suffering from either form cut down on the first appearance of their flagging. This is about all the information I can give you on the subject.

Enclosure 2, in No. 32.

From the Commissioner of the Nilgiris to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 19th July 1873.

I have the honour to enclose a letter from Mr. McIvor, in reply to Government Order, dated 14th October 1872, No. 1,418.

2. Mr. McIvor submits that the Nilgiri plantations have proved themselves so singularly free from canker that it is unlikely 327 Chinchona plants, exported for the Sikkim plantations, were on exportation affected with the disease, more especially as every precaution was taken to send away healthy plants, and the plants were chosen by skilled persons despatched from Bengal to select them.

3. From the same circumstance of the healthiness of the Nilgiri plantations, Mr. McIvor submits that other plants despatched must, in all probability, have been equally free from disease.

4. Mr. McIvor further submits that the written evidence recorded at the time shows all the Nilgiri plants to which it refers were healthy, and that it is only ten years afterwards that their freedom from disease on quitting the Nilgiris is called in question, and then, upon the *recollection* of gentlemen interested in the propagation of the plants in Bengal.

5. Finally, Mr. McIvor defends himself against the imputations of inaccuracy brought against him by the witnesses on whom Dr. King relies, and submits that the witnesses have fallen into error in every instance they cite.

From the Superintendent of the Government Chinchona Plantations to the Commissioner of the Nilgiris; dated Ootacamund, 12th July 1873.

I HAVE the honour to acknowledge Government Official Memorandum, Revenue Department, No. 97, dated 7th of May last, desiring to know whether I have any remarks to make on a letter of the Government of India, recorded in General Order, dated 14th October 1872, No. 1,418, in which the Government of India arrive at the conclusion that "canker is shown to have existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations."

2. The Government of India form this decision upon an inquiry conducted by Dr. King, Superintendent of the Chinchona Cultivation in Bengal. Dr. King encloses in his report the evidence upon which he bases his judgment.

3. I shall venture first to remark upon Dr. King's arguments and summing-up, and will then cursorily meet the adverse statements in the evidence he adduces.

4. Dr. King remarks, in paragraph 4 of his letter: "It appears Mr. McIvor is not inclined to admit that any plants sent by him from the Nilgiri plantations to Sikkim, for either the Government plantation or that of the Chinchona Association, could, on arrival in Sikkim, have been affected with the disease which he calls canker." I beg to submit that my position as thus described by Dr. King is not the position I have adopted, and which I maintain. My position is not that the plants when received at Sikkim were not tainted with canker, but that there was no taint on the plants when they quitted the Nilgiris. I can only argue on the condition of the plants as they left my hands. Obviously I can know nothing of the condition in which they reached the Himalaya Mountains. The distinction is of the utmost importance. My argument is that the plants left the Nilgiris free from disease, and that if they reached the Himalayas (as it is now stated they did) with canker, they contracted the malady on the road.

5. I will proceed to show how probable it is that such a state of things occurred. I must first, however, meet the argument of Dr. King in paragraph 5 of his letter to the effect that argument from probability is negative argument. I oppose to this objection that Dr. King, while condemning a negative argument in me, is driven to a negative argument himself. In paragraph 4 of his letter, he admits that Dr. Anderson did not, as a matter of fact, mention in any of his reports the existence of canker in the Nilgiri plants; and he accounts for his silence by the negative argument that Dr. Anderson probably "did not think it (canker) worth mentioning." This argument of Dr. King even goes beyond the point of mere negation; for Dr. Anderson does not merely pass over the existence of canker in the Nilgiri plants, and so leave it to be inferred the possibility of the existence of canker, but he states, at paragraph 6 of his letter, dated 11th February 1862, which was written from Calcutta after the arrival of the Nilgiri plants there, that the plants were "as healthy as they were at Ootacamund." At paragraph 2 of the same communication, speaking of the plants on the Nilgiris, he says: "Under such favourable circumstances the plants receive at once every condition necessary to their perfect health." In fact, all Dr. Anderson's reports of the Nilgiri plants not only make no mention of canker, but positively say the plants come from a healthy source, and are healthy. The matter stands thus: speaking of circumstances ten years after the event, which cannot be decided on evidence recorded at the time, Dr. King and I are both driven to negative arguments. I submit that, from the nature of the case, only negative arguments are possible.

6. Following this train of argument I shall, as I hope, demonstrate—

1st. That it is extremely unlikely the plants from the Nilgiris were affected with canker when they left the Nilgiris.

2nd. That it is, on the other hand, highly probable that the plants spontaneously generated canker on their journey to Sikkim.

7. Upon the first point it is only necessary to say that Dr. King, in his letter under discussion, admits, at paragraph 11, the infrequency of canker on the Nilgiris. He says: "I saw examples of both forms of disease in the Chinchona plantations on the Nilgiris during my recent visit to them, although neither is common there;" and to add that on the Nilgiris the Government plantations cover 1,200 acres, and only 600 cankered trees have been discovered since the commencement. I refer also to paragraph 2 of Dr. Anderson's letter quoted above, and to the fact, well known to physiologists, from the late eminent Mr. Knight downwards, that canker, even if introduced to a climate unfavourable to its diffusion, is arrested. The fact of canker never having gained a footing on the Nilgiris shows the Nilgiris possesses such a climate, and the inevitable inference appears to be that the plants did not leave the Nilgiris cankered.

8. The next point requires me, in the first instance, to demonstrate the nature of canker, and the conclusion that it might probably have been spontaneously generated between the date the plants left the Nilgiris and their arrival at Sikkim.

9. Upon

9. Upon the nature of canker it is stated in "Loudon's Suburban Horticulturist," chapter VI., page 123, and "Lindley's Gardeners' Chronicle" page 283, 2nd May 1846, canker is a disease caused by "unsuitableness of soil, unpropitiousness of climate, and want of access of air." The disease disappears when these conditions are changed. Mr. Scott, in his evidence before the Chinchona Commission, allows this; for he says, in reply to a question, "Would you willingly propagate from a cankered stock-plant?" "As readily as from a healthy plant, provided I could find a healthy shoot to make a cutting of." The answer shows that, in his opinion, Mr. Scott could get rid of canker by judicious treatment; for it is clear that if the healthy shoot from a cankered plant was placed in unfavourable conditions, it would continue to develop disease.

10. But hypothesis is not needed in the matter, as we have positive proof that canker arises from damp in wardian cases. The whole of the plants conveyed to Java from South America in 20 wardian cases by Dr. Hasskarl were so affected with disease that, as stated by Dr. McPherson to the Madras Government, dated 19th December 1860, paragraph 8, "most of the young trees on being planted out speedily died, and of all the trees imported only two survived." With some of the consignments sent to India from South America the loss was even more complete. The whole stock of *Calisaya* collected by Mr. Markham perished from confinement in wardian cases. The entire collection of Mr. Pritchett similarly perished before arrival in Bombay, and the only plants which survived long confinement in cases were those brought by Mr. Cross to Madras. These plants survived, because Mr. Cross kept the cases open, and daily forked up the earth about the roots. From these latter plants the Nilgiri stock was raised.

11. The opinion of Mr. Scott accords with these facts. Mr. Scott says, in the correspondence under reference: "Even supposing, however, that the plants were perfectly free from the disease when lifted out and despatched in wardian cases from the Nilgiris for Sikkim, I am quite of opinion that it might have originated during the journey, if the plants were kept in a wet soil and a close, hot, and moist atmosphere."

12. Thus it is shown positively that canker appears in wardian cases. And what was the treatment the Nilgiri plants received on the journey to Sikkim? Upon this point Dr. Anderson, in his report from the 1st April 1862 to 30th April 1863, writes: "That owing to the highly unfavourable circumstances in which the plants were placed after their arrival in Darjeeling, I was obliged to keep the Chinchona plants confined for two months in wardian cases, some of them having been already subjected to five months of this confinement." Further, Dr. Anderson writes: "No packages of any kind ever reached Darjeeling from Calcutta in less than six weeks, the usual time occupied in the transit being two months." In fine, Dr. Anderson proves to demonstration that the time all plants passed in wardian cases in their journey from the Nilgiris to the Himalayas was invariably sufficient to generate canker.

13. I have, in my report on the Sikkim plantations, stated my opinion that the climate of Sikkim is favourable to the development of canker. Even, therefore, if the extreme supposition was adopted that the Nilgiri plants escaped the peril of the journey to Sikkim, on their arrival they would have been placed in conditions adverse to health. The climate of Sikkim is condemned for Chinchona by Mr. Gammie, who writes, in paragraph 1 of his letter, Enclosure 4 in the letter of the Government of India: "I have every reason to believe that canker showed itself in the plants immediately after their arrival from Madras; but, at the same time, I think had even quite healthy plants been received, there would have been more or less canker in the Sikkim plantations."

14. The climate of Rungbee is much like the climate of the Travancore States, and is, I believe, too moist for Chinchona. I had the honour to report on the Travancore Government Chinchona Plantations in September 1872. I found the trees there permeated with canker. I am informed that they have now actually died out, and it is the intention to plant coffee on the sites. It will be seen in this report, and I beg to draw attention to the fact that I show there, that canker is a disease not only of the bark of Chinchona, but which attacks the roots also. From the correspondence now under reference, it seems that the Bengal authorities are under a misapprehension, and refer canker only to bark-disease.

15. I have thus endeavoured to show—

1st. That it is not probable the plants should have had canker when they left the Nilgiris, as they were forwarded from a pure source;

2nd. That nothing was easier than for them to contract the disease during their journey to Sikkim; and,

3rd. That, in the extreme supposition that they escaped the peril of the journey, Sikkim has a climate and soil described by the most eminent physiologists as presenting conditions favourable to the origination of canker.

16. I will now address myself to minor points, and to the inaccuracies ascribed to me by the witnesses cited by Dr. King.

17. Stress is laid by Dr. King on the evidence of Mr. Jaffrey, who, Dr. King states, has been on the Government plantation since its commencement. This is an error. Mr. Stubbs was originally in charge. Mr. Jaffrey took charge on the 13th of September 1862,

or nine months afterwards. The statement is made at paragraph 2 of Dr. Anderson report, 1862-63. Thus Mr. Jaffrey had no means of knowing the state of the original stock of plants until nine months after they had been submitted to the adverse climate of Sikkim.

18. In his evidence, referred to by Dr. King, it is stated by Mr. Jaffrey: "I received, during April 1863, 327 plants from the Nilgiris, amongst which canker was fully developed." It is worthy of remark that Mr. Jaffrey made no mention of so important a fact until 1872, and withheld it in his evidence before the Chinchona Commission in 1871. The following are the facts with regard to these 327 plants:—Dr. Anderson sent down a European gardener and a mallee from Calcutta to select and pack them; he writes on the 9th March 1863, to the late Sir W. Denison, then Governor of Madras: "You will probably like to hear that the Chinchona plants supplied to me from Ootacamund arrived here in excellent condition, and are still in this garden (Botanic, Calcutta), and have grown much, most of them having made three pairs of leaves since their arrival here." Referring to these plants after their arrival in Darjeeling, he writes: "Of the original number (350) received from Madras, only 23 had been lost between Calcutta and Darjeeling."

19. Referring to plants subsequently received by the Darjeeling Chinchona Association, Mr. Jaffrey, at paragraph 3 of his present letter, attributes their destruction "to their weakness and the wretched soil in which they had been transmitted." It may be permitted me to remark on the singularity of the circumstance, that taking the 327 plants received in April 1863 to have been affected with canker immediately recognisable by Mr. Jaffrey, and not to have been, as Mr. Anderson stated, quite healthy, Mr. Jaffrey could not detect the disease in plants received months afterwards, and was driven to attribute their decay to weakness and soil.

20. With regard to the evidence of Mr. Munro, referred to in paragraphs 5, 6, and 7 of Dr. King's letter, I observe that it shows the plants it refers to were received from a third party; that they were not ordered by Mr. Munro, or for him; and he did not pay for them. This is the reason his name does not appear in my books.

21. With regard to the evidence of Mr. Munro before the Chinchona Commission, to which I took exception at the time, I wish to remark that, whether Mr. Munro refers in it to the first plants sent to Government or to the Darjeeling Chinchona Association, he was not qualified to give an opinion, as he was not in India when the plants were received. Mr. Munro, in paragraph 4 of his present letter, says: "Of the first consignment I know nothing." Dr. Simpson also states that the first instalment of plants was received long before the arrival of Mr. Munro. Notwithstanding this, Mr. Munro. in his evidence, said: "We received our first cuttings from the Nilgiris, and they were extensively affected with canker." The only plants upon the condition of which Mr. Munro was in a position to pronounce on their arrival on the Himalayas formed the *last batch*. With regard to these plants Mr. Munro is silent in his evidence.

22. In his present letter he speaks of the plants thus. He writes: "They showed symptoms of the disease we have since learned to call canker, as soon as it could be distinguished from injuries received during the journey." Mr. Munro does not state how long this interval was. The records would indicate it as an interval of many years after the arrival of the last instalment of plants in Sikkim.

23. Mr. Munro accuses me of inaccuracy with regard to some seeds I supplied the association. He writes, in his present letter: "Mr. McIvor takes care not to mention the quantity of seeds sent. I will do so for him. It was of *C. Succirubra*, ¼ ounce." The letters noted in the margin, taken from my records, show that the quantity sent was 7½ ounces. I sent also about 2 ounces by pattern-post. My copy of the covering letter to this last consignment is mislaid, but no doubt the letter will be found on the records of the association.

Date of Letters advising Despatch of Seeds.		Oz.	Date of Application for, and Acknowledgment of Seeds sent.	
23 August 1866	C. Succirubra	1	W. Bourne, Esq.	Calcutta, 30 June 1866.
	C. Officinalis	1		Calcutta, 4 April 1867.
May 1867, Copy of Covering Letter mislaid	(Estimated)	2		
18 March 1868	C. Succirubra	1	Col. J. A. Angus	Darjeeling, 29 February 1868.
	C. Officinalis	0½		1 April 1868.
	C. Micrantha	1		
19 May 1868	C. Succirubra	1	W. Lloyd, Esq.	4 May 1868.
	C. Officinalis	2		
	Total	9½		

24. Dr. King, at paragraph 9 of his communication, calls in question my statement that the "Sikkim stock of Pahudiana, raised solely from Java plants, has also been destroyed by canker." He further expresses his surprise that I should be ignorant that the Pahudiana produces no quinine, and was on that account abandoned. In reply, I observe that it was I who brought the fact of the unproductiveness of the species in question to notice in my letter to Government of August 1861. I was aware the cultivation of the species has been stopped by the Secretary of State. But all this has nothing to do with the fact to which I alluded, namely, that of the 5,092 Pahudiana plants put out at Sikkim in 1865, all were affected with canker, and many had died out at the date of my visit in 1871.

25. Dr. King

25. Dr. King states, in paragraph 10 of his letter: "A third mistake into which Mr. McIvor has fallen in this same paragraph 7 is that of saying that the Java variety of *C. Calisaya* (*C. Josephiana*) has been so affected by canker that only one plant existed on the Sikkim plantations at the date of my visit in February 1871, out of all the seeds and plants received of this variety; whereas Mr. Gammie, in the concluding paragraph of his memorandum, estimates the number at 8,000." It is Dr. King who has here fallen into error; he confounds *C. Calisaya* and *C. Josephiana Calisaya*. Mr. Gammie does not speak in the memorandum at all of *C. Josephiana*.

26. Mr. Gammie apparently implies, at paragraph 5 of his letter, that all the varieties of tree Calisaya on the Sikkim plantation were raised from Java seeds. This is erroneous: all the varieties but one were raised from Mr. Ledger's collection of seeds purchased and imported to India by Mr. Money. The Dutch obtained the varieties in question also from Mr. Ledger's collection, having previously had only one variety of tree Calisaya.

27. I have omitted to notice that, at paragraph 4 of his letter, Mr. Gammie states that I am mistaken in my impression that the cultivation of *C. Officinalis* was abandoned on account of canker; but adds: "*C. Officinalis* certainly died out, but from the roots, and not from what I understand to be canker, which affects the bark and not the root. On the 31st of March 1870 there were 930,704 plants of *C. Officinalis* in the Government plantations in British Sikkim, of which 406,899 were in permanent plantations. On the 5th July 1872 Mr. Gammie informs us that these plants had certainly died out. I should remark here that these plants were raised from stock received from Ceylon, and not from the Nilgiris, and that they were raised principally from seeds. Their disappearance is attributable to nothing but canker, which, as I have shown above, attacks roots as well as bark.

Report on the Bengal Chinchona Plantations, dated Calcutta, 29 April 1870.

ORDER of the Madras Government thereon, 12th September 1873.

THE foregoing papers will be communicated to the Government of India, with reference to their Agricultural Secretary's letter, dated 1st October 1872, No. 418, and with the request that they may be published in the "Gazette of India" in continuation of previous correspondence.

2. It appears to the Governor in Council that Mr. McIvor has shown that it is extremely improbable that canker existed in the plants originally sent up from the Nilgiris as stock for the Sikkim plantations, though it is possible that the disease may have been generated on the journey.

Enclosure 3, in No. 32.

From the Acting Secretary to the Government of Madras, to the Secretary to the Government of India.

Sir, Ootacamund, 2 October 1873.

YOUR letter, dated 1st October 1872, No. 418, gave cover to certain papers from the Government of Bengal, which, it was observed, left little doubt, in the opinion of the Government of India, of the correctness of the assertion as to the existence of canker in the chinchona plants originally sent up from the Nilgiris as stock for the Sikkim plantations.

2. I am now directed to forward the enclosed proceedings* of this Government, embodying letters from the Commissioner of the Nilgiris and from Mr. McIvor, containing remarks on the subject; and to request that these papers may be published in the "Gazette of India" in continuation of previous correspondence.

* 12 September 1873, Nos. 90, 91.

3. It appears to this Government that Mr. McIvor has shown that it is extremely improbable that canker existed in the plants in question when originally sent up from the Nilgiris, though it is possible that the disease may have been generated on the journey to Sikkim.

— No. 33. —

(No. 25—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 16 December 1873.

* 11 July (No. 18) 1873.
31 July (No. 21) „
12 September (No. 24) 1873.
26 September (No. 30) „
10 October (No. 32) 1873.

Para. 1. I HAVE received and considered in Council your Excellency's Despatches noted in the margin,* on the subject of the cultivation of the Chinchona plants, and the analysis and sale of bark.

2. I observe with satisfaction that a statement of the out-turn as well as of the expenditure of the Chinchona plantations now appears in the tabular return, and that the figures have been rather under estimated. The receipts from the 25,000 lbs. of bark, the dispatch of which you announced in your letter of 12th September (No. 24) 1873, were estimated at 2,500 *l.* The sale took place on the 11th ultimo, and the sum realised was 3,490 *l.*, the average price secured being 2 *s.* 10 *d.* per lb., while one parcel was sold at the very unusual price of 5 *s.* 9 *d.* per lb. Something like this average may be applied to the 33,000 lbs. of dry bark used by Mr. Broughton in the manufacture of amorphous quinine, which will place its value at not less than 3,300 *l.*; and, judging from the same premises, the additional 50,000 lbs. of bark to be harvested this year will be worth 6,700 *l.* Thus, the total income from the plantations in 1873 will have been 13,490 *l.*, which should increase in future years. I consider this to be a satisfactory interest on the whole outlay, and it entirely removes Chinchona cultivation from the category of experiments.

3. The question between the coppicing and mossing systems of taking the crops of bark is deservedly receiving very careful attention. It would appear that, under scientific and skilled management, the trees which are treated with the mossing process can be made to yield three times as much bark in the same time as the same number when coppiced. This, at least, is the deduction of Mr. Cockerell, the Commissioner. It must however be borne in mind that the mossing process is not likely to be successful unless skilled scientific management is available, and that, under other circumstances, an ordinary cultivator must resort to coppicing. It is therefore desirable that both systems should continue to receive attention on the Government plantations.

4. The means of supplying the Chinchona febrifuge to the people of India in a cheap form, and in sufficient quantity, is a question which must always be considered as paramount in the conduct of the plantations. The object is to be attained in two ways, which must supplement each other; first, the manufacture from bark on the spot; and, second, for some years to come at least, the purchase of the febrifuge in the cheapest available form in Europe.

5. As regards the first way, I observe that the quinologist was supplied with 33,000 lbs. of dry bark during the current year, for the manufacture of so-called "amorphous quinine." I shall be glad to receive information respecting the quantity of this form of the febrifuge that is annually issued, the quantity that has been used in the Medical Departments, and the quantity that has been sold to the public, with the price, and the judgment that has been formed with respect to its efficacy. It would also be useful if some details could be furnished to me with reference to the cost of the manufacture, the prospect of reducing it if the demand increases, and the probable extent of such increase.

6. I perceive, from a return that has been prepared in the Store Department of this office, that latterly the indents for quinine and other Chinchona alkaloids from your Presidency have been very considerably smaller than those from Bombay. From 1869 to 1873 the indents for quinine from Bombay amounted to 3,382 lbs., while during the same period those for quinine and all other Chinchona alkaloids from Madras only amounted to 2,275 lbs. It will be interesting

interesting to ascertain whether this smaller demand from a larger Presidency is due to Mr. Broughton's local manufacture, and to what extent.

7. With reference to the second means of supplying the people of India with the febrifuge, namely, the purchase of the cheaper though equally efficacious alkaloids in this country, I am surprised to find that the valuable reports of the Chinchona Commission appointed by your Government five years ago should have borne so little fruit. It was the unanimous opinion of the medical men, who investigated the question with praiseworthy care and diligence, that the three other chinchona alkaloids that were supplied to them were almost, some thought quite, as efficacious as quinine. Yet chinchonine, chinchonidine, or quinidine have only been indented for in very small quantities by your Government since the date of the Report of the Commission.

8. Mr. Howard, the eminent quinine manufacturer, has been consulted on the subject, and I herewith transmit 20 copies of his letter.* You will see that he particularly points out the value of chinchonidine as likely, from its efficacy and cheapness, to supply the means of enabling us to bring the chinchona febrifuge within the reach of the mass of the people. Another very important advantage that will be derived from the extensive use of the febrifuge in the form of chinchonidine is that it will extend the cultivation and increase the value of *C. Succirubra*, the species which, while producing that particular alkaloid in very considerable quantities, also grows more readily and over a wider range than any other in the hill districts of your Presidency.

* Dated 21st Oct. 1873.—*See* Part I., page 139.

9. I request that the suggestions contained in Mr. Howard's letter may receive the careful consideration of your Excellency's Government, and that you will furnish me with your matured views on the subject.

10. The specimens in triplicate of the flowering and fruit-bearing branches and the barks of the species of chinchona grown on the Nilgiri Hills, referred to in your Despatch, dated 11th July (No. 18) 1873, have been duly received. One set has been presented to the Herbarium at Kew, another to the British Museum, and the third will be preserved in this office.

I have, &c.
(signed) *Argyll.*

— No. 34. —

(No. 40—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Duke, Fort St. George, 16 December 1873.

WITH reference to the Despatch marginally noted,* we have the honour to forward, for your Grace's information, our proceedings† of 2nd instant, No. 1,334, embodying a report from the Officiating Surgeon General, Indian Medical Department, on the therapeutic action of the Calcic Quinovinate manufactured by the Government Quinologist in the treatment of fevers, dysentery, and diarrhœa. The previous correspondence on the subject is also enclosed.

* From Secretary of State, 27 April 1871. No. 11, Public. *See* page 27.
† Proceedings of Govt., 5 June 1871.
„ „ 19 „ „
„ „ 12 July „
„ „ 2 Dec. 1873.

2. Your Grace will perceive from our proceedings of 2nd instant that further experiments with the drug are not considered necessary.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 34.

From the Government Quinologist to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 9th June 1871.

WITH reference to G. O., Revenue Department, No. 990, of 5th June 1871, I have the honour to state that in 1869 I addressed the Medical Inspector General on the subject of Quinovin, and gave a translation of parts of an article by Dr. Kermer, which had appeared in the *Vierteljahresschrift für practischi pharmacie* (Bol. xvii., s. 335). I also forwarded a sample of calcic quinovinate, and requested that it might be experimented upon therapeutically. The letter and extract were published, I found, in the "Madras Monthly Journal of Medical Science" for January 1870, where, in a footnote, the quinovinate was stated to be under trial.

2. About a year since I was applied to for a further quantity, which I furnished; but I have as yet received no report as to the results. I am greatly desirous of hearing the conclusions to which the Medical Department have arrived on the subject, and trust soon to receive the report. Further supplies of calcic quinovinate will be supplied if required.

Enclosure 2, in No. 34.

From the Acting Inspector General, Indian Medical Department, to the Secretary to Government, Revenue Department; dated Fort St. George, 1st July 1871.

G. O., Revenue Department, No. 990, of 5th June 1871; and G. O., No. 1085, of 19th June 1871.

I HAVE the honour, with reference to the proceedings of Government marginally noted, to submit a report on the medical value of the calcic quinovinate, a small supply of which was prepared and furnished by Mr. Broughton.

2. The cases in which it has been used are altogether insufficient in number to admit of any conclusions being arrived at as to its therapeutical virtues. But, so far as will be seen from the annexed tabular statement, the results have been unsatisfactory.

3. Five cases of malarious fever were treated with the drug, and of these three recovered, one was not relieved, and in the fifth there was a doubt as to whether the case had ever been one of fever. A further experience, therefore, will be needed before an opinion can be formed as to its antiperiodic powers.

4. In 10 cases of diarrhœa the effects were even less satisfactory, but in some of the cases the remedy had not a fair trial, as the patients were old and debilitated, and the disease had been of long standing.

5. Only one case of dysentery was subjected to the action of the drug, and the patient recovered, but no deduction can be drawn from the result of a single case.

6. It is, however, extremely desirable that a remedy so highly spoken of should be subjected to more extensive trials in the manner proposed by the Right Honourable the Secretary of State for India; and to permit of this being done, I have the honour to recommend that Mr. Broughton may be requested to furnish me with at least five pounds of the calcic quinovinate.

TABULAR STATEMENT of the Results of Trials of the Therapeutical Effects of the Calcic Quinovinate manufactured by *J. Broughton*, Esq.

DISEASES.	Number of Cases.	Average Quantity of the Drug administered in each Case.	RESULTS.		
			Successful.	Unsuccessful.	Doubtful.
Febris, intermittens	4	111¼	2	1	1
„ remittens	1	80	1	—	—
„ typhodes	1	72	- -	1	—
Diarrhœa	10	156⅗	2	4	4
Dysentena chronica	1	120	1	—	-

ORDER of the Madras Government thereon, 12th July 1871.

COMMUNICATED to the Government Quinologist, who will furnish the Inspector-General, Indian Medical Department, with five pounds of the calcic quinovinate, as requested by him in paragraph 6; and the Inspector General will in due course report the results of the trials with this further supply.

Enclosure 3, in No. 34.

From the Officiating Surgeon General, Indian Medical Department, to the Secretary to Government, Revenue Department, Fort St. George; dated 16th September 1873.

Proceedings of Government, Revenue Department, No. 1202, of 12th July 1871.

IN submitting this report on the therapeutic action of calcic quinovinate in the treatment of fevers, dysentery, and diarrhœa, I have the honour to express regret at the delay in its transmission.

2. The subjoined tabular statement shows that the drug was used in 144 case; its exhibition was successful in 70, doubtful in 7, and unsuccessful in 67.

TABULAR STATEMENT of the Results of Trials of the Therapeutic Action of the Calcic Quinovinate, manufactured by *J. Broughton*, Esq. (from 31st January 1870 to 10th February 1873).

DISEASES.	Number of Cases.	Average Quantity of the Drug administered in each Case.	RESULTS.		
			Successful.	Unsuccessful.	Doubtful.
		Oz. Grains.			
Intermittent fever	79	0 124⅗	44	34	1
Simple continued fever	1	0 48	- -	- -	1
Febricula	8	0 98	5	3	—
Dysentery	35	0 69⅝	12	22	1
„ chronic	2	3 91½	2	—	—
Diarrhœa	19	0 49⅗	7	8	4

3. In less than half of the cases, therefore, can the calcic quinovinate be credited with any remedial power, while in almost the same number it failed to bring about recovery.

4. Quinine, as a febrifuge and antiperiodic in intermittent and remittent fevers, and ipecacuanha in dysentery, have been by long experience proved to be medicines of much greater potency. The success of the calcic quinovinate cannot compare with that of their administration in the diseases in question.

5. As it is clearly a physician's duty to restore his patient to health as speedily as possible, he is bound to use those means that are best calculated to bring about this result. Acting on this principle, he must prefer resorting in the first instance to the employment of medicaments of proved efficacy, like quinine and ipecacuanha, to using one, like calcic quinovinate, which is as likely to fail as to succeed.

6. Still, the experiments which have been made show the drug in question to have some therapeutic action in those diseases for the treatment of which it has been recommended; and it is quite possible that calcic quinovinate may, in certain cases, prove a successful remedy, when quinine in fevers and ipecacuanha in dysentery may have failed. As a second resort it may be beneficial; as a first resort it is not justifiable.

7. In conclusion, I beg to forward, as an Appendix, extracts from the reports of the several medical officers who were called upon to try the calcic quinovinate.

Appendix.

Extract from the Report of Surgeon Major *C. J. Rogers.*

Native Infirmary, Madras.—" In the six cases of diarrhœa and dysentery treated, only two recovered.

" In fever the treatment appeared more successful; two recovered out of three treated."

Extract from the Report of Surgeon *W. N. Chipperfield.*

General Hospital, Madras.—" The results at which I have arrived are that the remedy may be found useful in cases of very chronic dysentery; that it is a slowly-acting remedy, and requires to be long continued before its efforts become manifested; that in the two instances in which I have found it beneficial, I had to combine opium with it; that as an astringent for ordinary diarrhœa it is useless; that I have not observed any febrifuge properties in the preparation; and that one great objection to its use is its being required to be given so frequently as every hour or two, and both day and night."

Extract from the Report of Surgeon Major *L. W. Stewart.*

Secunderabad.—" To summarise and draw conclusions from these cases, I am of opinion that the calcic quinovinate is not at all equal as an antiperiodic to quinine, but it would appear to possess only tonic properties, similar to most other vegetable bitters, *e.g.*, chiretta, calumba, &c.

" In cases of febricula, I consider the medicine might be employed with advantage, but not as an antiperiodic in the intermittent type of fever, or in acute dysentery. As far as my time has admitted, after a careful consideration in the treatment of these and former cases of both ague and dysentery with this medicine, I beg now respectfully to record the above as my opinion on the virtues of the calcic quinovinate."

Extract from Report of Surgeon *L. C. Nanney.*

Secunderabad.—"The result of my experiments was not sufficiently encouraging to induce me to risk the employment of it in a severe case, nor could I conscientiously attempt its use in dysentery, or peril life by the use of a drug which so insufficiently fulfilled the claims that had been advanced for it, when I had reliable remedies at hand.

"From my brief experience of the calcic quinovinate, I doubt the possibility of its substitution for ipecacuanha. With regard to its use as a substitute for quinine, I do not think more efficacy can be claimed for it than that of a tonic of the mildest description, in which form the tediousness of its preparation would preclude its being largely employed.

"In three cases out of six now recorded the fever was checked by the treatment adopted; these were of so mild a type that probably rest with a simple aperient might have proved sufficient to produce the same effect.

"In the second case, the fever appeared to be merely temporary, as the fever returned after an interval of four days, when I thought it inexpedient to persevere with the experiment.

"In the three remaining cases, it appeared to exert no effect, and, after continuing its use for seven days without any favourable result, other treatment had to be adopted, to which the fever yielded in a single day in each case.

" From these remarks, it will be seen that my experience of the calcic quinovinate in the mild cases, on which I thought it prudent first to ascertain its qualities, was not such as to warrant my employing it in any severe cases, especially in dysentery, in which the experiment might prove to be at the expense of life to the sufferer."

Extract from Report from Surgeon *C. A. Andrews.*

Mercara.—" The conclusion at which I have arrived is that the drug has some curative power in certain cases of dysentery, but it is far less certain in its action than ipecacuanha; it is, however, free from the nauseous properties of the latter drug, and in some cases even will effect a cure when the latter fails.

" I have had so few opportunities of experimenting with the drug in genuine, uncomplicated cases of dysentery, that I hesitate to give a more decided opinion about its action; but, although it is not likely to supersede ipecacuanha, it will, I think, become a valuable aid in the treatment of this disease."

Extract from Report of Surgeon *J. Houston*, M.D.

Mysore.—" The medicine, in the form of solution, has been exhibited to 17 patients, suffering from dysentery or diarrhœa; of these 10 were treated at the civil hospital and seven in the Mysore Jail. It has not proved successful in my hands, except in one instance, when it was administered to a prisoner for seven days. Patients suffering from dysentery and diarrhœa at the civil hospital are often on admission in a very reduced state, and if the treatment adopted is not quickly effective, it cannot be persevered with, but must give way to such other measures as the nature of the case may seem to demand. I therefore usually did not consider it advisable to continue the use of the Quinovinate beyond a day or two, and at the jail, where the cases of dysentery were second or third attacks, I thought it safest to have recourse at once to more established remedies.

" Though my experience of the Quinovinate has hitherto been discouraging, it appears to me probable that it may prove serviceable in bowel complaints, when complicated with splenic enlargement."

Extract from Report of Surgeon *D. W. Trimnell.*

Raepur.—" The number of days each case was under treatment was five and half days; in 21 cases no result was obtained, and the medicine had to be discontinued; each case under treatment was five and half days.

" In seven cases, irritation of the stomach and bowels occurred. The quantity taken by each case cured was 97½ grains; of those not cured 102 grains.

" In one case a protracted trial of 18 days was made, but without results.

" I am of opinion that the drug is less efficacious than Quinine."

— No. 35. —

(No. 1—Revenue.)

From the Government of Madras to the Secretary of State for India.

Fort St. George, 13 January 1874.

My Lord Duke,

We have the honour to forward, for your Grace's information, our proceedings marginally noted, embodying a report from the Government Quinologist of the results of his investigation of the tubers of *Aconitum heterophyllum*, or the native febrifuge," Atis." 8th December 187

We have, &c.
(signed) *Hobart*, &c.

Enclosure in No. 35.

From the Government Quinologist to the Acting Secretary to Government, Revenue Department; dated Ootacamund, 25th October 1873:—

In accordance with G. O. No. 714, dated 9th July 1873, Revenue Department, I have the honour to communicate the results of my investigation of the tubers of *Aconitum heterophyllum*, of which the Hindustani name is " Atis."

2. The examination of this native medicine was undertaken by the advice of a Bengal medical officer, who informed me that of all the febrifuge medicines employed in India, except

except chinchona, this was the most effective. It has a place in the Indian Pharmacopœia, and at page 434 of that work high therapeutic value is given to it; the names of Drs. Heming, Balfour, Dymock, Moore, Forbes Watson, and others being cited. Though the plant grows on the western Himalaya it can be purchased in nearly all the bazaars of South India, though its use is, of course, more general in the northern Presidences.*

3. The appearance of the tubers is described at page 4 of the Indian Pharmacopœia They are farinaceous, have an intensely bitter taste, and are not poisonous, being, as therein stated, free from the poisonous alkaloid aconitine.

4. After much labour I succeeded in isolating the bitter febrifuge alkaloid, which, from its composition and properties, I find to be a new substance to which I propose to give the name "Atisine."

5. The method which I have found the most convenient for obtaining this alkaloid is as follows:—

6. The roughly powdered tubers are submitted to two exhaustions with boiling alcohol, and the resulting tincture is separated by filteration through cloth. The whole of the alcohol is then separated by distillation, and the thick extract is mixed with an equal bulk of cold water, made alkaline with caustic soda, agitated with chloroform and allowed to settle. The whole of the atisine is then in solution in the chloroform, which is separated, the chloroform distilled off, and the atisine dissolved in dilute sulphuric acid, and decolourized by animal charcoal. From this solution atisine nearly pure is precipitated as an extremely bulky white hydrate on the addition of caustic potash. In order to obtain it pure, it has to be re-dissolved in ether, again re-distilled and again dissolved in dilute hydrochloric acid precipitated by dilute ammonia and dried. The separation of atisine is neither difficult nor laborious.

7. Atisine is soluble to a considerable extent in water, to which it imparts a most intensely bitter taste. It forms a very bulky hydrate from which the water separates at a steam heat. It becomes anhydrous at 100° C. It commences to agglutinate at 76° C, and is perfectly fused at 85°. After fusion, it exactly resembles quinine in a similar state. Its alkaline properties are well marked, as it reddens moistened turmeric paper, and completely neutralizes all acids. It is soluble in carbonic disulphide and benzol. I have not succeeded in obtaining the free alkaloid in a crystalline form.

8. Its composition was determined by an analysis of its platinum double salt, which is readily precipitated from the hydrochloric acid solution of the alkaloid by the addition of platinum letrachloride. Without entering into details, I find the formula of atisine is C_{46} H_{74} N_2 O_5, the truth of which I was able to corroborate by a carefully conducted volumetric determination of the amount of hydrochloric acid required for neutralization. Atisine appears to have no rotatory effect on a beam of plane polarized light. Like quinine, atisine is diacid. Solution of its salts with oxygen acids are fluorescent.

9. I have obtained a crystalline sulphate of atisine, but with much difficulty in presmatic needles. The hydrochlorate is readily obtained by pouring dilute acid over a mass of the free base in the cold; crystalline crusts readily forming, which resemble quinidine hydrochlorate on examination. I have failed to obtain any other crystalline salts, though I have prepared the acetate, nitrate, and oxalate as amorphous masses.

10. A solution of an atisine salt is precipitated by tannin, mercuric chloride, potassic chromate, and ferrocyanide; also by phospho-molybdic acid and biniodide. Atisine quietly dissolves in strong sulphuric and nitric acids without any decomposition. It is a well and clearly defined alkaloid, quite new to chemists, and will very probably be of future use in medicine.

11. A further description of the chemical properties of atisine would be out of place in the present communication. I propose communicating a fuller description to the Chemical Society.

12. As the amount of atisine actually present in the tubers is but small, it would appear that this alkaloid would require to be medicinally used in very small doses. I have the honour to forward a specimen of "Atis," and one of Atisine hydrochlorate, the salt of the base most fit for therapeutical use. I would suggest that these specimens, if not otherwise required, should be presented to the Central Museum at Madras.

---

* In a white febrifuge medicine employed by the Karens in British Burmah, I have detected "Atisine;" herefore, atis is a component of the drug.

ORDER of the Madras Government thereon, 8th December 1873.

COMMUNICATED to the Surgeons-General, British and Indian Medical Departments, to whom a specimen of Atisine hydrochlorate should also be sent by the Government Quinologist.

2. The specimen forwarded will be sent to the Museum as suggested.

3. Mr. Broughton is thanked for his report, copy of which will be forwarded to the Secretary of State and Government of India.

— No. 36. —

(No. 2—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 19 March 1874.

1. I HAVE received and considered in Council your Excellency's Despatches, dated 16th December (No. 40), 1873, and 13th January (No. 1), 1874, the former reporting the result of experiments on the therapeutic action of calcic quinovate in the treatment of fever and dysentery, and the latter forwarding Mr. Broughton's account of the results of his investigations of the tubers of *Aconitum heterophyllum*.

2. The use of quinovinate was recommended on account of its cheapness and the facility with which abundant supplies can be procured. Its inferiority to quinine in cases of fever, and to ipecacuanha in dysentery was understood, but it was believed, with reference to the greater cost of the more potent medicines, that quinovinate might prove a valuable auxiliary in the treatment of diseases which annually commit such ravages in British India. I observe that Dr. Andrews, of Mercara, is of opinion that quinovinate will become a valuable aid in the treatment of dysentery; and Dr. Houston, of Mysore, also thinks that it would prove serviceable.

3. I am certainly of opinion, looking to the high price of the more potent remedies, that the importance of making the natives of India acquainted with a more economical though less efficacious remedy ought not to be lost sight of. At a time when epidemics are ravaging a district the sufferers are occasionally so numerous that the more expensive medicines can only be administered to a small portion of them. In April 1871, for instance, 114,012 persons sought relief at the dispensaries in the Burdwar district, and many undoubtedly succumbed owing to the impossibility of supplying them with expensive remedies.

4. On these grounds I have to request that you will cause further and careful experiments to be instituted as to the value of the drug in the treatment of dysentery.

5. I have perused Mr. Broughton's report on the results of his investigation of the tubers of *Aconitum heterophyllum*, the Hindustani *Atis*, and perceive that he has succeeded in extracting a new alkaloid previously unknown, to which he has given the name of *Atisine*, the separation of which is neither difficult nor laborious. This substance may prove of future use in medicine, and, as it is quite new to chemists, I desire that specimens of the drug, as sold in the bazaars, and of the *Atisine hydrochlorate*, may be forwarded to this office.

I have, &c.
(signed) *Salisbury*.

— No. 37. —

(No. 25—Revenue.)

From the Government of Madras to the Secretary of State for India.

Proceedings of Government, 2nd September 1874.

My Lord Marquis, Ootacamund, 30 October 1874.

WE have the honour to forward, for your Lordship's information, the Report on the Government Chinchona Plantations on the Nilgiri Hills, for the official year 1873–74, together with our Proceedings, dated 2nd September 1874 embodying the observations and orders recorded by us on a review of the Paper.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 37.

From the Commissioner of the Nilgiris to the Acting Secretary to Government, Revenu Department; dated Ootacamund, 30th June 1874.

I HAVE the honour to submit the report on the Government Chinchona Plantations on the Nilgiri Hills, for the official year 1873-74.

2. The season was a severe one, and the plantations suffered from frost. Seven acres of chinchona in one plot were destroyed by frost at Ossington, adjoining the Government plantation at Neddivuttum.

3. Propagation has this year been confined to the new species and varieties. Mr. McIvor has issued to the public 83¼ oz. of chinchona seeds. Mr. Broughton has received 91,773 lbs. of green bark during the year. Half of it was branch bark of high quality. Inferior branch bark from the Government plantations fetched from 2 *s.* 4 *d.* to 3 *s.* 6 *d.* per lb. in the London market.

4. In May 58 *succirubra* of 12 years old were, under the direction of Mr. Broughton, coppiced a foot from the ground, leaving the shoots on the stools standing; and in June 53 crown barks were similarly coppiced. In October 57 *succirubra* were coppiced close to the ground at the request of Mr. Broughton. Twenty-one of these plants have died.

5. The season has been very dry for barking, and not so much bark has been, therefore, taken as was anticipated. Referring to a plot of 1,000 *succirubru*, Mr. McIvor reports they have been barked during the year, and have yielded in all 9 lbs. of dry bark each in three years' harvesting.

6. Mr. McIvor proceeds to touch upon the cost of mossing and peeling bark, and reports it as 1-5 per lb. of dry bark in the above 1,000 trees. He states, however, that the larger the tree the greater the cost, owing to ladders being used which take time and labour to move about. Mr. McIvor hopes to reduce the cost of mossing and barking large trees by employing suitable scaffolding instead of ladders.

7. Referring to the prices obtained for the consignments of bark sent to England during the year under report, Mr. McIvor reports that mossed bark has continued to sell at higher rates than natural bark.

8. Mr. McIvor draws attention to the circumstance that the high prices ruling for bark in the past season have attracted double the usual quantity of bark from South America. He points out that this increased supply was quite opposed to anticipation, and dwells upon it as an incident of exceeding interest in relation to the prosperity of Chinchona cultivation. It is obvious that, if enhanced prices bring forward enhanced supplies from natural forests, the success of the Nilgiri plantations, in a commercial point of view, will be seriously jeopardised.

9. Mr. McIvor reports the discovery of a new hybrid which has been called *C. Pubescens*. It appears that it is very hardy and extraordinarily rich in alkaloids. Mr. McIvor proposes to propagate this hybrid.

10. The

10. The application of manure to plots on the Government plantations has not shown any certain results.

11. Mr. McIvor commends the officers in his establishment, and thanks Dr. DeVry and Mr. Howard for their kindness during the year under report in making analysis of Government bark.

Enclosure 2, in No. 37.

Report on the Government Chinchona Plantations on the Nilgiris for the Official Year 1873-74.

THE past season has been an exceptional one with severe and long-continued drought. The heaviest frost observed during the last 25 years occurred on the night of the 13th January. This frost did great damage to private Chinchona plantations; fortunately, however, the Government plantations have escaped with comparative immunity. On the Dodabetta Plantation about 175 trees were killed down to the ground. Our extensive plantations at Neddivuttum escaped without any plants being destroyed. Here, however, the effects of the cold caused the leaves to fall off from such trees as were planted in low or land-locked situations, as these situations retain the cold air as it settles down from the neighbouring hills. In such places the growth of the plants was retarded for the time, but they have now quite recovered from the effects of the cold. On a private estate, immediately adjoining Neddivuttum, the frost on the night in question killed about 7,000 large trees of seven years' growth, and destroyed 23,000 younger plants, or in all about 30,000. Some of the private chinchona plantations on the east side of the hills also sustained damage from this frost. The long dry weather which succeeded this severe cold has also been very trying, especially to young plants. The season has, therefore, been altogether an unfavourable one.

2. As mentioned in last report our propagation is now confined to the new species and varieties of Pitayo bark and *C. Angustifolia*. The average monthly increase of these varieties has been 578. The total number of plants of *C. Pitayensis* propagated during the year is 2,293 and of *C. Officinalis* var. angustifolia 4,639, making a total of 6,932.

3. The extension of our permanent plantations during the last year has been confined to *C. Pitayensis* and *C. Angustifolia*. Of the former 4,686 plants, and of the latter 15,743 plants were permanently planted out on the Hooker estate at Pykarra.

4. The total number of plants planted out in permanent plantations up to 31st March last was as follows:—

C. Officinalis or crown barks	508,878
Do. var. Angustifolia	22,404
C. Succirubra or red barks	579,938
C. Calisaya or yellow barks	34,250
C. Micrantha or Peruvian or grey barks	28,759
C. Pitayensis (Pitayo bark)	13,380
Other species	2,849
Total	1,190,458

5. The average height of our oldest and finest plants of *C. Succirubra* is 32 feet, with a circumference of stem of 28 inches; the average height of our finest plants of *C. Officinalis* being 25 feet, with a circumference of 18 inches. The number of plants issued to the public during the year is 964, and 83½ oz. seeds or seeds sufficient to raise 2,087,250 seedlings. Of tea plants 2,030 and of green tea leaf 1,017½ lbs. have been supplied to Major Jennings. The quantity of green bark supplied to the Government quinologist is 91,773 lbs., viz., 45,206 lbs. of stem and 46,567 lbs. of branch bark. The whole of this branch bark was of high quality, and of the remainder, much of which was rejected as not being "worth the cost of working," sold in the London market at from 2 *s.* 4 *d.* to 3 *s.* 6 *d.* per lb.

6. With the exception of 1,748 lbs. of trunk and 464 lbs. of branch bark obtained by coppicing, the bark harvested this season has been taken by the mossing process only.

7. The principal work performed has been the general conservancy of the estates, collection of bark, clearing, weeding, maintaining drains and fences, felling, pitting, and bringing into cultivation 25 acres of land on the Hooker estate at Pykarra for the reception of our new varieties of *C. Pubescens*, *C. Pitayens*, and *C. Angustifolia*.

8. During the two previous years no coppicing has been done, in consequence of representations made by Mr. Broughton in paragraph 3 of his letter of the 7th June 1871 (recorded in G. O., 13th July 1871), where that gentleman states, "At least two more years should elapse before coppicing can be profitably conducted." Accordingly last

spring our coppicing experiments were resumed. On the 30th of May 1873 Mr. Broughton selected a plot of 58 plants of the finest *red bark* trees of the planting of August and September 1862. These trees were coppiced at or within a foot from the ground, the shoots springing from the stools being left. These shoots varied from 2¼ to 14 feet in height at the date of coppicing. They were again measured on 30th May 1874, and the average growth in one year was found to be 1 foot 11½ inches; the maximum growth 4 feet, the minimum growth 3 inches. One plant only had died. The largest tree at the date of coppicing was 36 feet in height. These 58 plants gave 286½ lbs. of dry trunk bark, equal to 4·93 lbs. per tree. The cost of cutting down and barking the trees was rs. 7., or as. 1. 11. per tree, and about 5 pies per lb. of dry bark.

9. On the 2nd June 1873, a similar plot of 53 *crown bark* trees of the planting of 1863 was selected by Mr. Broughton, and coppiced in the same manner as the trees of *C. Succirubra* described above. These 53 trees yielded 193 lbs. of green stem bark and 9 lbs. of branch bark; in all, 202 lbs., equal to 85¾ lbs. of dry bark, or 1·61 lbs. per tree. The cost of felling the trees and barking was rs. 4. 15. 6., or as. 1½. per tree, and about 11 pies per lb. of dry bark. The shoots of these trees were left on the stools. They were measured on the 2nd June 1874. The average growth was found to be 1 foot 7½ inches; the maximum growth 2¼ feet, the minimum 5 inches. Nine plants had not sprouted, and one had died.

10. Another plot of 57 *C. Succirubra* or *red bark* trees of the planting of August and September 1862, was selected by Mr. Broughton, at Neddivuttum, on the 14th October 1873, and, at that gentleman's request, coppiced close to the ground (*i. e.*, within 6 inches), and all the shoots removed. The bark obtained from these trees was 746 lbs. of green trunk bark, equal to 264 lbs. of dry bark, or 4·64 lbs. per tree. The cost of coppicing and taking the bark was rs. 6., or as. 1. 8. per tree, or about 4½ pies per lb. of dry stem bark. These trees were examined on the 5th June 1874. The average growth of the shoots was 1 foot in 7½ months, the maximum growth 1¾ feet, the minimum ¼ foot. One plant had not sprouted, *and twenty-one had died.* This forms the fifth coppicing experiment carried out in the Government plantations, and the results obtained show the collection of bark by coppicing to cost 8 pies per lb. of dry bark from 8 year old trees, and 4½ pies per lb. from 11 year old trees. Our experience up to the present date show the collection of bark by mossing from 8 and 9 year old trees to be as. 1. 2. per lb. of dry bark, and as. 1. 7. per lb. when collected from 10 and 11 year old trees. The cost of collection of bark, therefore, by the mossing process is nearly twice as expensive when taken from young trees which can be reached from the ground, and when taken from trees where ladders have to be used is more than four times as expensive as the collection of bark by coppicing.

11. In consequence of the long-continued drought, it has been found impossible to collect the usual quantity of bark this spring, as the sap had not risen in the plants at the time of our spring barkings. From the 1,000 experimental mossed trees we collected during the year 1,546 lbs. of renewed bark, and 770 lbs. of natural bark from the upper strips of the trees. This gives the total yield of these 1,000 trees 6,068 lbs. of dry trunk bark. In addition to this trunk or stem bark, over 10,000 lbs. of green *branch bark*, equal to 3,000 lbs. dry bark, has also been collected from the 1,000 11 year old mossed trees, making the total yield of dry bark upwards of 9 lbs. per tree in three years.

	Lbs.	
In 1871-72	2,988	mossed, original.
In 1872-73	764	renewed.
In 1873-74	1,546	ditto.
In 1873-74	770	upper strips.
	6,068	

12. At paragraph 14 of my Annual Report for 1871-72, recorded in Proceedings of Government of 20th August 1872, I gave the cost of mossing and collecting 2,988 lbs. of dry bark from these 1,000 experimental trees at rs. 221. 13. 4., or as. 1. 2. per lb. Since that date we have collected 3,080 lbs. at rs. 312. 8. 0., or as. 1. 7. per lb. of dry trunk bark. This includes all cost for labour, moss, mossing, repairs, etc., but not the cost for superintendence. We then find that the cost of removing the 6,068 lbs. of dry trunk bark during the three years from the 1,000 trees experimented on as being as. 1. 5. per lb. of dry bark. The bark within 6 feet from the ground is removed at a trifling cost, not exceeding as. 2. 2. per tree, including all charges; but the removal of the upper strips of bark is expensive, the cost being, when the men have to use ladders and new moss, on an average as. 3. 3. per tree. This arises from the loss of time in moving the ladders from tree to tree. In future, no doubt this cost will be decreased when properly constructed planks and trestles are applied instead of the ladders now in use. The bark has been removed from these 1,000 trees to a height of between 17 and 20 feet from the ground.

	Lbs.
In 1871-72	1,174
In 1872-73	2,365
In 1873-74	2,227
Upper strips	626
	6,392

13. From the 3,000 experimental trees, which were barked at six years old and now in their ninth year of growth, we have collected 6,392 lbs. of dry stem bark, or 2·13 lbs. per tree. The branch bark from these trees has been supplied to Mr. Broughton for manufacture on the spot, and the stem bark sold in the London market.

14. By paragraph 2 of the Despatch of the Secretary of State of 16th December 1873, recorded in G. O., 2nd March 1874, it appears that the 23,646 lbs. of chinchona bark, forwarded from these plantations in July last, realised in the London market 3,490 *l.* In these sales the mossed crown bark from Dodabetta realised 2 *s.* 2 *d.* per lb. more than the unmossed bark from that plantation, and the mossed bark from Neddivuttum 10 *d.* per lb. more than the unmossed bark. This bark arrived in the London market when the prices were

were at the highest point touched since 1853. Now the price of bark and quinine is slowly but steadily decreasing. This arises from the fact that the extreme rates realised for bark during 1873 so stimulated the import from South America that it rose to upwards of 5,000,000 lbs., or more than double the quantity ever imported in any one year; the average imports for the last 30 years being one and a quarter million annually. The largest quantity imported in one year previous to 1873 was a little more than two and a half million pounds. These facts appear to indicate (contrary to general received opinions) that the bark supply of South America has not in any way become exhausted, but, on the contrary, is capable of being extended to an unlimited degree when the prices are sufficient to incite the cascarilleros to indent extensively on what appears to be an unlimited supply of bark in the natural Peruvian forests.

15. A very important variety of chinchona (*C. Pubescens*, Howard) has been discovered among the various varieties which we have hitherto termed hybrids. In 1871 I directed the attention of the Government quinologist to this hairy-leaved variety, and to another of the same habit and nearly allied, but with smooth leaves, both being remarkable for their rapid growth and hardy constitution. They stand wind well, which is of great advantage, as wind is very injurious to chinchona cultivation on the Nilgiris. They also yield a thick bark, and are altogether most promising varieties. Mr. Broughton informed me that the yield of quinine in this bark was unsatisfactory, and at paragraph 12 of that gentleman's report, recorded in G. O. of the 26th September 1871, remarks: "Since that time I have made numerous analyses of the bark of various hybrids that I have observed, but in no instance have I found any of special excellence. In fact, it appears to me that these hybrids combine the bad qualities of both their parents." These results caused me for a time to suspend further inquiry into the value of these barks. In December 1872, together with a number of other kinds of bark, I forwarded to Dr. De Vrij a sample of the barks in question, and that gentleman obtained from the hairy-leaved variety the enormous quantity of 10·67 per cent. of total alkaloids, of which 4·72 per cent. was crystallised sulphate of quinine. In order further to test the value of this variety, I sent to Mr. Howard a sample grown on a different soil and exposure for commercial analysis, which that gentleman very kindly undertook. The results obtained by Mr. Howard were still more favourable, and I quote at foot,* from his letter of 20th February 1874, the opinion of this eminent quinologist with reference to this species which he has named "pubescens." It is also worthy of notice that Dr. De Vrij found the smooth-leaved hybrid above referred to, to give 6·05 per cent. of total alkaloids, of which 2·97 per cent. was crystallised sulphate of quinine; therefore, this variety is also of great value for its quinine-producing qualities, although much inferior to *C. Pubescens*, while in vigour of growth and hardy constitution it is simply its equal. A piece of land is now being prepared to form a small plantation of *C. Pubescens*.

16. A quantity of farmyard manure has been collected for application to the trees of *C. Officinalis* on the Dodabetta and Neddivuttum plantations. The manure supplied by Messrs. McMeikan & Co., of Melbourne, was applied last year to 355 plants of *C. Officinalis* on the Dodabetta plantation, each alternate row being manured with farmyard manure, in order that the difference may be recorded. As yet there is no indication of any difference in the condition of the plants, and it is probably too early to expect any; a detailed account of the action of different manures will, therefore, be forwarded hereafter.

17. Appended is a table giving the results of the expenditure on the plantations from 1860 to the 31st March 1874, a table of income and of the rainfall at Neddivuttum. Also a table showing the number and date of plants placed in permanent plantations.

18. There has been no change in our establishment during the year, and it affords me much satisfaction to be able to state that I have every reason to be satisfied with the zeal and ability displayed by all my assistants; especially by Mr. Rowson, the assistant superintendent at Neddivuttum, Narrainswamy Naidoo, in charge of Dodabetta, and Mr. McNair, the office manager.

19. In

* "In reply to yours of the 20th December, I have to congratulate you on the discovery of the hairy-leaved variety of the *C. Officinalis* which is clearly a great success. We make the contents of the bark of the individual tree growing at N.E. exposure to be a little better than that examined by Dr. DeVry at the N.W. exposure, but it is possible that if tried by the same person the difference would be not much.

"That sent me gives the following astonishing result:—

Sulph.	Quinine	6·00
„	Chinchonidine	5·00
„	Chinchonine	·60
„	Amorphous	·60
		12·20

"Very accurate testing would doubtless diminish a little the quinine and increase the chinchonidine, so that it might be *safer* to divide the 11 per cent. between them; but even with this deduction it is clear that you have an extraordinary bark, and one which, with its good qualities, throws the *C. Mirabilis* (Angustofolia) quite into the shade."

Chinchona Plants permanently planted out, Dates of planting, and Number of Acres by base and surface measurement under cultivation of the Government Plantations on the Nilgiris.

DATE.	Total Number Species of Chinchona Plants Planted.							Denison, Kilgraston, and Napier Estates, Neddivuttum.						
	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	Total.	Acres.	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	Acres Surface.	Acres Base.
1862–63	18,550	12,500	500	3,100	350	35,000	63	4,200	12,000	500	3,000	300	–	–
1863–64	20,432	7,700	1,000	2,500	–	31,632	55	16,000	4,700	1,000	1,500	–	–	–
1864–65	56,700	38,500	–	3,512	–	98,719	99	10,000	23,500	–	2,500	–	–	–
1865–66	45,500	34,020	–	–	–	79,520	80	2,000	22,720	–	–	–	–	–
1866–67	67,000	77,000	9,200	3,140	–	156,340	156	5,000	49,000	8,000	1,140	–	–	–
1867–68	150,701	163,800	9,600	14,000	1,600	339,701	340	15,000	94,800	6,200	9,000	–	–	–
1868–69	65,000	77,945	7,700	2,500	–	153,145	153	20,000	72,000	7,700	2,500	–	–	–
1869–70	84,995	168,473	–	–	899	254,367	254	3,550	70,680	–	–	–	–	–
1870–71	–	–	3,500	–	–	3,500	2	–	–	3,500	–	–	–	–
1871–72	700	–	2,750	–	800	4,250	5	–	–	2,750	–	–	–	–
1872–73	5,961	–	–	–	7,894	13,855	15	–	–	–	–	–	–	–
1873–74	15,743	–	–	–	4,686	20,429	–	–	–	–	–	–	–	–
	531,282	579,938	34,250	28,759	16,229	1,190,458	1,244	75,750	349,400	29,650	19,640	300	455	371·2

DATE.	Dodabetta.							Wood and Hooker Estates, Pykara.						Stanley Estate, Mailcoonda				
	Crown Barks.	Red Barks.	Yellow Barks.	Grey Barks.	Other Species.	Acres Surface.	Acres Base.	Crown Barks.	Red Barks.	Grey Barks.	Other Species.	Acres Surface.	Acres Base.	Crown Barks.	Red Barks.	Other Species.	Acres Surface.	Acres Base.
1862–63	14,350	500	–	100	50	–	–	–	–	–	–	–	–	–	–	–	–	–
1863–64	2,432	–	–	–	–	–	–	2,000	3,000	1,000	–	–	–	–	–	–	–	–
1864–65	32,000	–	–	–	–	–	–	14,700	15,000	1,019	–	–	–	–	–	–	–	–
1865–66	39,000	–	–	–	–	–	–	4,500	11,300	–	–	–	–	–	–	–	–	–
1866–67	55,000	–	1,200	–	–	–	–	7,000	28,000	2,000	–	–	–	–	–	–	–	–
1867–68	105,000	–	3,400	–	1,600	–	–	25,701	54,000	5,000	–	–	–	5,000	15,000	–	–	–
1868–69	40,000	–	–	–	–	–	–	–	–	–	–	–	–	5,000	5,945	–	–	–
1869–70	49,048	–	–	–	–	–	–	18,297	78,483	–	–	–	–	14,100	19,310	899	–	–
1870–71	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1871–72	–	–	–	–	800	–	–	700	–	–	–	–	–	–	–	–	–	–
1872–73	1,000	–	–	–	500	–	–	4,961	–	–	7,394	–	–	–	–	–	–	–
1873–74	–	–	–	–	–	–	–	15,743	–	–	4,686	–	–	–	–	–	–	–
Total	337,830	500	4,600	100	2,950	378	287·25	93,602	180,783	9,019	12,080	336	243	24,100	40,255	899	75	428

Order of the Madras Government thereon, 2nd September 1874.

From the Report of the Superintendent of Chinchona Plantations it appears that upwards of 20,000 young trees were planted out in 1873–74, and that more than three-fourths were of the valuable variety *C. Angustifolia.*

The superintendent calculates that up to the 1st April last 1,190,458 plants had been planted out in the plantations.

2. The season was exceptionally unfavourable owing to lengthened drought and severe frost. During the year 91,773 lbs. of green bark were supplied to the manufactory at Neddiwattam, and 23,646 lbs. of dry bark were sent to England. A small amount of the bark was collected from three plots of trees which were coppiced after selection by the Government quinologist, but the bulk was harvested under the mossing process.

The superintendent makes certain calculations as to the cost per pound of thus collecting the bark; but he does not give the data upon which they are based, nor state whether they refer to the Neddiwattam or other estates. In future reports these points should be noticed in full detail, as the cost of collecting moss and other items must vary in different localities.

3. The bark sent to England was sold for 3,490*l.*, or nearly 3*s.* per lb. on an average; it is noted that the prices realised must be considered exceptional, and were due to the bark arriving at a time when it was in special demand. Mossed bark, it is observed, realised considerably more than unmossed bark.

4. The Government are pleased to learn that a new variety of chinchona, which has been discovered on the plantations, promises to be even more valuable than the *C. Angustifolia* which has hitherto yielded the best analytical results. The attention of the Government quinologist should be again called to this variety on his return, and after submitting its bark to a series of careful analyses he should report the result.

5. The results of the year are satisfactory, and reflect great credit on Mr. McIvor.

— No. 38. —

Report on the Number, Distribution, and Condition of Chinchona Plants on the *Nilgiris* for the half-year ending 31st July 1874.

Number of Species.	Botanical Names.	Commercial Names.	Number of Plants.	Value per lb. of dry Bark in the London Market.
				s. d. s. d.
1	C. Succirubra	Red bark	1,215,963	2 6 to 8 9
2	C. Calisaya C. Calisaya var. Frutex C. Calisaya var. Vera	Yellow bark	54,881	2 10 to 7 –
3	C. Officinalis C. Officinalis var. Condamenia C. Officinalis var. Bonplandiana C. Officinalis var. Crispa	— Original loxa bark Select crown bark Fine crown bark	— 1,183,159 87,509 4,355	— 2 10 to 7 – 2 10 to 7 – 2 10 to 6 –
4	C. Lancifolia	Pitayo bark	279	1 8 to 2 10
5	C. Nitida	Genuine grey bark	2,786	1 8 to 2 9
6	C. species without name	Fine grey bark	8,500	1 8 to 2 10
7	C. Micrantha	Grey bark	46,730	1 8 to 2 9
8	C. Peruviana	Finest grey bark	3,389	1 8 to 2 10
9	C. Pahudiana	Unknown	425	Unknown.
10	C. lanceolata-leaved variety of C. Officinalis.		15,085	- ditto.
11	C. Pitayo, raised from imported seeds.		25,896	- ditto.
12	C. Pitayo plants brought out by Dr. Simpson.		76	- ditto.
	Total Number of Plants		2,649,033	

Table showing the Growth of the different Species of Plants planted out in the Plantations for the half year ending 31 July 1874.

Number of Plants.	Where planted.	Species.	When Planted.	Maximum Growth.	Average Growth.	Height of the Tallest Tree.	Girth near the Ground.
				In.	*In.*	*Ft.*	*In.*
12	Neddivuttum	C. Succirubra	30 Sept. 1862	11	4¾	32¾	28½
12	Neddivuttum	C. Micrantha	30 Sept. 1862	7	2¾	31	32½
12	Dodabetta	C. Officinalis	30 Sept. 1863	18	10¼	25½	18

Table showing the Propagation and Distribution of Plants and Seeds during the half-year ending 31 July 1874.

DATE.	Total Number of Plants Propagated.	Total Number of Plants Permanently Planted out.	Total Number of Plants Distributed to Private Individuals.	Total Quantity of Seeds Distributed.
				Oz.
February 1874	380	–	–	9
March 1874	1,260	–	–	8
April 1874	—	—	—	—
May 1874	780	–	–	1
June 1874	540	–	8,000	2
July 1874	700	–	32,100	—
Total	3,660	–	40,100	20
Previously	2,645,373	1,190,458	194,431	449½
Grand Total	2,649,033	1,190,458	234,531	469½

Remarks.

The number of plants propagated during the past half-year is 3,660, viz., 3,360 of *C. Angustifolia* (*var.* Lanceolata) and 300 of *C. Pitayensis.*

Forty thousand one hundred chinchona plants have been issued to the planters in Ouchterlony Valley and Wynaad.

Twenty ounces of chinchona seeds have been supplied to the public.

Six hundred and eighty lbs. of green tea leaf have been furnished to Major Jennings.

Three thousand and forty-seven lbs. of trunk and 34,488 lbs. of branch bark have been supplied to the Government Quinologist since April last for the manufacture of amorphous quinine.

Ootacamund, 3 September 1874.

ORDER of the Madras Government thereon, 25 September 1874.

Ordered to be forwarded to the Secretary of State, to the Supreme Government, and other governments in India, to the superintendent of the chinchona plantations in Java, and to Mr. W. F. M. Dennison, Batavia, Java.

2. A copy will also be laid on the editor's table.

— No. 39. —

(No. 3—Revenue.)

From the Secretary of State for India to the Government of Madras.

My Lord, India Office, London, 28 January 1875.

Para. 1. I have received and considered in Council your Excellency's Despatch, dated 30th October (No. 25) 1874, forwarding the Report on the Nilgiri Chinchona Plantations for the year 1873–74; but I am not yet in receipt of the detailed report on the results of the alkaloid manufactory, with regard to the quantity produced, the price, the efficacy of Mr. Broughton's preparation, and the extent to which it has been used by the Government Departments and by the public.

2. The best method of harvesting the bark is still undecided, and it is important that both the mossing and the coppicing systems should have a fair trial, in order that a definite conclusion may be reached after careful scientific investigation. Yet I observe that only a small amount of bark has been collected from coppiced trees, while the bulk was harvested under the mossing process. I shall be glad to be informed why, so early as in July 1871, the supply of bark for the alkaloid manufactory was ordered to be obtained by mossing, while, contrary to the advice of the quinologist, the coppicing system has been tried to so small an extent. If, as Mr. Broughton reports, the appearance of the alkaloids in the renewed bark is attended with a considerable impoverishment in the alkaloid content of the old bark remaining on the tree, it is a very serious matter that so large an extent of the plantations should have been given up to the mossing system.

3. I think it necessary to request the serious attention of your Excellency's Government to the importance of not allowing either plan to preponderate until a really decisive conclusion has been reached with regard to their respective merits.

4. I desire that copies of any report that may have been made by Dr. Bidie, after his examination of the plantations, may be transmitted to me, together with the report, already called for, on the manufacture of the so-called amorphous quinine.

I have, &c.,
(signed) *Salisbury.*

— No. 40. —

(No. 6—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Marquis, Ootacamund, 9 March 1875.

IN a Despatch from your Lordship's predecessor, dated the 16th December 1873,* information was asked for with reference to the cost and efficiency of the "so-called Amorphous Quinine" manufactured on the Nilgiris under the supervision of the Government Quinologist, and to its influence in reducing the indents for quinine and other alkaloids, and also as to the cause of the cheaper alkaloids being indented for in very small quantities.

* Revenue No. 42

2. We have now the honour to forward two reports from the Government Quinologist detailing his mode of manufacture and his estimate as to the cost of the product, together with a report from the Surgeon General showing the quantities issued and the results obtained where its efficacy was tested.

Dated 1st December 1873, and 14th March 1874, recorded in G.O., 1st April 1874.
Proceedings of Government, 9th March 1875.

3. After the receipt of these reports, we saw reason to entertain some doubts as to the working of the factory, and therefore deputed the Commissioner of the Nilgiris and the Sanitary Commissioner to inquire and report on the cost and medicinal value of the product. These gentlemen, having visited the plantations and the factory, examined the quinologist, Mr. Broughton, and the superintendent, Mr. McIvor, and had before them the reports adverted to above, have now submitted a most valuable and lucid report which is incorporated and reviewed in our proceedings marginally noted. They have satisfactorily demonstrated that, while the present prices of chinchona bark obtain, the local product is being manufactured at a considerable loss, and that its commercial value is less than one-half the value of the raw material and manufacturing charges, the value being less than 1,500 *l.* and the cost rather above 3,000 *l.* They state that its efficacy as a febrifuge is undoubted, and this is supported by the record of cases treated with it, submitted by the Surgeon General; but they also show that, as at present prepared from different barks, it is "always varying in composition," and the process of manufacture does not extract from the bark a yield at all approximating to the estimated amount, as calculated by analysis of samples of the bark used.

Proceedings of Government, 22nd June 1874, with Proceedings of Government, 15th December 1873.

Dated 11th February 1875.

4. As, therefore, it appears to be conclusively shown that the manufacture is being carried on at a very serious loss to the public revenue, we have directed it to be for the present wholly discontinued, and now forward all the papers for your Lordship's information.

5. We especially desire to call attention to paragraphs 9 and 53—57 of the joint report. In the former it is suggested that information as to the buyers of the bark sent to England might, in future, be advantageously communicated; and, in the latter, it is pointed out that, while the therapeutical value of mixed alkaloids is beyond question, the framers of the British Parmacopœia, by insisting on the separation of quinine, have led to the waste of large quantities of associated alkaloids. Such a separation being unnecessary, and an important element in determining the price of the recognised febrifuge, we would support the recommendation that a reference should be made to the Royal College of Physicians, with a view to obtaining their influence in support of the recognition of some preparation of mixed chinchona alkaloids, which shall be popular in form and an inexpensive but effective febrifuge.

6. On the other points noticed in the Despatch, we have to state that the use of the locally manufactured product has undoubtedly contributed to lessen the quantity of quinine and other alkaloids indented for, while the cause of what are now the cheaper alkaloids not having been used is to be found in the fact that when, owing to their therapeutical value having been established, indents were made for supplies, "the prices charged in the case of chinchonidine and quinidine were actually higher than the current rates for sulphate of quinine."

7. We shall shortly address your Lordship regarding the appointment of Government Quinologist, the present incumbent having resigned and his resignation having been accepted.

We have, &c.
(signed) *Hobart*, &c.

Enclosure 1, in No. 40.

From the Government Quinologist to the Secretary to the Government, Revenue Department, Fort St. George; dated Ootacamund, 1st December 1873.

Subject of report.

I HAVE the honour in the following pages to make a report on the manufacture of alkaloid from the Chinchona bark of the Nilgiri Government Plantations, the reasons for my adoption of that form of febrifuge alkaloid, named by the late Inspector General of Hospitals "Amorphous quinine," and the mode of preparation of that substance, together with the present results from the manufactory at Neddivuttum. In this report I will briefly recapitulate former statements and proceedings, in order that Government may have the matter fully before them.

My original instructions.

2. My instructions from the Home Government, given in September 1866, with reference to this part of my duties, are as follows (Chinchona Return, 1870, page 4), "Finally, it will be expected from the chemist that he should, through his investigations, enable Her Majesty's Government to arrive at a decision with respect to the best and cheapest method of preparing the febrifuge for use among the labouring classes of the natives of India. He will also be required to consider the question connected with the manufacture of the chinchona febrifuge for the use of hospitals and troops in India.

Alkaloids of red bark mainly not quinine.

3. Two years after my arrival in this country, I obtained, by experience, a knowledge of the advantages and defects of the chinchona species cultivated on the plantations. That of which the largest number of plants was cultivated was the *C. Succirubra*. This species has by far the most vigorous growth, and still forms the most considerable part of the plantations. Though when young its bark yields much quinine, experience shows that the amount of this alkaloid diminishes with age. The main alkaloids of this plant, however, are chinchonidine and chinchonine. In gross amount of alkaloid in its bark, this species is surpassed by few others. I became convinced from the small amount of quinine this species yields, and the difficulty with which it is obtained in a pure form, that the red bark offered the least prospect of profitable demand by the European quinine manufacturer. I have, therefore, done my best in all reports to check its cultivation, though in this respect I have been somewhat ineffectual, until too large a number had been planted. My estimate of the final low market-value of this species is quite unchanged.

Influence of reports of the Chinchona Commission.

4. The reports of the Chinchona Commissioners in this and other Presidencies have, however, conclusively shown that the other chinchona alkaloids possess a febrifuge power little, if at all, inferior to that of quinine. This conclusion, though it was fully expected on chemical and historical grounds, is of the highest importance. It was this that led me to the adoption of the bark of *C. Succirubra* as a satisfactory material for the preparation of a febrifuge which would be as effective as quinine sulphate.

Reasons for manufacturing alkaloids n India.

5. The grounds on which I have long concluded that the febrifuge employed in the hands of Government for use in India can be more cheaply prepared in this country, have already been communicated (my letter attached to G. O., No. 249, of the 7th February 1871). They are briefly these: the alkaloids are extracted with somewhat greater ease from the fresh green bark, than from dry. The necessity of drying, powdering, and the freight of the bark to Europe, is saved. The supply being in the hands of Government, allows a rougher, and, therefore, a cheaper, mode of manufacture being adopted, than is usual in Europe for the preparation of the alkaloid sulphates. Against these, there are, of course, considerable difficulties to be expected in the carrying out of any systematic process worked by natives, from the lonely situations of the plantations of red bark, and the annoyances that consequently arise in such an undertaking in a manner almost peculiar to this country.

Therapeutical considerations and results.

6. The actual chinchona bases being, of course, the active medicinal constituents in the sulphates or other salts employed as febrifuge, it was necessarily believed that the bases themselves would be as effective medicines as these salts. The considerable amount of tinctures and extracts of chinchona bark still employed in medicinal practice clearly show the efficacy of salts other than sulphates, nor, as far as I could learn, do the preparations made from chinchona bark destitute of real quinine, show any failure in febrifuge efficacy, a fact readily explained by the results of the Madras Chinchona Commission. Pure quinine sulphate contains but 73·55 per cent. of quinine. It was, therefore, believed that a preparation of the chinchona alkaloids, in the proportion that they naturally exist in the barks, which would contain about 97 per cent. of the pure bases, would admit os exactly the same medicinal doses being employed as of quinine sulphate. If there should be, for which there is no evidence, a somewhat inferior febrifuge quality in the alkaloids other than quinine, this would, it was believed, be compensated for by the larger amount of the real bases in the preparation in comparison with quinine sulphate. The report of the Medical Inspector General, attached to G.O., No. 29, of the 11th January 1871, appears subsequently to corroborate these suppositions, as he states it to be "a remedy in malarious fever, scarcely, if at all, inferior to quinine." The evidence for the belief expressed

expressed by the Government of Madras in paragraph 3 of G.O., No. 714, of the 9th July 1873, I am unacquainted with.

Methods of manufactures considered.

7. Before describing the method of preparation I have adopted for the manufacture of the chinchona alkaloids I believe it will be of service if I detail with brevity various modes of preparation which it was necessary to try and the objections that have arisen to each.

Alkaloids exist in bark as insoluble quinotannates.

8. In a report appearing in Return on Chinchona Cultivation, 1870, page 243, paragraph 54, and more fully in a memoir in Phil. Trans. Roy. Soc., 1870, I show that six-sevenths of the alkaloids in the bark of *C. Succirubra* occur in the form of quinotannates. As this salt is nearly insoluble in water, the presence of a strong acid is necessary for its decomposition and complete solution of the alkaloid. It is this circumstance which constitutes the main difficulty in the preparation of alkaloid, since, even after the tannates have been decomposed in hot or dilute solutions, they partially re-form when the same solutions become cold or are increased in strength.

Method of percolation with dilute acid.

9. A method which has actually been employed in European manufactures, and which possesses great simplicity, is the percolation of the dried and powdered bark by cold dilute acid and the precipitation of the alkaloid by caustic soda. It will be perceived that this method either compels one to forego the advantage of obtaining the bark in its fresh, green state or renders a complete preliminary crushing necessary. I, however, carefully and repeatedly tried the method. The objections to it were that a large and expensive amount of acid was necessary for the nearly complete extraction of the alkaloid, which had subsequently to be neutralised with soda, and that on a manufacturing scale only two-thirds of the total amount of alkaloid was ever obtainable, and then not by any means in a pure state. The concentration of the bulky solution by evaporation increased the latter evil. In India the utmost possible economy in the use of acid is necessary.

Crystallized sulphates of quinine and cinchonidine can be obtained by the foregoing method modified.

10 I may here state that I prepared the crystallised sulphates of quinine and chinchonidine from fresh red bark by digestion in the cold with dilute sulphuric acid and neutralization and evaporation of the extract. It was with great regret that after much trial I found it impossible to obtain more than a quarter of the total sulphates by this very simple method.

Method by heating the extract to 120° C.

11. A method of manufacture which, though I finally abandoned it, has the great advantage of not requiring the use of alcohol may be here briefly described. An extract is made by boiling the bark in the usual manner with 4 per cent of sulphuric acid. When the bark is exhausted the extracts are evaporated to dryness, and kept for half an hour at a temperature of 120° C. This completely decomposes the quinotannic acid. The solid residue is powdered, exhausted with water filtered, and the alkaloid precipitated with caustic soda. It is thus obtained tolerably pure, though one-third of the amount is lost, and much of the alkaloid is converted into the non-crystallisable isomerides.

Clark's and other methods.

12. The method of Clark and many others were also carefully and quantitatively tried, but the result led to their abandonment. Mineral oils, &c., were also experimented with to use in the place of alcohol, but without economical success.

Delondre s method.

13. The method of Delondre, which, before I came to India, had been tried by Mr. Markham (for the preparation of "quinium") was also fairly tried by me (Chinchona Return, 1866, page 218). It consists in mixing the powdered bark with calcic hydrate and water, drying and exhausting with alcohol. Nearly the whole of the alkaloid is thus obtained mixed with much resin and calcic salts, from which, however, it can be afterwards purified. The necessary preliminary fine division of the bark is a disadvantage of this process, but the most serious is the waste of alcohol which it entails, it being found very difficult to wash out the spirit from the spent bark as the latter swells up immediately water is applied. In extremely rich barks the method would be applicable, but with poor barks the great waste of spirit in proportion to the amount of alkaloid obtained renders the method quite unfit for the preparation of a cheap febrifuge. It consequently had to be abandoned, as I believe is now the case in the Havre manufactory.

Principle of method in use.

14. The method I have adopted is quite similar in principle to the usual method that, since the time of Pelletier, has prevailed in manufactories of Chinchona alkaloids. It consists in precipitating the alkaloids in an insoluble state, and subsequently separating them from the mass of impurities with which they are mixed by solution in alcohol. The method is, however, so contrived that the very cheapest materials are used and the greatest economy is practicable with those materials which are not found on the plantations. The only material of which the consumption is large is that of wood fuel, which some years ago it was believed would be furnished in any amount by the chinchona plantations by trees which had been coppiced. This, however, has not been the case, owing to the adoption of Mr. McIvor's system of mossing, respecting which I have already expressed an opinion which I need not further reiterate.

Experimental results of method.

15. The process was first tried in my small laboratory at Ootacamund, and I found that from 80 to 95 per cent. of the total amount of alkaloid in the bark was obtained by

it. If done with analytic precision, which, of course, cannot be practically carried out i a manufactory, 97·1 per cent. of that amount is obtainable, though I have never obtaine this result when working with native coolies, but only when the work was performed b myself or by my laboratory assistant.

First trials of manufacture.

16. The first product of this process, named by the late principal Medical Inspector General "Amorphous quinine," was prepared in the small experimental manufactory erected at Ootacamund, where enough was prepared from red bark grown at Neddivuttum for a fair trial of its medical efficacy. The results of its medical trial are contained in a report of the Principal Medical Inspector General attached to G. O., No. 29, of the 11th January 1871, which was considered highly favourable.

Description of method now employed. Extraction of bark.

17. I will now describe the method of manufacture I have adopted, which though in the course of work has been constantly modified and improved, is, of course, susceptible of further improvements in detail.

The bark, in long strips, exactly as taken from the tree, is placed in a copper pan with 1½ per cent. of sulphuric acid* and a quantity of water that has already been used for the fourth extraction of nearly spent bark boiled for an hour. The liquid and bark are then separated by a strong pressure in a screw press, the former falling in a wooden vat placed underneath. The squeezed and nearly dry bark is again boiled with liquid that has been used for a third boiling of other bark and another half per cent. of acid is added. After an hour's boiling it is again squeezed; it is then again boiled with a liquid that has come off nearly spent bark, again squeezed, and finally boiled with water. During these four boilings, the bark, after each squeezing, diminishes greatly in bulk, and becomes almost pulp, so that it occupies far less room in a pan at the third boiling to what it did at the first. The order in which the several liquids used in extraction are employed depends on the qualities of bark under manufacture; but it is so arranged as to obtain finally a liquid containing as much alkaloid as possible in solution, and also that, as far as possible, the bark should be exhausted of alkaloid. Finally, there arrives a point when the amount of alkaloid in the bark has become so small as not to repay the expense of further extraction. The bark then is dried in the sun, and used as fuel.

Precipitation of extracts with lime.

18. The liquid, which, if the foregoing be judiciously managed should be intensely bitter and strong, is evaporated to about one-sixth of its bulk, transferred to a tub, and allowed to cool. It is then decomposed by neutralization with milk of lime which precipitates the alkaloids, decomposing the quinotannates and sulphates with formation of insoluble lime salts. A slight excess of lime is always added. After standing for a day the precipitate is separated by filtration, squeezed, dried, and powdered in a common ragi mill. The liquid, which contains abundance of calcic quinate in solution, is thrown away.

Evaporation was at first dispensed with. Necessity for the use of lime.

19. As first conducted, the evaporation mentioned in the foregoing paragraph was omitted, the precipitation being at once performed in the original liquid. But, as alkaloid is unfortunately slightly soluble in lime-water, this proceeding was found to produce considerable waste, and therefore it was found necessary to evaporate in order to reduce this waste to a minimum. In India lime must necessarily be the precipitant as it is by far the cheapest of all the alkaline bases. I have tried both English caustic soda and Indian soudoo as precipitants of the alkaloid, but for many reasons do not now employ them.

20. The powdered lime precipitate is then packed in the apparatus, of which a drawing is given, ABCD, being a large cone of sheet-iron, through the centre of which passes an upright tube, the upper end of which terminates in a cross-piece with four openings. The lower end of the tube is also open and supplied on a flat perforated circular disk (CD) made of sheet-iron. This allows it to rest in the cone. Below, and tightly fitting to the lower part of the cone, is an under copper vessel (FG). The cone is supported by chains, and above it is placed in connection with the lower end of a simple worm-tub (not shown in the drawing) by means of a tube (H). The powdered lime precipitate is filled in the cone till immediately under the cross tube (E). The upper lid of cone is fitted on and alcohol poured on till, by passing through the precipitate, the lower vessel becomes about a third full. The spirit is then saturated with alkaloid, which is neutralized with care by diluted sulphuric acid of which the strength is known. Then the upper lid of the cone is put into connection with the upper condenser by the tube E, and a fire is lighted below. The spirit boiling in FG rises in vapour through the inner tube, and passes out at the four openings of the cross-piece. It here generally condenses to a liquid, but if not, it passes into the copper condenser, where it, of course, condenses, so that by a judicious arrangement of the fire a layer of liquid is kept on the surface

Proceedings employed to exhaust with alcohol.

* This is the amount of acid employed for *trunk* bark, for *prunings* but one per cent. or even less is ordinarily used.

surface of the precipitate. A gauge (BI) allows this to be seen from the outside. If the fire is, however, kept too fierce, no harm can ensue, since, if the layer of liquid rises in consequence higher than the percolation through the precipitate removes it, it simply passes down through the centre tube into the lower vessel. Hence the apparatus is self-acting, and the cooly workpeople have no connection with the alcohol, which is all inside the apparatus. A small amount of alcohol by constant circulation through the apparatus thus completely dissolves the whole of the chinchona bases without any waste of spirit or alkaloid. Every two days the alkaloid is neutralized with dilute acid. If this be done with moderate care there is no chance of the copper under vessel being in the least attacked, but if very carelessly done a mere trace of oxide of copper is dissolved. This, however, rarely occurs; but, if it does, it is readily remedied subsequently.

Recovery and actual waste of alcohol.

21. The fire is thus kept up until the whole of the alkaloid is dissolved and passes into the lower vessel. This state of things is known by the alkalinity of the liquid in the lower vessel not increasing. But to make sure the spirit dropping from the cone is usually tested when the process draws near its end. When finished, the exhausted precipitate does not contain a trace of alkaloid, all being in the lower vessel. The lower vessel is then removed, and the alcohol separated by distillation. Water is also poured on the cone, in order to wash out the alcohol with which the precipitate is still moistened, until the latter is quite removed. The alcohol is thus nearly all recovered, and is purified for another operation by distillation. With care, waste of spirit practically does not occur, but I have been unable yet to prevent all loss of spirit from the carelessness with which every operation in this country appears more or less attended. The loss, however, has not exceeded 6 per cent., and has fallen frequently much below this.

Purification and precipitation of alkaloid.

22. The alkaloid sulphates in the lower vessel is suddenly diluted with about 10 times its bulk of cold water. This separates a considerable amount of black resin. Since the contamination of copper occurred in Bengal in the alkaloid, I have always as a precaution added a small amount of a dilute acidulated solution of sodic sulphide to the liquid. This completely removes copper if it be present, though with very moderate care it is completely unnecessary. The solution is still, however, coloured with impurities, to remove which a small amount of alkaloid is precipitated by the addition of dilute caustic soda, which carries down with it the colouring matters. The whole is then filtered through a cloth bag, and the alkaloid in the filtrate is precipitated by caustic soda, separated by filtration, squeezed, dried, and powdered. It is then "amorphous quinine." Before it leaves the manufactory as a precautionary measure it is always tested for copper.

Potash should be obtained from ashes of fuel.

23. Formerly, from the ashes of the fuel employed, caustic potash was prepared to use as precipitant instead of soda. But lately so small an amount of potash has occurred in the ashes that this has been discontinued. If the chinchona wood from coppiced trees was employed as fuel this might be again resumed and thus a further saving effected.

Why sulphuric acid is preferred for extraction of bark.

24. Sulphuric acid has been used in preference to hydrochloric acid, mainly because it is the cheaper acid. While the cost is nearly the same the effective work produced by the sulphuric acid is nearly double that of hydrochloric acid for equal weights. It has also some better qualities for transit through the tropics. The use of sulphuric acid has also some chemical advantages which I need not further particularise. With red bark there is unfortunately no fear of the sudden crystallization of quinine sulplate on the dilution mentioned in paragraph 22 as there would be with crown bark.

Alkaloid contained in the resin is not wasted.

25. The alkaloid which is carried down in connection with the precipitated resin, and in the purification by fractional precipitation, is, of course, from time to time obtained free from impurities by the obvious methods of drying and digestion with dilute acids &c. Thus obtained it is generally very pure and colourless.

Simple apparatus throughout have been preferred.

26. Throughout the whole course of manufacture simplicity of arrangement has been carried out as far as possible. The reasons for this are—

1st. That certain labour-saving appliances which are used in England would here be a source of considerable expense and are obtainable with great difficulty and delay. Until alkaloid manufacture in South India has proved itself a permanent success, I have, therefore, felt it wiser to refrain from all dispensable expenditure for apparatus for which simple substitutes could be provided.

2nd. That the simpler the apparatus the more readily are they repaired, when necessary, in India.

3rd. The intelligence of Canarese coolies on the Nilgiris is fully exercised by the simplest proceedings of manufacture, therefore any increase in their apparent complexity has to be made with a risk of loss and injury to the apparatus.

Trunk bark is only supplied at beginning and end of monsoon.

27. The whole of the trunk bark supplied to the manufactory during the year 1872-73, has been obtained under the mossing system which has virtually been adopted by the Madras Government. This method of cropping bark has the disadvantage of only permitting the supply of good bark to be furnished during the two months at the beginning and the two months that end the monsoon. Hence during that time the pressure of work is very considerable, while during the remainder of the year it is very light, so that I have

have been glad at the latter period to work with very inferior prunings, for the purpose of keeping the establishment employed, although I knew such bark could not be worked with profit.

Plantations have not supplied fuel for manufactory.

28. Though I am aware the refraining from coppicing cannot be permanent, it has had a further result for which at the commencement of manufacture I was unprepared. At that time I believed the supply of fuel from the plantation would be unlimited from the coppicing of the trees. But up to the present time, as coppicing has not been practically carried out, no fuel has been obtained from the chinchonas. The fuel hitherto employed has been furnished by the trunks and branches of trees that once formed part of the original shola on whose site the plantations were formed, and now lie among the chinchona-trees. In a short time this source of fuel will be exhausted, and is now a more costly fuel than chinchona-wood would be.

29. I will now state the results that have been obtained in the year 1872-73 in the manufacture of chinchona alkaloid and the actual cost of preparing the same.

A correction of the amount of bark supplied.

30. I should state that a more recent examination of returns has shown that the 3,613 lbs. of officinalis prunings mentioned in my annual report (paragraph 2, G. O., No. 714, of the 9th July 1873), had previously been included in the 46,440 lbs. stated as red-bark prunings, and thus were mentioned twice over. The correction will, therefore, reduce the total amount of bark supplied to the manufactory by 3,613 lbs. I correct this for the sake of accuracy, though the difference to the amount of alkaloid due is but 4½ lbs.

Superintendent's pay not charged in subsequent expenses.

31. I have the honour to give in Appendix to this report a statement of the actual expenditure subsequent to last official year that has been necessary to work up the unfinished product of that year, which was in the state described in paragraph 18, or lime-precipitate. The pay of the superintendent is not included, as during the time he has been mainly occupied in extracting fresh bark, and during the early part of 1872-73 he might have been similarly occupied in working up the lime-precipitate of the previous working season, had any remained. Every real expense has, however, been charged that has been required for the preparation of the alkaloid fit for sending to the Medical Stores, Madras. No repairs of apparatus have been required. All the resin, fractional precipitates, &c. have had the alkaloid separated in order to ascertain the true result of the work of 1872-73, so that nothing is assumed on estimate.

Amount of amorphous quinine obtained from lime-precipitate.

32. From the lime-precipitate obtained during the last official year that remained for exhaustion with alcohol 130 lbs. and 11 oz of "amorphous quinine" have been obtained. This is less than I at first expected and stated in my annual report. My estimate was founded on the amount of lime-precipitate that required treatment, the yield of which was fairly assumed to be the same as that worked up in the year. I therefore hoped that a quantity of alkaloid not very far below the theoretical amount would be obtained. I now find that lime-precipitate from poor prunings, like those worked up during the latter part of last year, contains far less alkaloid than that obtained from good bark. The extra expenditure necessary for obtaining this 130 lbs. and 11 oz. is, however, but small, being but 1 anna and 8 pies per ounce.

Theoretical yield of total bark supplied.

33. In order to determine the true total yield of the barks that were supplied in 1872-73, I have placed in Appendix the results of the many analyses that have constantly been made during the year. These have been performed, as far as possible, on a carefully selected average sample of each kind supplied. The results of this multiplied by the respective weights of the barks will express closely the total yield of the bark supplied. The total shows that 537·9 lbs. was contained in the whole of the bark. The total weight of alkaloid obtained in manufacture is 345·68 lbs.

Analytical results can never be obtained in manufacture.

34. It must not be supposed that it is possible, in manufacture, to obtain the same results as are obtained in analysis, as analytical methods of procedure cannot be carried out on large scale, even if the cost permitted. Whether manufacturers, however, compared th theoretical yield of total alkaloids in the bark worked with the actual amounts they obtai in manufacture I do not know, but there is no record of their having done so. Quinin manufacturers are only specially interested in obtaining all the quinine from the bark and would have no great care for the other alkaloids, which at the time I left Europ usually accumulated on their hands unsold. It is therefore probable that a comparison such as I have made is made for the first time. It is on this account I have been anxious to have it as complete as possible, and hence the delay in the submission of this report.

Sources of waste of alkaloid in manufacture.

35. I will indicate the sources of the loss of alkaloid which occur in the manufacture nearly the whole of which are preventible only at a greatly increased cost of labour and product:—

1st. The not quite complete exhaustion of the bark of alkaloid on first extraction with acidulated water. Usually, the bark at the end of the boilings described in paragraph 16 of this report still contains a small amount of alkaloid which another boiling

boiling and squeezing would remove. This is not now performed, as the small amount of alkaloid obtained would not repay the cost of the labour, fuel, and subsequent evaporation.

2nd. Spilling and waste of extract, and occasionally of bark itself, by the carelessness and indifference of the coolies. This is not preventible in India.

3rd. Waste of material in grinding the lime-precipitate and in final powdering of the alkaloid. This may, with care and training, be diminished, but cannot entirely be obviated.

4th. The solubility to a small extent of the alkaloid in lime-water. At the beginning of the year 1872-73 loss from this source occurred. It has since, as I have before mentioned, been prevented by the evaporation of the liquid extract of bark down to a small bulk, before the precipitation with milk of lime is performed. I cannot fairly estimate the amount of waste that has occurred from this source, but believe it will not have exceeded 20 lbs. of alkaloid.

36. As a measure of precaution I have repeatedly tested whether the lime-precipitate is completely exhausted of alkaloid by the alcohol before throwing it away, and have always found that no alkaloid is wasted by imperfect exhaustion, as might otherwise be naturally supposed.

Quinologist's pay excluded from manufactory expenses.

37. I will now state the total cost of manufacturing the alkaloid. In Appendix I give a statement of all the expenditure connected with the works for the working-up of the bark supplied during the year 1872-73. This excludes the cost of apparatus and repairs, the latter expense being, however, but small. It also excludes my own pay, as manufacturing work can go on, after once established, under the superintendent, without the necessity of a chemist's intervention. During the year my time has been more occupied with other duties than with the alkaloid works at Neddivuttum, which I visit but weekly.

Cost of manufacturing per ounce of alkaloid.

38. The total expenses, therefore, have been *Rs.* 2,823. 11. 9., and 345 lbs. and 11 oz. of amorphous quinine have been obtained. This shows that the expense of preparing each ounce has been 8 annas and 2 pies. This does not, of course, include the cost of the bark, but is that of manufacture only. This cost is within my original estimate (letter attached to G. O., No. 249, of the 7th February 1871). This estimate was framed on the assumption that 800 lbs. were manufactured, and that the bark worked had a mean yield of 4 per cent. of alkaloid when dry. The bark supplied in 1872-73 has had a mean percentage of scarcely three, on account of the large quantity of nearly worthless bark from prunings supplied during the dry weather, which frequently contained but 0·5 per cent. of alkaloid when dry. The results of manufacture on the score of cost appear, therefore, satisfactory.

Requests leave to discuss Government Order.

39. G. O., No. 714, of the 9th July 1873, does me the honour of requesting my matured opinion on the expediency of manufacturing any febrifuge in this country. Before expressing this I beg respectfully to make some remarks on paragraph 3 of the same Government Order.

Value of bark attributed.

40. In this paragraph it is accurately stated that 1 *s.* per pound may be taken as the value of (green) red bark, basing this estimate on the Despatch from his Grace the Secretary of State, recorded in G. O., No. 1,429, of the 16th October 1872, in which it is stated that (commercially dry) red bark sold at from 2 *s.* 1 *d.* to 3 *s.* 1 *d.* per pound in England. This, of course, would be the value of the dried and packed bark after conveyance home. But if the manufactory be charged English price for bark grown on the spot in India, it will follow that the febrifuge must be produced at something near the English price of quinine sulphate, or, as the Government Order states, the cost of the alkaloid will be *Rs.* 3. 9. 6. per ounce. The present English price of quinine sulphate is 9 *s.* 6 *d.* per ounce, or roughly *Rs.* 4. 12. If the Madras Government, therefore, desire the profit on the sale of chinchona-bark at the present English prices, it must not expect at the same time a febrifuge for Indian use at the price of one rupee per ounce.

Reasons why the price of red bark will decline.

41. I will again state the reasons that to me appear convincing why the present English price of red bark cannot continue. This bark, whether renewed under moss or not, is nearly unfitted for the manufacture of quinine, as it contains so little, and that litttle is difficult to obtain as crystallised sulphate. It is used for the manufacture of tincture and other pharmaceutical preparations. I am informed, on good authority, that annually 100,000 lbs. of chinchona-bark are used for these purposes in England. Without counting the Government plantations, the private plantations of the Nilgiris contain nearly a million and a half of trees of *C. Succirubra*, which will in a short time supply at least 15 times that amount annually. To this must be added the yield of the private plantations in Bengal and in other parts of the world. I cannot but conclude that with this enormous supply the price of red bark must very shortly fall in the English market, till it only just pays for the cultivation and export. It is quite possible that the employment of chinchonidine and chinchonine in medicine may hereafter give red bark a certain manufacturer's value, but much time must elapse first. At the present time the qualities of Indian red bark are scarcely known in England, but they will shortly become so. The foregoing are, therefore, the reasons, as I before stated, on which my choice of the form of febrifuge and the bark from which it is to be obtained are mainly founded.

42. But

English prices of bark incompatible with cheapness of febrifuge.

42. But for a short time to come the value of the bark attributed to it by Government will doubtless be the main influence in their estimates of the expediency of manufacture in South India. In all papers previous to G. O., No. 714, of the 9th July, it appears to be implied that the actual cost-price of the bark on the plantations should be the element of cost in that of the alkaloid. If the present prices obtained by the sale of bark in England be debited to the alkaloid manufactory for its raw material, it is quite clear that a cheap febrifuge will be impossible, and I could have positively stated this before coming to India. The profits of sale and cheapness of febrifuge cannot coexist. If all the bark whose alkaloids will finally be used in India be exported, the additional and apparently unnecessary labour of drying, packing, transport, and sale of bark will be taken, and the advantage of the control of manufacture will be sacrificed which permits a more abundantly occurring form of febrifuge to be used in India. It is for His Excellency the Governor in Council to determine whether the profit of sale of red bark in England or cheapness of febrifuge for use in India be the end to be obtained.

Manufacture to some extent must continue.

43. My matured opinion, therefore, does not differ from the one I formerly expressed concerning alkaloid manufacture in India (letter recorded in G. O., No. 219, of the 7th February 1871). But, under any circumstances, as long as Government export red bark, advantage will be found in having some means of obtaining the alkaloid contained in the bark of prunings and waste bark that is not worth carriage to England, which must always occur on the plantations in considerable quantities. Therefore, if my opinion is not held by Government, the small manufactory now established in action will still have work.

Suggests further medical report on amorphous quinine.

44. I would suggest that, if any doubt is felt of the medicinal efficacy of amorphous quinine after the original report of the Inspector General of Hospitals, recorded in G. O., No. 29, of the 11th January 1871, that a further expression of the opinion of the medical authorities on the same should be called for by Government.

APPENDIX.

Cost of Alkaloid Manufacture from the Chinchona Bark supplied during the Year 1872–73.

Description of Charges.	Cost.		
In the Year 1872–73:	*Rs.*	*a.*	*p.*
Pay of Superintendent and Coolies	1,744	8	–
Extra labour	62	15	6
Contingent expenses	102	11	6
Fuel	82	–	–
Lime	72	8	–
Carriage of alcohol and lime	33	10	9
Cost of alcohol used	90	–	–
Cost of acid sent out by India Office	407	–	–
Cost of soda	19	13	10
Subsequent Expenses:			
Cost of collecting fuel	37	3	–
Labour	56	8	6
Soda	9	13	6
Alcohol	84	–	8
Acid	6	5	–
Oil	11	9	4
Cost of powdering the alkaloid	3	–	–
Total *Rs.*	2,823	11	9

	Bark sent green as analysed.	Per Cent. Dry.	Weight of Dry Bark.	Per Cent. of Alkaloid.	Weight of Alkaloid.
Bark of *C. succirubra.*					
1 April to 20 May 1872:					
Neddivuttum, trunk	943	30	282	4·1	15·5
Ditto – prunings	10	—	—	—	—
20 May to 18 June:					
Neddivuttum, trunk	2,118	28	612	7·1	43·4
18 June to 3 July:					
Neddivuttum, trunk	3,140	29	910	—	38·2
3 July to 18 July:					
Neddivuttum, trunk	2,184	29	633	5·1	32·2
18 July to 7 October:					
Neddivuttum, trunk*	7,767	30	2,330	4·8	111·8
7 October to 16 October:					
Neddivuttum, trunk	7,357	26·8	1,971	4·3	84·7
Ditto – prunings	814	25	203	1·7	3·4
16 October to 24 October:					
Neddivuttum, trunk	2,679	25·8	691	3·5	24·1
Ditto – prunings	533	25	133	2·6	3·4
24 October to 4 November:					
Neddivuttum, trunk	3,860	27·7	1,071	4·3	46·0
Ditto – prunings	4,749	24	1,139	2·6	29·6
Pykara, trunk	958	27	258	5·0	12·9
Ditto, prunings	1,480	25	370	1·6	5·9
4 November to 21 November:					
2 Neddivuttum, trunk	24	28	6	5·0	0·3
Pykara, trunk	750	27	202	5·2	10·5
Ditto, prunings	1,486	25	317	1·5	5·5
21 November to 13 December:					
Neddivuttum, trunk	22	27	6	4·0	0·2
Ditto – prunings	66	25	16	2·2	3·5
Pykara, trunk	1,419	27	383	4·0	15·3
Ditto, prunings	4,875	25	1,219	1·1	13·4
13 December to 9 January 1873:					
Neddivuttum, prunings	1,251	25	312	1·8	5·6
Pykara, prunings	7,100	24	1,700	0·5	8·5
9 January to 10 January 1873:					
Neddivuttum, prunings	135	25	148	0·7	1·0
Pykara, prunings	450				
10 January to 27 January:					
Neddivuttum, prunings	1,671	24	1,636	0·5	8·1
Pykara, prunings	5,147				
27 January to 24 February:					
Neddivuttum, prunings	†7,603	25	1,900	0·6	11·4
Pykara, prunings					
24 February to 3 March:					
Pykara, prunings	1,890	25	472	0·5	2·3
3 March to 18 March:					
Neddivuttum, prunings	1,147	Not worked.		—	—
Pykara, prunings	2,520				
Prunings of *C. calisaya*	450	27	121	1·0	1·
Ditto of *C. officinalis*	3,613	Nearly worthless.		—	—
Total	80,281	–	19,041	79·5	537·1

* 600 lbs. from decayed trees.
† 3,613 lbs. of prunings of *C. officinalis* have here been deducted.

Enclosure 2, in No. 40.

From the Government Quinologist, Ootacamund, to the Acting Secretary to Government, Revenue Department, Fort St. George, dated 14th March 1874.

I HAVE the honour, as directed in G. O., No. 286, of 2nd March 1874, to submit a statement of the total expenditure connected with the alkaloid manufactory, the quantity of bark consumed, and the outturn of "amorphous quinine," since the year 1869.

2. In a report of December last, I had the honour to detail the full cost connected with the manufactory during the year 1872–73, and extending to the time that the manufacture of the bark supplied during that year was completed. I also, in that report, entered fully into the various reasons which induced me to adopt the form of febrifuge I have since prepared, and the various hindrances and advantages connected with manufacture in India. Of the hindrances, the most important is a purely artificial one, which is due to the Commissioner of the Nilgiris and the Superintendent of the Plantations, and not to the merits of its cause; I allude to the "mossing process," which has limited the supply of good bark to the manufactory to but four months of the year. As the objections to this method of cropping will shortly speak for themselves, I need not further discuss them.

3. The figures I have now the honour to submit are therefore those more connected with a time when the manufacture was mainly experimental. This is specially the case with the details of the Ootacamund manufactory. They should not therefore be taken as those of a constant and current manufacture. The adaptation of a manufacture of a new substance to meet a special want to the conditions of an Asiatic country necessarily renders tentative work unavoidable. A constant and regular supply of bark to the manufacture, such as might be easily rendered, would yet diminish the current cost of "amorphous quinine" to a lower figure than I have hitherto been able to reduce it. For a fuller discussion of the conditions of working and value of bark, &c., I must, however, refer to my report of December last. The bark has been almost exclusively that of *C. succirubra*, much of which has been prunings of but small value, the weights are those of the green bark. The market value of a substance like "amorphous quinine," which is in a form quite unused in European medicine, must depend on its intrinsic value. From the Report of the Medical Inspector General it appears to have perhaps the same febrifuge effect as quinine sulphate.

4. I fully coincide in the views stated by Mr. Howard in his letter accompanying G. O., No. 286, of 2nd March, with respect to the advisability of by degrees substituting chinchonidine sulphate for the quinine sulphate. This will have the ultimate effect of raising the value of *C. succirubra* bark, which otherwise will, from its large production, fall very low. I have stated this fully in my report of December 1873. From information I have gathered from medical officers in this country, I am convinced that there is no risk of efficiency, but in some respects positive gain, in the cautious substitution recommended by that gentleman.

5. Mr. Howard also recomends that the *C. succirubra* cultivation should partially be changed for that of *C. calisaya*. I had the honour to recommend the same in my report of August 1873, attached to G. O., No. 208, of 15th December 1873, and remain entirely of the same opinion I then expressed. As the matter has been referred to the Commissioner of the Nilgiris for the opinion of the Superintendent of the Plantations, I am glad to have my recommendation corroborated by that of Mr. Howard.

6. The details I now submit are rendered briefer by the circumstance that I am preparing to leave India on the six months' leave granted in G. O., No. 102, of 23rd January, and have already commenced my preparatory leave from the 4th instant. The details, however, appear to contain all those requested by Government, and a full discussion of the question was submitted in December last.

MENT showing Expenditure incurred on the Alkaloid Manufactory during the Official Years 1869–1873, inclusive.

Description of Charges.	Cost.	Total.
AT OOTACAMUND, 1869, 1870, 1871:	*Rs. a. p.*	*Rs. a. p.*
Buildings	7,309 4 6	
Apparatus	750 12 11	
Water Supply	400 – –	
Alteration of Press	160 – –	
Alcohol	174 12 11	
Soda	20 – –	
Acid	47 – –	
Fuel	304 13 1	
Sanctioned Establishment	2,108 5 7	
Contingent Expenditure	459 3 2	
		11,735 – 2
AT NEDDIVUTTUM, 1871, 1872, 1873:		
Adapting Convict Jail for a Manufactory	1,626 11 –	
Erecting Cone-sheds	4,600 – –	
Apparatus	2,441 11 3	
Ditto, carriage of	184 2 3	
Alcohol	689 6 5	
Ditto, carriage of	88 4 5	
Weighing Machine	80 – –	
Bark-presses	1,075 – –	
Acid	514 1 –	
Soda	162 13 4	
Quicklime	100 – –	
Cart-hire	406 12 3	
Vats	54 – –	
Sanctioned Establishment	2,792 2 11	
Extra Labour	134 3 2	
Contingent Expenditure	497 0 6	
Arbuthnot & Co., for landing charges, &c.	25 1 –	
		15,471 5 6
Total	*Rs.*	27,206 5 8

BARK SUPPLY AND OUTTURN.

		Lbs.	
OOTACAMUND MANUFACTORY	1869–70:		
	Bark supplied	17,793	
	Out-turn:		
	Amorphous quinine	21¼	
	1870–71:		
	Bark supplied	51,352	
	Out-turn:		
	Amorphous quinine	127	
NEDIVUTTUM MANUFACTORY	1871–72:		
	Bark supplied—		
	Trunk	22,243	
	Prunings	12,829	
			35,072
	Out-turn:		
	Amorphous quinine		100
	1872–73:		
	Bark supplied—		
	Trunk	33,841	
	Prunings	46,440	
			80,281
	Out-turn:		
	Amorphous quinine		215
	Amorphous quinine from the same bark		130¼

Enclosure 3, in No. 40.

From the Surgeon General of Hospitals, Indian Medical Department, Fort St. George, to the Acting Secretary to Government, Revenue Department; dated Fort St. George, 28th April 1874.

WITH reference to paragraph 2 of Government Order, No. 286, of 2nd March 1874, I have the honour to submit, for the consideration of the Right Honourable the Governor in Council, the following remarks on the points raised by Her Majesty's Secretary of State for India, with regard to the use of quinine, chinchonidine, quinidine, chinchonine, and of amorphous quinine in this presidency.

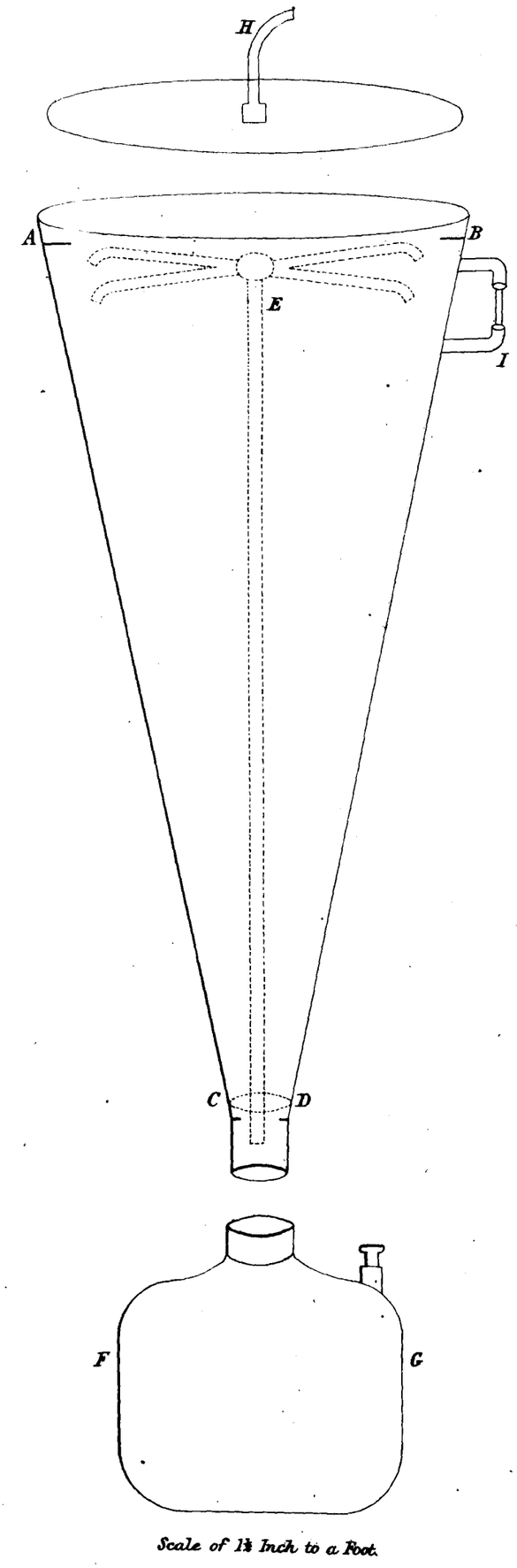
2. In paragraph 7 of this Despatch, the Secretary of State expresses surprise that the valuable reports of the Chinchona Commission of this presidency should have borne so little fruit in the way of encouraging medical men to use the other alkaloids in lieu of quinine; and, with reference to this, I beg to explain that in the year 1868, immediately after the Chinchona Commission's report established the therapeutical value of the sulphates of chinchonidine and quinidine, the price charged for each of these articles was no less than 4 *l.* per pound at a time when quinine was being purchased at 3 *l.* 4 *s.* per pound. On my predecessor becoming aware of this, he omitted chinchonidine and quinidine altogether from his next annual indent, and observed that "quinine has been indented for in consequence of the Examiner of Medical Accounts having intimated that, according to the price-list received by him, it is cheaper than any of the new alkaloids except chinchonine." The omission of these alkaloids from the 1869 indent, of course, reduced the established proportion, which, in turn, diminished the issues in succeeding years, and thus the demands for these articles have fallen off. But, whilst the high price of the alkaloids prevented their being indented for, it is proper to say that the profession generally have not acquired the same confidence in chinchonidine, quinidine, and chinchonine that they have in quinine, and this feeling has also contributed to decrease the demands for the articles in the home indents. Like all other new remedies, it will take time to establish their reputation, more especially as they have to take the place of the well-known quinine. Medical men may have a certain amount of confidence in their therapeutical value, and yet hesitate, in critical cases, to use them in preference to quinine, in which they have, from prolonged experience, the fullest reliance. A few officers, indeed, have little or no faith in the febrifuge properties of quinidine, chinchonidine, and chinchonine, and object to use them under any circumstances, though the results of the trials carried out under the auspices of the Chinchona Commission, and subsequent experience, leave no doubt that these preparations will, in course of time, occupy a much higher place in the list of febrifuges than has hitherto been accorded to them by the profession generally. The remedies must, however, be allowed to work their way on their own merits into professional favour.

Price of Chinchona Alkaloids, as given by Examiner of Medical Accounts.

	Rs.
Sulphate of quinine -	32
„ quinidine - -	40
„ chinchonidine -	40
„ chinchonine -	12

3. I consider the suggestion of Mr. Howard to encourage the use of chinchonidine a most valuable one, and if, as he believes, it could ultimately be sold in Indian bazaars at one rupee per ounce, the boon to the fever-scourged people of this presidency would be simply inestimable. The total deaths from all causes registered in the Madras Presidency during 1872 were 508,182, and of these no less than 214,149 are attributed to fever. From this death-roll can be estimated the amount of fever cases not fatal, and of other diseases which fevers have called into existence, and from which the sufferers ultimately die. There is no popular want so pressing at the present moment, as that of a cheap chinchona febrifuge, as I firmly believe that a vast amount of sickness and suffering, of which nothing is heard, and 50 per cent. at least of the deaths which now take place from fever, would be prevented by such an agent. I am further of opinion that chinchonidine would fully meet this want, if supplied in sufficient quantity and at a low price, say one rupee per ounce. At this rate, a poor man could for one anna obtain 27 grains of the drug, which, in ordinary cases, would probably be sufficient to cure an attack of fever. Considering, however, the very scant means and even poverty of a large body of the people, even one rupee the ounce is a high price if this drug is to become a febrifuge within the reach of the masses; and it is proper to mention here that I entertain grave doubts as to chinchonidine ever being supplied at that rate even in Great Britain, putting aside freight and other charges which would be incurred before it reached Madras. Rich bark would probably yield more than 4 per cent. of the alkaloid, if so much, so that it would require more than 1¼ lbs. of bark to get one ounce of alkaloid. Assuming, then, that such rich bark could be purchased at 18 pence per pound, it will be seen that the cost of the bark alone would exceed the price at which it is proposed to sell the alkaloid.

4. With regard to the therapeutical value of chinchonidine, I need only quote the opinion of the Chinchona Commission, who say that "ordinary sulphate of quinine and sulphate of quinidine possess equal febrifuge power," and that "sulphate of chinchonidine is only slightly less efficacious." If, therefore, Mr. Howard's anticipation as to the price of chinchonidine could only be realised, there would be no doubt about the propriety of making it the febrifuge of the future for the people of India. I must not



Scale of 1½ Inch to a Foot.

omit to notice one advantage that it possesses, viz., its great resemblance to quinine, both in appearance and taste. The latter drug has now become quite familiar to the great bulk of the people, and it is of no little importance that the new article should resemble it in all points as nearly as possible. In fact, a great many would look on chinchonidine sulphate as an old friend with a new name.

5. In the 6th paragraph of his Despatch, the Secretary of State notices that latterly the indents for quinine and other chinchona alkaloids from Madras have been smaller than the demands from Bombay, although the latter is the lesser presidency, and wishes to know whether the reduction in demand is due to the use of Mr. Broughton's local manufacture. In answer to this inquiry, I have the honour to mention that the issues of the Nilgiri preparation from 1870, the year of its introduction, to March 1874 inclusive, have been as per margin, and there can be no doubt that they have reduced the consumption of the European preparations to an extent commensurate with the total quantities used of the local manufacture. It will be observed that the issues during 1873 were considerably less than in the two preceding years. This was chiefly due to the available stock of the "amorphous quinine" having been reduced by the transmission in the course of the year of 160 lbs. in two instalments to Calcutta, and 50 lbs. to Bombay. The first supply to Calcutta was forwarded in February 1873, to meet a demand for chinchona alkaloids during the outbreak of Burdwan fever; and as a subsequent demand was made in September 1873 for another supply of the local preparation, it is legitimate to infer that the drug had been found efficacious in the treatment of the severe type of fever which was then ravaging that part of Bengal, and a further supply of 80 lbs. has since been sent to Calcutta in January 1874.

		Lbs.	*oz.*
1870	Issues	8	6½
1871	ditto	89	10
1872	ditto	85	10
1873	ditto	30	2
1874	ditto	10	12
TOTAL		224	8½

6. In paragraph 5 I have given a statement of the annual supplies of the Nilgiri "amorphous quinine" furnished to the Medical Department, and it now only remains to notice, in compliance with the request in paragraph 5 of the Secretary of State's Despatch, "the quantity that has been sold to the public, with the price, and the judgment that has been formed with reference to its efficacy;" I therefore place in the margin a statement showing the issues that have been made to hospitals and to civil authorities, for sale and gratuitous distribution, during each year since its first introduction. From the statement given in this and the preceding paragraph it will be gathered that the total supplies of the Nilgiri preparation sent to the Medical Store Depôt, Madras, have been disposed of as follows:—

	Lbs.	*oz.*
To Calcutta	210	0
„ Bombay	80	0
„ Military Hospitals in this presidency	33	8½
„ Civil „ „	58	8
„ Collectors for sale and gratuitous distribution in this presidency.	132	8
TOTAL	514	8½

	Lbs.	*oz.*
1870:		
To Military hospitals	0	0
„ Civil hospitals	8	6
1871:		
„ Military hospitals	20	10
„ Civil hospitals	21	0
„ Collectors for sale and gratuitous distribution	48	0
1872:		
„ Military hospitals	6	0
„ Civil hospitals	8	10
„ Collectors for sale and gratuitous distribution	71	0
1873:		
„ Military hospitals	6	12
„ Civil hospitals	13	14
„ Collectors for sale and gratuitous distribution	9	8
1874 (three months)		
„ Military hospitals	0	2
„ Civil hospitals	6	10
„ Collectors for sale and gratuitous distribution	5	0
TOTAL	224	8½

The greater portion of the issues in this presidency has been to collectors for sale and gratuitous distribution, and steps will now be taken to ascertain the respective quantities which have been sold and distributed gratis. It will be observed that the supplies sent to Calcutta for use in the Burdwan district exceed the total consumption in this presidency. The rate at which amorphous quinine is sold to the public is *Rs.* 1·8 per ounce, that price having been fixed in Government Order, No. 710, of 20th April 1871, in communication with Mr. Broughton. In paragraph 38 of this officer's report in Government Order, No. 408, of 1st April 1874, it is stated that the expense of making each ounce of the amorphous preparation is now only 8 *a.* 2 *p.*; and as there is used in the manufacture a good deal of bark which in Europe would be commercially worthless, this should be considered when calculating the cost, and the selling price might now be reduced at least to half-rupee the ounce, which will probably be found a remunerative rate, and thus the benevolent intentions of Government, with regard to supplying a cheap febrifuge for the country at large, would be in a measure met.

7. It now remains to notice the judgment that has been formed by the Medical Department with reference to the efficacy of the amorphous preparation as a febrifuge. With a view of submitting it to a rigorous test, small quantities of the drug have been, from time to time, supplied to civil and military hospitals, some of which are situated in notoriously malarious districts. At the same time, blank forms, similar to those used by the Chinchona Commission, were issued for the tabulation of results, so that the qualities of the febrifuge might be subjected to the logic of figures. I append a table showing the results of the whole of these trials. Altogether 1,882 cases were treated with the drug, and of this number 1,711 were of the quotidian, 128 of the tertian, 34 of the quartan, and nine of

the remittent type. There was thus in the variety of type ample scope for a searching test of the febrifuge powers of the new preparation, while, on the other hand, the fever met with in some of the districts in which the experiments were conducted is of a most obstinate character, and very frequently accompanied with dangerous complications. To these latter peculiarities in the nature of the fever at Lackady in Wynaad are to be attributed partly the great length of time the patients were under treatment and the large consumption of the febrifuge. On the whole, the results are favourable, and, but for the Lackady figures, they might have been pronounced very satisfactory. Out of the 1,882 cases that came under treatment, it will be observed that in only four instances did the drug fail to effect a cure. In one case the final result was not known, as the patient did not return after the first dose. The average time that each patient was under treatment was 13·2 days, and the average quantity of the drug administered from first to last in each case 162·3 grains. These high averages are chiefly due to the Lackady figures. As already stated, fevers contracted in that neighbourhood are very obstinate, and often complicated with other affections; and it is, therefore, quite possible that the hospital assistants who conducted the experiments may have allowed cases to remain under the heading of "Fever" not only till the paroxysms were checked, but also till the complications of the disease were finally cured. Indeed, there seems no other method of accounting for the very exceptional results recorded at this place. At Goodalore, another Wynaad station, the type of fever may be said to be identical with that prevailing at Lackady, and yet the results were very different. Putting the Lackady figures aside, the remaining results show that, under the use of amorphous quinine, a cure is effected in a period nearly the same as that required by chinchonidine, quinidine, or quinine, but with a somewhat larger expenditure of the drug. In submitting the returns of results of treatment, medical officers commented (in some instances most favourably, in others less so), on the properties of this new febrifuge; but I have not deemed it necessary to transcribe these, as the tabular statement contains the pith of the whole, and will place before Government the facts from which I have formed my opinion. In conclusion, I beg to state briefly that "amorphous quinine" is a sure febrifuge but little inferior to the European chinchona alkaloids, and that if it can be sold at one rupee per ounce, or a cheaper rate, it is extremely desirable that it should be manufactured in larger quantities.

TABLE showing the Results of Treatment of Malarious Fever by the Amorphous Alkaloids prepared from Indian-grown Barks.

STATION.	Name of Medical Officer.	TYPE.					Average Time under Treatment.	Average Quantity of Drug used.	RESULT.		REMARKS.
		Total Cases treated.	Quotidian.	Tertian.	Quartan.	Remittent.			Cured.	Doubtful.	
							Days.	Grains.			
Lackady (Wynaad)	Hospital Assistant: T. Israel; C. T. Venkatroyooloo; A. Parthasarathy Pillay; T. R. Dorasawmy Pillay	566	480	57	29	–	73	1030·7	566	–	
Goodalore (ditto)	Assistant Apothecary Wade	80	68	5	5	2	2·1	24	78	*2	* Patient did not return after first dose.
Upper Godavery Barrier Works.	Assistant Surgeon Hazlett; Ditto A. E. Dalgairns	92	87	2	–	3	7·4	91·8	89	3	
Raneepett	Dr. Scudder	55	51	–	–	4	8·7	52	55	–	
11th Regiment N.I., Raepore	Assistant Surgeon C. A. Harvey	180	167	13	–	–	4·7	49·4	180	–	
South Arcot District:											
Kullacoorchy Taluq	Syed Alli Mahomed	268	232	36	–	–	4·3	19	268	–	One died.
Chengum and Trikaloor Taluqs	T. L. Thavasagayum Pillay	526	520	6	–	–	2	4·7	526	–	
Trinomalay Taluq	Syed Alli Mahomed	115	106	9	–	–	3·3	27·4	115	–	
	TOTAL	1,882	1,711	128	34	9	13·2	162·3	1,877	5	

Fort St. George, 28th April 1874.

Enclosure 4, in No. 40.

From the Commissioner of the Nilgiris, to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 14th March 1874.

WITH reference to the Government Order, Revenue Department, 15th December 1873, No. 1,428, directing me to obtain any observations the Superintendent of the Chinchona Plantations may have to offer on a report of the Government Quinologist upon the changes produced by age and growth in the chinchona-trees in the Government plantations on the Nilgiri Hills, and at the same time to submit my own remarks, I have the honour to forward a letter from Mr. McIvor on the subject.

2. Mr. McIvor has for a long time held the opinion put forward by Mr. Broughton that after a certain age the cellular tissue in bark which contains the alkaloids gives way to liber fibre, and that the further this metamorphosis extends the greater is the deterioration in the bark. A complete substitution of liber fibre for cellular tissue is, in fact, a conversion of bark into a material worthless to the quinine manufacturer. Mr. McIvor concurring thus completely with the quinologist, accepts further the statement that the bark in our oldest Succirubra plants has entered upon the course of decline; and he suggests that the bark of these trees should be harvested. There are 6,000 of them. Mr. McIvor would advocate harvesting also the crown-barks of eleven years old, on the same grounds. There are 18,000 of these trees. The deterioration of bark by age was fully discussed in Mr. McIvor's letter and in mine in Government Order, 5th September 1873, Revenue Department, No. 952, and the identical conclusions now stated detailed. But in that Order the Government were pleased to direct one-fourth of the unmossed trees of 11 and 10 years old should be preserved for coppicing until the mossing process was demonstrated to be superior. The Government remarked that the immediate loss in bark thus entailed was not of any moment. I see no sound reason for a modification of the Order at present, because circumstances have not changed since it was published, and though I agree with Mr. McIvor, I cannot recommend that the older trees shall be harvested at present in greater proportion than is expressed in the Order.

3. Mr. McIvor next touches upon the question of filling vacancies with Calisaya. He states this species is weakly, and remarks upon the fact that a plant of a weak character will not grow amongst more vigorous plants which overshadow and choke it.

4. The next point touched by Mr. McIvor is the sale of Java bark noticed by Mr. Broughton. This bark did not fetch such good prices in Amsterdam as the bark sent home from the Nilgiris last year realised in the London market. It may be objected that the circumstances of the two sales may have been different, and the higher price obtained for the Nilgiri bark not be a perfect test of its superiority. The fact, however, is that, if anything, better prices are habitually obtained for bark at Amsterdam than in London. Purchasers in London must be discriminating purchasers, because bark is invariably sold on analysis. There is no guesswork in the matter. The Government will have noticed with pleasure that even the worst barks of the 23,000 lbs. sent home last year fetched a good price. Certain crown-barks, not worth working up in Mr. Broughton's factory, realised from 2 *s.* to 3 *s.* 6 *d.* a-pound. Mr. Broughton anticipated this bark might sell fairly, though he was adverse to its shipment, as he stated in his letter in Government Order, 8th September 1873, No. 955, Revenue Department. The sales enumerated do not tend to establish a need for particular attention being bestowed on the Calisaya.

5. With regard to the views expressed by Mr. Howard upon the red barks, I quoted them in a letter, dated 7th January 1874, No. 3, I addressed Government on that subject exclusively.

6. I shall forward the samples of barks required by the 2nd paragraph of the Order under reply so soon as I receive them from Mr. Broughton.

From the Superintendent of the Government Chinchona Plantations, to the Commissioner of the Nilgiris; dated Ootacamund, 14th February 1874.

I HAVE the honour to acknowledge the receipt of Government Order, dated 15th December 1873, No. 1,428, with your endorsement of the 19th, calling for any observations I may wish to offer in connection with the subjects discussed in the papers recorded in the above proceedings.

2. The report submitted by Mr. Broughton details certain changes "produced by age and growth" in the bark of several species of chinchona, and as that gentleman's observations appear to establish and confirm the well-known and generally accepted conclusion

arrive

arrived at years ago, this part requires no remark further than bringing prominently to notice the very important fact that the "bark on our oldest trees of *C. Succirubra* has passed its age of maximum yield of alkaloid;" and I submit, therefore, that this bark should be harvested as early as possible in order to prevent further deterioration.

3. I observe that, at paragraph 14 of his report, Mr. Broughton recommends the extension of our Calisaya cultivation by filling up all failures which occur among the trees of *C. Succirubra* with plants of *C. Calisaya*. In my opinion there are several reasons which would render any attempt to carry out this system unprofitable and unsuccessful. In the first place, *C. Calisaya* is a species which has hitherto, in all the varieties yet imported and grown on the Nilgiris, given unmistakable indications of being unsuited to our climate. The plant is weak and of delicate growth. It is extremely liable to disease, and for these reasons I believe it to be the most unprofitable species to cultivate on the Nilgiris. Moreover, its weak habit of growth renders it quite unsuited to fill up failures among a strong-growing and vigorous species such as *C. Succirubra*. Its delicate constitution is another serious drawback to using the species at all for filling up vacancies, it being well known to all practical planters that successfully to establish plants in vacancies requires a more vigorous plant than that originally planted. The reason of this is plain: the established plants in the neighbourhood grow faster than *C. Calisaya*, spreading their roots and branches farther, and thus robs the weaker plant of nourishment and moisture while the branches overshade it. This even takes place when strong-growing and less vigorous species are planted out at the same time together, to such an extent that the stronger-growing invariably destroys the weaker. For the above reasons, the experienced planters would carefully avoid the selection of a slow-growing and delicate species to fill up vacancies among a strong-growing and vigorous variety.

4. In Mr. Broughton's covering letter, that gentleman further urges the adoption of this system by bringing prominently forward the fact that "certain specimens of *C. Calisaya* have sold in Amsterdam for the extraordinary prices of 8 *s.* to 9 *s.* 5 *d.* per kilogramme, or 3 *s.* 7½ *d.* and 4 *s.* 3¼ *d.* per lb.," and concludes by giving an analysis of certain Java calisaya bark as yielding 7·65 per cent. of total alkaloids and 6·91 of quinine, remarking: "This bark, therefore, is of better quality than any grown on our plantations, with the exception of var. Angustifolia." I annex to this letter the invoice and analysis in detail of these Java barks sold in Amsterdam. It will be noticed that, although four cases containing 261 kilogrammes brought the high figures quoted, the average prices realised were low.

5. I think it proper to place in juxtaposition to this list of prices obtained for Java barks the list of prices obtained for the 23,000 lbs. of bark sent home from the Nilgiri plantations last year. Our *C. Officinalis* stem-bark fetched from 4 *s.* 6 *d.* to 5 *s.* 9 *d.* per lb., and the general prices obtained were much higher than those brought by the Java barks. The price of the *C. Officinalis* would indicate, contrary to Mr. Broughton's impression, that this is better than the Java calisaya bark.

6. At paragraph 14 Mr. Broughton states: "It appears to me to have been unfortunate that chinchona cultivation should have been so greatly occupied with *C. Succirubra* at its commencement." This opinion is apparently founded on the statement given at paragraph 7, that "Succirubra appears the worst species for producing bark for export." Upon this point I beg to draw your attention to a private letter I received from Mr. Howard some time ago, and the statements in which I believe you communicated to Government. The succirubra bark in our consignment above mentioned brought us high as 3 *s.* ½ *d.* per lb.

7. At paragraph 20 Mr. Broughton brings to notice that the beneficial effects of mossing become less evident with the increased age of the tree. If this means that renewed bark on the oldest trees we possess is not so rich as renewed bark on young trees, I am not prepared to follow Mr. Broughton. My experience is that renewed bark two years old is at the best state for cropping as regards the quantity of contained alkaloids, and that this bark, speaking without formal precision, is as valuable on old as on young trees.

8. I never for a moment contemplated bark as old as the tree on which it is grown continuing to improve. I have all along acted on the knowledge that beyond a certain age, cellular tissue, which Mr. Broughton justly states contains the alkaloids, gives way to liber fibre, which the older it is the less alkaloid it must yield.

DUTCH TRADING COMPANY.

DESCRIPTION of the Parcels of Java Barks of Crop 1872, sold by Public Auction on the 27th May 1873.

CLASS.	Chests.	Kilo.	Prices Realised per 12 Kilo.	Percentage of Alkaloid variable.	Quinine variable.
Calisaya A	72	4,666	113 *c*	—	—
Ditto B	23	1,525	194 *c*	Variable	Variable.
Ditto C	3	140	116 *c*	Ditto	Ditto.
Ditto D	5	346	158 *c*	5 per cent.	Uncertain.
Ditto E	4	261	457 *c*	7 per cent.	¾
Haskarliana	20	1,358	141 *c*	4 to 5 per cent.	½ to ¾
Succirubra	5	362	115 *c*	—	—
Officinalis	8	407	201 *c*	4 per cent.	½
Caloptera	1	62	173 *c*	4 to 5 per cent.	—
Pahudiana	35	2,193	128 *c*	1 to 4 per cent.	—
Powder	29	3,519	16 *c*	—	—
Ditto	3	—	13 *c.*	—	—

Ootacamund, 14 February 1874.

CHINCHONA BARK from the Government Plantations on the Nilgiris, sold by Public Auction in London on the 11th November 1873.

Class.	Cases.	Lbs.	Price.	Class.	Cases.	Lbs.	Price.
			s. *d.*				*s.* *d.*
Crown bark	2	343	5 9	Red bark	2	314⅓	2 11
Ditto	27	6,670	4 7	Ditto	6	1,038	2 10
Ditto	2	297	4 6	Ditto	9	1,756½	2 7
Ditto	1	210	4 5	Ditto	1	238	2 6
Ditto	3	368⅓	4 –	Ditto	1	182	2 5
Ditto	2	396⅓	3 10	Ditto	2	394	2 4
Ditto	5	743⅓	3 8	Ditto	4	1,136	2 3
Ditto	1	173⅓	3 6	Ditto	1	524⅓	2 1
Ditto	2	302⅓	3 5	Ditto	1	161⅓	2 –
Branch bark	2	466	3 6	Ditto	3	271	1 4
Ditto	9	1,341⅓	2 6	Ditto	3	470	1 3
Ditto	2	308	2 4	Branch bark	7	972⅓	2 3
Red bark	2	671	3 2	Ditto	1	194	2 2
Ditto	1	166⅓	3 1	Ditto	1	161⅓	2 –
Ditto	6	1,625⅓	3 –				

Enclosure 5, in No. 40.

MINUTE by the Hon. *J. D. Sim*, C.S.I.

FROM the papers submitted it appears that we have now 6,000 trees of *C. Succirubra* which have reached the age when the yield of alkaloids begins to decrease. The fact that after a certain age this result would ensue was, as the Commissioner observes, long since noted by Mr. McIvor; and as the analyses of Mr. Howard and Mr. Broughton confirm the conclusion, so far at least as *C. Succirubra* is concerned, we may safely act on it, and proceed to harvest the bulk of the bark of these 6,000 trees before further deterioration ensues. In the Order of the 5th September 1873, No. 952, Government directed that one-fourth of these trees should be "retained for coppicing," and three-fourths treated according to the mossing system. The intention of Government was, as I understood, that the trees should be *coppiced*, and not merely *retained* for that purpose. I understand that 1,000 of the trees have been mossed. I would now suggest that 1,000 more be thus dealt with, and 2,000 coppiced, the remaining 2,000 being retained for experimental purposes; a small number being annually mossed and coppiced in equal proportions in order to test, over a long series of years, the consequences of age and the effects of each mode of harvesting on this particular species of chinchona.

2. Besides the above 6,000 succirubra trees, we have 18,000 crown-barks of 11 years' age, which it is proposed to harvest at once. As regards this species it does not seem to me that deterioration from age, at least so soon, is so clearly established that we need harvest these trees simply and solely to escape that consequence. In his letter to the Secretary of State, dated 16th January 1872, Mr. Howard says he has "no doubt that these barks will improve with age," and again that "there is no fear that these varieties of *C. Officinalis* should deteriorate with age." In another part of his letter Mr. Howard speaks of this deterioration after a certain age as "the peculiar habit of the species succirubra." Mr. Broughton cannot yet state the changes taking place in the quality of crown-barks, as they advance in age, with the same precision as in the case of *C. Succirubra*; but as yet the analyses "show that no cessation of the formation of alkaloids, or any deterioration of quality is yet apparent from the increase of the age of the bark." I see no need, therefore, for harvesting these trees solely for the object of avoiding waste of alkaloids, and would leave this to be done as our requirements of bark dictate. I do not see any reason to alter the proportion of trees to be mossed and coppiced, which was prescribed in our Order of the 5th September last, No. 952; but it should be explained that the trees are not to be "retained for coppicing," but that mossing and coppicing should proceed *pari passu* in the proportion fixed.

Mr. Broughton's letter to Government, 22 August 1873, pp. 10 and 11.

3. The other question for decision is the extension of *C. Calisaya*. This cannot be done in the manner proposed by Mr. Broughton, but there is nothing to prevent additional land being planted with this variety if Government deem it desirable. My own opinion is adverse to such a measure, because, as Mr. McIvor states, experience has shown that the climate of the Neilgherries is not suited to it, and because in *C. Officinalis* we have a species nearly, if not quite, its equal which succeeds well. Mr. Howard writes in high terms of the crown-barks (*C. Officinalis*), and Mr. Broughton believes "the final success of chinchona cultivation on the Neilgherries will result from the export of these crown-barks."

Note.—As a disadvantage of the *C. Officinalis*, Mr. Broughton mentions that the branches are early valueless. Mr. Howard, however, says that "the very youngest shoots that could be peeled have often been sold and even preferred by the trade."

Under these circumstances we may, I think, rest content with the 55,000 trees we possess of the calisaya variety, and rather add to our stock of *C. Officinalis* the varieties especially noted for their excellence by Mr. Howard.

4. One important subject for consideration is what to do with our barks. The *C. Succirubra* is declared on the best authority *not* to be the quinine-producing tree of the family; it yields the other alkaloids in greater proportion. Its bark still fetches a high price in the English market; but Mr. Broughton says, emphatically, "it appears to be the worst species for the production of bark for export," and Mr. Howard especially dwells on the importance of regarding it as a "chinchonidine-producing material." It seems to me, therefore, that our best course is to send home only so much of the succirubra bark as may be needed for special purposes, such as analysis, testing of market value, etc., and to reserve the great bulk for conversion on Government account into sulphate of chinchonidine for the use of our native population who cannot afford to buy quinine. I conclude Mr. Broughton will have no difficulty in using up all the bark we have of this one species, and of manufacturing the product as economically as it is manufactured at home; but if he cannot do so the surplus must, of course, be sent home for manufacture there. The crown and other barks, on the other hand, should be chiefly sent home, as their quinine-yielding properties render them especially valuable there. Of course this measure cannot be adopted immediately, but it should be our guiding principle.

Letter to Government, dated 22 August 1873, para. 7.

5. The paper which accompanies Mr. McIvor's letter to the Commissioner gives the prices which our bark has realised in England in comparison with the prices realised by the Java barks. Mr. Broughton laid especial stress on the high price realised by some Java

Java calisaya bark; but our own crown-barks fetched even higher prices, and the general average of our bark is, as Mr. McIvor points out, considerably higher than that of the Java bark. It will be observed that some branch crown-bark sent home (Mr. Broughton stated contrary to his advice, and, the Commissioner adds, rejected by him as unfit for the use of the factory at Neddivuttum) realised from 2 *s.* to 3 *s.* 6 *d.* per pound. If this be the case, the result naturally suggests a doubt as to whether there is not some defect in his process of manufacture which fails to extract all the alkaloids in the bark. In this bark which he rejected there must, I should suppose from the price realised, have been some 2 per cent. of quinine. Mr. Broughton has described his method of manufacture very fully in his letter of the 1st December 1873. It is evident, from the prices realised in the English market for bark rejected here, that there must be a great loss between the laboratory and the manufactory results. This is a very important subject, and merits our serious consideration; for on it turns the question whether we should continue to manufacture here, or leave this to be done in England. One object of the manufactory here was to utilise bark which it would not be worth while to send to England. I would suggest that the amorphous quinine which has been issued for experimental use in our hospitals should be submitted to the analysis and valuation of Mr. Howard and Dr. DeVrij.

27th April 1874.

MINUTE by the Hon. *W. Robinson*, C.S.I.

I AGREE with Mr. Sim on the whole. But unless medical science establishes the efficacy of alkaloids other than quinine, and thus raises the value of *C. Succirubra*, the further use of this species, even for filling vacancies, should be given up entirely; not that the matter of filling vacancies is pressing as regards the plantations at Neddivuttum, for thinning must be the order of the day for long there. On this point, therefore, a decision is needed. One of the other two species, *C. Officinalis* or *C. Calisaya*, must be used.

2. Mr. Sim advocates the former, and I agree with him for the reasons he gives, wherever the *C. Calisaya* does not thrive; wherever it does thrive fairly, the *C. Calisaya* should be preferred.

3. I think that the doubt raised as to the efficiency of the factory should be inquired into and set at rest at once; and I am inclined, on further consideration, to think that Mr. Sim's proposal to have the analysis conducted at home the best plan.

30th April 1874.

MINUTE by His Excellency the Commander-in-Chief.

I FULLY concur with the Hon. J. D. Sim, especially as regards the method by which he would test the value of Mr. Broughton's operations at Neddivuttum. We have no knowledge of Dr. Bidie's qualifications as a chemist, whereas in a matter of such vast importance we should take care to obtain the opinion of the most eminent available. We could hardly ascribe much value to that of any other.

2. We should not be in too great a hurry to condemn *C. Succirubra*; for I observe that whilst Mr. Howard speaks most disparagingly of that bark from coppice, he speaks highly of the bark renewed under the mossing process (*vide* "Gardeners' Chronicle," March 28th, 1874, page 408).

23rd May 1874.

MINUTE by His Excellency the Governor.

I THINK that sufficient reason is shown for the action which is proposed by the Hon. Mr. Sim respecting the *C. Succirubra* trees. As regards the choice between *C. Officinalis* and *C. Calisaya*, Mr. McIvor says that the latter will not grow well on the Nilgiris, and this seems to be sufficient reason for preferring the former. I think that the subject noticed by Mr. Sim in the last paragraph of his Minute, respecting the process of manufacture in the factory and the real value of its results, is one requiring serious consideration; and I would select, as suggested by the Hon. Mr. Robinson, some person or persons to inquire into and report upon it, with a view to a satisfactory solution of the question whether our manufacture should be continued.

6th June 1874.

ORDER of the Madras Government thereon, 22nd June 1874, No. 759.

IN August last Mr. Broughton forwarded an account of the results obtained by him in the analysis of specimens of different species of chinchona, "in order to trace the changes produced by age and growth of the several kinds."

This report was sent to Mr. McIvor for his remarks, which have now been received.

2. Mr. Broughton first pointed out that the analysis of bark from the oldest trees of *C. Succirubra* show that this bark "has passed its age of maximum yield of alkaloids," and

 "appears

"appears to be even deteriorating in total yield of alkaloids." This is in accordance with the known "peculiar habit of the species," to use the words of Mr. Howard, who in 1872 remarked that "the bark does not really improve by age, but the contrary."

3. Mr. McIvor, who predicted the probability of this result in his report for 1864-65, concurs, and proposes to harvest the whole of the older trees, whose number, the Commissioner states, is 6,000.

4. Mr. McIvor would appear to contest Mr. Broughton's low estimate of the value of *C. Succirubra* for *export* purposes, probably on the ground that succirubra is still worth exporting, as it fetches 3 *s.* 6 *d.* per lb. (not that it is better than calisaya and officinalis). Mr. Howard, however, has already remarked that "it cannot be looked upon as the quinine-tree of the future;" and on Mr. McIvor's own showing, the *highest* price obtained at the recent sales of *stem* bark of this species was less than the *lowest* obtained for *stem* bark of *C. Officinalis.*

5. From *C. Succirubra* Mr. Broughton turns to *C. Officinalis*, but none of his remarks on this species are noticed by Mr. McIvor.

The Commissioner, indeed, states that Mr. McIvor would harvest the older barks of this species also, on the ground apparently that they will deteriorate; but Mr. Broughton notices no deterioration, nor any cessation of the formation of alkaloids, and Mr. Howard has stated of the good varieties of this species that "there is no fear" of the bark deteriorating with age.

6. As to the species of *C. Calisaya*, Mr. Broughton remarks that its bark, "notwithstanding its youth, is fully equal to good South American calisaya in yield of quinine." He anticipates much success from the export of this species when of fit age, and points out that the Netherlands Government are cultivating it largely, that it has the greatest reputation of any of the chinchonæ in the European market, and that its branch-bark is better than that of *C. Officinalis*. On these grounds he would recommend casualties among the *C. Succirubra* being replaced by plants of *C. Calisaya.*

7. Mr. McIvor contests this recommendation, on the following grounds:—1st, that the plant is, on the Nilgiris, a delicate one, and therefore will not grow well among the more robust succirubra; and, 2ndly, that, as tested by recent sales, *C. Officinalis*, which grows well here, brings higher prices.

8. In regard to *C. Succirubra*, it is plainly shown that the 6,000 trees referred to have reached the age when the yield of alkaloids begins to decrease, and the bulk of the bark should, therefore, be harvested. The Government understand that 1,000 of these trees have already been mossed. A similar number should be treated in the same way, and 2,000* should be *coppiced*, that is, cut down and allowed to come up again, the remaining 2,000 being retained for experimental purposes. This so far modifies the Order, dated 5th September 1873, No. 952, which contemplated the harvesting of all these trees.

*Note.—This number will form one-third of those to be coppiced under Government Order, 11 April 1874, No. 434, para. 4.

9. Of the 2,000 trees reserved by the preceding paragraph, a small number should be annually mossed and coppiced in equal proportions, in order to test, over a long series of years, the consequences of age, and the effects of each method of harvesting on this particular species of chinchona.

10. In regard to the 18,000 crown-barks (*C. Officinalis*), it does not appear that deterioration from age need be alleged as a reason for harvesting these trees. On the contrary, in his letter to the Secretary of State, dated 16th January 1872, Mr. Howard states that he has "no doubt that these barks will improve with age," and again that "there is no fear that these varieties of *C. Officinalis* should deteriorate with age."

Mr. Broughton cannot (*vide* paragraphs 10 and 11 of his letter, dated 22nd August 1873) yet state the changes taking place in the quality of crown-barks as they advance in age with the same precision as in the case of *C. Succirubra*; but, so far, "the analyses show that no cessation of the formation of alkaloids or any deterioration of quality is yet apparent from the increase of the age of the bark." These trees need not, therefore, be harvested solely with the object of avoiding waste of alkaloids, but may be dealt with as the requirements for bark dictate; the instructions in Government Order, 5th September 1873, No. 952, being observed as to the proportions to be mossed and coppiced. It should be understood that the expression in that order "retained for coppicing" is meant to imply that mossing and coppicing should proceed *pari passu* in the proportion fixed.

11. With reference to the opinion expressed by Mr. McIvor about *C. Calisaya*, it is not advisable to extend its cultivation in the manner proposed by Mr. Broughton. The Superintendent Government Chinchona Plantations will be requested to advise as to the best mode of filling up the vacancies among the *C. Succirubra*. It is observed that Mr. Howard writes in high terms of *C. Officinalis*, and Mr. Broughton believes "the final success of chinchona cultivation on the Nilgiris will result from the export of these crown-barks." Rather than add to the stock of *C. Calisaya*, it seems preferable to increase the cultivation of *C. Officinalis* by growing the varieties especially noted for their excellence by Mr. Howard.

12. It

12. It is important to consider the best mode of disposing of the different kinds of bark when harvested. *C. Succirubra* has been declared on the best authority *not* to be the quinine-producing tree of the family, but it yields the other alkaloids in greater proportion. Its bark still fetches a high price in the English market; but Mr. Broughton says emphatically, "It appears to be the worst species for the production of bark for export;" and Mr. Howard dwells on the importance of regarding it as a "chinchonidine-producing material." The Government, therefore, consider that only so much of this bark should be sent to England as may be needed for special purposes, *e.g.*, analysis, testing of market value, and so forth; the bulk being retained here for conversion into sulphate of chinchonidine for the use of the native population who cannot afford to buy quinine. His Excellency in Council concludes that Mr. Broughton will have no difficulty in using up all available bark of this one species, but he will report on this point. If he cannot do so the surplus must be sent home. The crown and other barks, on the other hand, should be chiefly shipped to England, as their quinine-yielding properties render them especially valuable there. Of course the shipments of succirubra bark cannot be immediately stopped, but the course above indicated should be the guiding principle, viz., that the red barks should be regarded as the source of supply of cheap febrifuge for India, while the crown and other quinine-yielding barks should be reserved for the Home market.

13. The enclosure to Mr. McIvor's letter to the Commissioner gives the prices which the Nilgiri bark has realised in England compared with those obtained for Java bark at Amsterdam. Mr. Broughton laid special stress on the enhanced price fetched by some Java calisaya bark; but it is observed that the Indian crown barks were sold at even a higher figure, and the general average of the Nilgiri is, as Mr. McIvor points out, considerably greater than that of the Java bark.

14. It is also noticed that some branch crown bark sent, as stated by Mr. Broughton, contrary to his advice, and (the Commissioner adds) rejected by him as unfit for the use of the factory at Neddivuttum, realised from 2 *s.* to 3 *s.* 6 *d.* per lb. This result naturally suggests a doubt as to whether there is not some defect in the process of manufacture now in operation, owing to which all the alkaloids are not extracted from the bark. In the sample thus rejected there must, judging from the price realised, have been 2 per cent. of quinine. The subject is very important, and merits serious consideration, for on it turns the question whether the manufacture should be carried on here or in England. It was stated as one reason for working up the material on the spot that bark would be utilised which it would not be worth while to export, but the instance noted does not bear this out.

15. His Excellency the Governor in Council resolves to depute Mr. Cornish and the Commissioner of the Nilgiris to inquire and report on the subject so soon as Mr. Broughton returns from leave, in order that the efficiency of the factory may be determined, and a satisfactory solution be arrived at upon the question whether the existing arrangements should be continued. The points for special inquiry are (1) the cost and (2) the medicinal value of the product. In regard to the former, it should be considered how much of Mr. Broughton's salary should be debited to the factory.

16. The Surgeon-General, Indian Medical Department, will be desired to forward some of the amorphous quinine already issued for experimental trial, in order that it may be submitted for analysis and valuation to Mr. Howard and Dr. DeVrij.

17. The samples of barks called for in Government Order, 15th December 1873, No. 1,428, have, it is observed, not yet been forwarded.

18. The Government will be obliged to the Commissioner for a full report on the subject of the plantations, &c., up to date.

Enclosure 6, in No. 40.

Read the following Letter from the Government Quinologist to the Acting Secretary to Government, Revenue Department, dated Ootacamund, August 1873:—

I HAVE the honour to forward a report, which is concerned mainly with the changes of growth and age on the various species of chinchona on the Government plantations. I request that I may be allowed to correct the printer's proofs before publication, and be furnished with three copies of the same on publication.

2. It may justify the suggestion made in paragraph 14 of this report, if I quote certain reasons other than I have stated in report. I have received a set of specimens of the Java barks, of which those of *C. Calisaya* are of admirable appearance. The attention of the Netherlands Government is now almost exclusively directed to this species, the extension of the cultivation of *C. Succirubra* being discontinued. Certain specimens of *C. Calisaya* have sold in Amsterdam for the extraordinary prices of 8 *s.* to 9 *s.* 5 *d.* per

 kilogramme

kilogramme, or 3 *s.* 7½ *d.* and 4 *s.* 3¼ *d.* per lb. I quote an analysis of certain bark from a tree, seven years of age, which I have made of Java bark, the seed of which was derived from the same source as the plants of the Madras Government:—

	Per Cent.
Total alkaloid	7·65
Quinine	0·91
Chinchonidine and chinchonine	0·74

The quinine yielded the usual amount of sulphate.

This bark, therefore, is of better quality than any grown on our plantations, with the exception of var. *Angustifolia*, though I fully believe that as good would be obtained on suitable sites of growth.

From the Government Quinologist, to the Acting Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 22nd August 1873.

Subject of Report.

I HAVE the honour to report in the following pages on the present state of the various chinchona species growing on the Government plantations, in order to trace the changes produced by age and growth on the several kinds.

Changes in *C. Succirubra* up to 1871.

2. I will commence with the species which has generally the largest contents of alkaloids in its bark, and the quickest and most vigorous growth. I allude to the *Cinchona Succirubra*, of which on the plantations there are 579,938 trees of various ages. I quote below the results already obtained with the bark of oldest trees examined in May, or the time of year in which the yield is greatest. These trees were planted out in August 1862:—

	1868.	1869.	1870.	1871.
Total alkaloids	6·74	7·43	7·60	7·85
Total sulphates obtained	6·06	6·43	6·00	5·45
Quinine	2·40	1·72	1·73	1·80
Chinchonidine and chinchonine	4·34	5·71	5·87	6·05
Sulphate quinine, obtained crystallised	2·21	1·51	1·40	1·15
Sulphate chinchonidine, obtained crystallised	2·85	4·92	4·60	4·30

Subsequent changes.

3. During the months of May 1872 and 1873 similar careful analyses have been made. As the variation in the bark of Succirubra in single trees, though generally slight, is occasionally marked, a mean of two or more analyses has been taken, each being performed on the bark of six trees. The height of trunk from which the specimens were taken has been, as far as possible, the same throughout the whole series, so that now the trees are 30 feet in height, the bark has become that from the lowest portion of the trunk. As the later analyses appear to show an increase in chinchonine at the expense of chinchonidine, I have paid special attention to the examination of that point. I quote the analyses for 1872 and 1873:—

	1872.	1873.
Total alkaloids	7·67	7·38
Total sulphates obtained	4·96	3·84
Quinine	1·49	1·31
Chinchonidine and chinchonine	6·18	6·07
Sulphate quinine, obtained crystallised	1·10	0·88
Sulphate chinchonidine, obtained crystallised	3·86	3·01

4. I can

Red-bark trees have passed the time of greatest yield in their oldest bark.

4. I can but conclude from the foregoing analyses that the oldest bark on our oldest trees of *C. Succirubra* has passed its age of maximum yield of alkaloids, and from the same indication it appears to be even deteriorating in total yield of alkaloids. This deterioration is, however, but slight, and it is even possible may have occurred in part from the influence of the monsoon this year, which has been of unusually early occurrence. In paragraph 37 *et seq.* of a report published in return "Chinchona Cultivation," 1870, page 241, I have shown the considerable influence the rainy season has on the amount of alkaloid in the bark. But as the growth of the bark of this age is mainly an increased development of liber fibres and not of the cellular tissue, which is the main seat of the alkaloid, I incline, on a further ground, to the opinion that a diminution of the per-centage of alkaloids will ensue, though it may be but slight.

The chinchonine is increasing at expense of chinchonidine and quinine.

5. The foregoing analyses also indicate another change in the yield of our red barks with increase of age. This is that the amount of chinchonine is increasing, and that of chinchonidine is decreasing. As I have consistently excluded chinchonine sulphate from the amount of crystalline sulphates in all previous analyses, this will be evident in the foregoing *résumé* of analyses. But this change in the bark will be somewhat more obvious if I state the analyses of 1871 and 1873 in the following form, which is readily done by appropriate calculation. The numbers will be approximately accurate:—

	1871.	1873.
Total alkaloids	7·85	7·38
Consisting of:—		
Chinchonidine	3·22	2·25
Chinchonine	2·83	3·82
Quinine susceptible of crystallisation	0·95	0·68
Quinicine	0·85	0·63

This form of statement takes no account of chinchonicine or chinchonine unsusceptible of crystallisation which exists in small quantity in the bark. But it will here be evident that in two years the amount of chinchonidine has diminished 1 per cent., while chinchonine has increased nearly in the same proportion. The amount of true quinine has also diminished by 0·27 per cent. in the same period.

Present yield of oldest red bark corroborates Mr. Howard's statement.

6. In a report by Mr. Howard, dated 16th January 1872, in which, by the request of the Secretary of State, he discussed certain matters mentioned in a report of mine which is attached to Government Order, No. 1,686, of 26th September 1871, occurs the following:— "It is needful to remark that the *waste* of alkaloid which has been apparent to the writer in the examination of South American bark of the age perhaps of one or two centuries has not yet taken place in these still young Indian specimens." From the foregoing analyses I fear it will be apparent that the process of the waste of alkaloids mentioned has begun, and that it commences after the ninth year of the age of the plant. It is probable that the waste really begins from the first year, but that the rapid simultaneous formation of alkaloid by the plant in its earlier years prevents its being noticed, the processes of formation and waste going on side by side.

Objection to the growth of red bark.

7. I do not apprehend this deterioration in the quality of the red bark by age will be of essential importance for some years to come, since younger bark is forming constantly on the same tree, though this younger bark never appears quite equal that of the best trunk bark of young trees. Though I quite recognise the fact that *C. Succirubra* is the chinchona which produces the largest amount of alkaloid in the shortest time, it appears to be worst species for the production of bark for export. As it is in no respect the best source for the preparation of crystalline sulphates of its alkaloid, I feel convinced the time will come when it will no longer even be worth while to export it from the Government plantations.

Red bark at high elevations.

8. The superintendent of the plantations has, with much judgment, planted out a few dozen *C. Succirubra* trees on the plantation of Dodabet. In this comparatively cold climate their rate of growth quite forbids any expectation of their profitable cultivation. But they have the great interest of indicating the influence of a low temperature and high elevation on the formation of alkaloids in the bark of a variety which is the inhabitant of a warm climate. Hence, as soon as their bark was sufficiently formed, its analysis possessed much interest. The trees from which it was taken were eight years old, but of stunted growth. I subjoin its results:—

Total alkaloids	3·16
Quinine	0·75
Chinchonine	2·14
Sulphate quinine, obtained crystallised	0·55

The bark was thus comparatively poor in alkaloids. The effect of the climate and slowness of growth has thus also the remarkable effect of quite preventing the formation of chinchonidine. The bark is of little value, but its analysis demonstrating the effect of elevation has, I submit, considerable interest.

Extensive cultivation of *C. Succirubra.*

9. In the "Gottingen Jahresbericht über die Fortschritte der Pharmacognosie," 1871, in addition to Sikkim, Ceylon, Kangra in India, the success of *C. Succirubra* is detailed in Jamaica, St. Helena, Réunion. The reports from Java give similar details. As this species is of easy cultivation in most tropical table-lands with moist climate, there is no doubt it is now grown to a greater extent than the European market requires. I believe that more is now flourishing on the Nilgiris than will be required in England for the manufacture of pharmaceutical preparations. By the quinine manufacturer it will be little used as long as barks richer in quinine are obtainable.

C, Officinalis.

10. *C. Officinalis* is the kind next in commercial importance, the plantations containing, according to the statement of the superintendent, 508,878 plants. I have in former reports had occasion to speak in high praise of this species as a quinine-yielding kind. From the great variability in its quality of bark, it is not possible to state the changes therein taking place with the same precision as is the case with *C. Succirubra*. I beg to quote the following analyses, as representing results obtained in an attempt to obtain the mean yield of alkaloids in the bark of the lower part of the trunks of the oldest trees and those of nine years of age:—

	Oldest Trees about Ten Years of Age. 1	Trees about Nine Years old. 2	Neddivuttum. Nine Years old. 3
Total alkaloids	7·39	8·33	5·24
Quinine	3·81	4 52	4·17
Chinchonidine and chinchonine	3·58	3·81	1·07
Quinine sulphate, obtained crystallised	3·67	4·35	undetermined.
Chinchonidine, " "	1·58	1·40	"

The above admirable results show that at present in mere yield of alkaloids certain of the crown barks equal that of C. *Succirubra*, while it far surpasses the latter as a source of quinine. It has every excellence in the ease with which sulphate of quinine can be prepared from it.

Success of chinchon cultivation will depend on *C. Officinalis* on Nilgiris.

11. The final success of chinchona cultivation on the Nilgiris will result from the export of these crown barks. The tree has the disadvantage of comparatively slow growth, and the bark of its branches is nearly valueless. The analyses, of course, show that no cessation of the formation of alkaloids or any deterioration of quality is yet apparent from the increase of the age of the bark. Analysis 2 really shows a somewhat abnormal yield.

Roots of *C. Officinalis.*

12. I have been able to obtain specimens of the bark of the secondary and main roots of this species. The specimen was from the Belmont plantation at Ootacamund. The latter will represent the quality of similar bark on the Government plantations. I state both analyses:—

	Belmont, No. 1.	Belmont, No. 2.
Total alkaoids	7·65	11·17
Quinine	0·42	4·27
Chinchonine and chinchonidine	7·23	6·90
Quinine sulphate, obtained crystallised	undetermined	3·54
Chinchonidine	0 59	4·40

The foregoing remarkable results show the extraordinarily large amount of alkaloids contained in the bark of the roots. Ten years ago the analyses of Dr. de Vrij showed that in the *C. Paludiana* of Java the root bark surpassed that of the stem in its yield of alkaloids, though the increase was far less marked. The greater part of the alkaloids, however,

however, consists of chinchonine, though in the second analysis the yield of quinine is also large. I am, however, of decided opinion that, on account of the expense of procuring the bark, that the roots will scarcely be a profitable source of alkaloids, notwithstanding its enormous yield. The physiological explanation of this peculiarity is discussed in paragraph 20. The roots of *C. Succirubra* have been examined by me, and results enumerated in report, appearing at page 117 of Chinchona Return, 1870, and by Mr. Howard in his report, dated 1st September 1868.

Special variety of crown bark.

13. I may here detail a singular result obtained with a peculiar variety of what appears to be *C. Officinalis*. This species, as I have in earlier reports remarked, seems to possess a large number of varieties, one of which, named by Dr. Weddell var. *Angustifolia*, I have shown in a report appearing in "Chinchona Return, 1870," page 205, is the most valuable kind of chinchona known. The kind now under discussion was brought to my notice by Mr. McIvor, who thought it to be the real parent of what is called the hybrid between *Succirubra* and *Officinalis*, an opinion quite contrary to mine. It has large leathery leaves and peculiar aspect. Its bark gave the following results on analysis: total alkaloids 1·25 per cent., of which the whole was chinchonine, not even traces of quinine or chinchonidine being apparent. This bark thus has the composition of a grey bark, but with a totally different appearance, and is certainly not the source of the hybrid mentioned. Of course the kind is almost destitute of value; but from its remarkable character it is well worthy of notice, and I propose to send a specimen of its flower, foliage, and bark home for botanical notice.

14. The kind of chinchona next in importance is the *C. Calisaya*, of which I am glad to learn from the superintendent of the plantations as many as 33,850 are planted out. Like *Officinalis*, the number of varieties of this is very great. In a report attached to Government Order, No. 1, 686, of 26th September 1871, I had the honour of stating the special kind (with leaves red on the under-surface) that was the best worth cultivation. At end of May last I made the analysis of bark taken from six of these trees, which gave the following results:—

Total alkaloids	5·30
Quinine	3·00
Chinchonine and chinchonidine	2·30
Quinine sulphate, obtained crystallised	2·81
Chinchonidine	0·75

C. Calisaya.

Hence this bark, though two years younger than our second age *Officinalis*, nearly equals it in value. *Calisaya* is the species that has the greatest reputation of any of the chinchonæ in the European market, and this reputation is justified by the foregoing and former analyses. I have mentioned in paragraph 11 the worthlessness of the branch bark of the erect-growing *Officinalis*. The somewhat shrubby habit of *Calisaya* produces many branches of which the bark presents a good appearance. To ascertain its quality, bark was taken from a quantity of secondary, not primary branches, and analysed. These, when quite fresh, did not lose so much weight on drying as the trunk bark of *C. Succirubra*. The analysis was as follows:—

Total alkaloids	2·71
Quinine	2·40
Chinchonidine and chinchonine	0·31

The bark, therefore, notwithstanding its youth, is fully equal to good South American *Calisaya* in yield of quinine. I anticipate much success from the export of this species when of fit age. The Netherlands Government appear to be carrying out its cultivation largely, having obtained the original seeds from the same source as the Madras Government. I would strongly recommend that in all suitable spots, where a tree of *C. Succirubra* has died from any cause, a plant of *Calisaya* should be substituted in its place. It appears to me to have been unfortunate that chinchona cultivation should have been so greatly occupied with *C. Succirubra* at its commencement.

Water in chinch barks.

15. The amounts of water which the several kinds of bark when green lose on drying is an important datum in comparative estimates of their value for cultivation. In all analyses of chinchona bark the amounts of alkaloids are invariably stated in per-centages of quite dry bark. But the fresh bark of several species of chinchona yield different amounts of dry bark. Though different specimens of the same bark contain variable amounts of water, the quantities of true dry bark yielded by the oldest trunk bark of the various species largely grown on the Government plantations is, roughly, as follows:—*C. Officinalis*, 36 per cent.; *C. Calisaya*, 33 per cent.; *C. Succirubra*, 30 per cent. These proportions vary with the weather and the season of the year, but generally preserve the same relation to one another. It will be observed that this furnishes another advantage possessed by *C. Officinalis*, and in some measure compensates for the slower growth of the species. I quite believe when our trees of *C. Calisaya* are of the same age they will equal those

those of *C. Officinalis* in this respect. The advantage of a smaller loss of weight on drying for export needs no explanation. Ordinary bark of the market contains from 10 to 12 per cent. of water.

16. As I am desirous of making some remarks on the barks lately exported, I beg permission to quote a statement of the analyses of samples of each kind which I have already communicated to Government:—

	Mossed Red Bark, Neddivuttum.	Renewed Red Bark, Neddivuttum.		Red Bark, Neddivuttum.	Red Bark, Pykara.	Branch Red Bark.	Crown Bark, Neddivuttum.	Crown Bark, Pykara.	Mossed Crown Bark, Dodabetta.	Crown Bark, Dodabetta.	Branch Crown Bark.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Total alkaloids - - - -	6·20	5·82	2·75	4·45	5·11	3·58	4·32	3·42	6·60	3·61	0·91
Quinine and quinicine - -	1·14	3·25	-	1·81	0·97	1·33	3·08	2·32	3·89	2·07	-
Chinchonidine and cinicine -	5·06	2·57	2·75	3·14	4·14	2·25	1·24	1·10	2·71	1·54	-
Pure sulphate quinine, obtained crystallised - - - -	0·74	2·62	-	0·74	0·62	0·81	3·11	2·39	3·86	2·04	-
Pure sulphate chinchonidine, obtained crystallised - -	3·47	0·88	1·	1·61	2·22	1·14	0·85	0·67	1·	0·99	-

Of these, I would first remark that the mossed and renewed red barks from Neddivuttum (Analyses 1 and 2) are of the best the plantation affords, being mainly taken from the experimental trees. The natural red bark from Neddivuttum (Analysis 4) is however inferior, being taken either from the upper part of the trunks, or from younger trees. From its inferior quality it will not, of course, find an equal price with our better bark. The natural red bark from Pykara (Analysis 5), though from young trees, is of higher quality. The crown barks from Neddivuttum and Pykara (Nos. 7 and 8) afford indications in a high degree encouraging, and demonstrate the success of the species in a warmer climate than Ootacamund. For some years this species remained nearly stationary in growth at Neddivuttum, and the analyses of its bark were less encouraging than that obtained from Dodabet; but during the last three its growth has become more rapid, and the amount of true quinine in its bark has increased. I am glad to report that in none of our plantations am I now disposed to limit the success that will accrue from this excellent species. I would, however, remark that the crown bark from Pykara and Dodabet is of considerably inferior yield to what it would have had if the trees producing it had been allowed two years' further growth before cropping. While I am of opinion that duplicate stems should be removed, I can see little gain that can accrue to chinchona cultivation by exporting bark that has not yet come near its full yield of quinine. The natural crown bark from Dodabet is from younger trees than that furnishing the mossed bark.

Grey bark exported.

17. The grey bark has been sent home in but small quantity; its analysis (No. 3) shows that it is of by no means superior quality, but is equal to that usually sent from South America. It appears to be mainly obtained from *C. Peruviana*, from the considerable amount of chinchonidine it contains.

Order of formation and conversion of alkaloids.

18. In the whole chinchona genus cultivated on the Nilgiris, with the exception of the grey barks, certain definite changes appear to take place which I have formerly mentioned,* and now desire to enumerate with greater precision. These were first made evident by the examination of bark naturally renewed, and have been, on the whole, corroborated and extended by careful observation and analysis during the last five years. The general principle is as follows:—The alkaloid first formed in the bark of all the species, except the grey barks, is uncrystallisable quinine or quinicine. This alkaloid quickly in *C. Officinalis*, and less quickly in *C. Succirubra*, changes into pure crystallisable quinine. Again, after a time, with much rapidity in *C. Succirubra*, and with great slowness in *C. Officinalis*, this quinine changes into chinchonidine. Finally, after a considerable lapse of time, the chinchonidine changes into chinchonine, the last form in which the alkaloid as such exists. The composition of each of these alkaloids is so nearly identical that I am convinced I am accurate in speaking of their actual conversion in the tissues of the living bark. Warmth of climate accelerates these changes, which all go on simultaneously; hence, in low-grown *C. Succirubra* the amount of quinine is smaller than in bark grown at high elevations, and the amount of chinchonine also is larger. I have never yet met with a specimen of this bark destitute of quinine, though in unhealthy trees, where its formation has nearly ceased, it is but very small in amount, while that of chinchonine is large.

* Return "Chinchona Cultivation," 1870, pp. 194, 242.

large. The same results are remarkable in trees of *C. Officinalis* in warm climates when the growth is slow, as the bark then contains little quinine.

Certain evidences of order of formation and conversion.

19. If a tree of *C. Succirubra* on the Nilgiris be in a state of rapid and vigorous growth, a more considerable amount of quinicine and quinine is found in its trunk bark, as their formation is then more rapid than the transformation of those alkaloids into chinchonidine. In a vigorous growing *C. Officinalis* tree this peculiarity is most marked, as the bark of such trees is invariably rich in quinine, the change of that alkaloid into chinchonidine being slow in this species. On the other hand, if a slow-growing and stumpy tree be selected for analysis, the alkaloid in its comparatively inactive bark tissues will be found to be in large amount chinchonidine and chinchonine, the quinine having been changed into those alkaloids faster than it is formed. In the whole species of chinchona, I have reason to believe these changes are similar in nature, but differ in degree, according to the habit of the plant.

Destruction of alkaloids.

20. In former reports I have stated abundant reasons for my belief that sunlight is one considerable agent in the final destruction of the alkaloids. When the tree is young, and the bark is thin, this destruction is rapid, but the vigour of formation is so also. Hence the great improvement in the bark produced by mossing young trees. As the bark gets thicker by increase of age, one great cause of the destruction of alkaloids is diminished in its action, but the processes of growth are locally less vigorous in the thicker epiderm protected by a thicker cork, and thus the gain of mossing disappears. This condition appears to take place in about the eighth year of growth. In the bark of the roots which are, during their whole existence, entirely secured from light, the alkaloids accumulate in large amount, though the chemical transformations mentioned in the preceding paragraph of course occur. Hence, the alkaloids to be found in the root bark are large quantities of alkaloids consisting mainly of chinchonine and chichonidine.

ORDER of the Madras Government thereon, 15th December 1873.

ORDERED, that the foregoing letter and a copy of Mr. Broughton's report be forwarded to the Commissioner of the Nilgiris, with a view to his obtaining and forwarding, at an early date, with his own remarks, any observations on it that the Superintendent of Chinchona Plantations may wish to make.

2. The Commissioner will also, in communication with Mr. Broughton, select and forward to the Government carefully prepared samples of the different barks now reported upon, taking care that they are procured from trees of the same age, and grown under similar conditions in the matter of soil, elevation, aspect, and culture generally.

Enclosure 7, in No. 40.

From the Committee appointed under Government Order, No. 759, of 22nd June 1874, to Report on the Efficiency of the Chinchona Factory at Neddivuttum, to the Secretary to Government, Revenue Department, Fort St. George; dated Ootacamund, 28th November 1874.

WITH reference to Government Order, No. 759, of the 22nd June 1874, we have the honour to submit the following report.

2. Two questions have been submitted to us for opinion:—

(*a.*) The cost of manufacturing chinchona alkaloids under Mr. Broughton's superintendence at Neddivuttum.

(*b.*) The medicinal value of the locally prepared alkaloids.

3. In regard to the latter question the Sanitary Commissioner is responsible for the remarks made.

4. With regard to the first question, we may note that doubts have been suggested as to the profitable extraction of alkaloids in this country, by the fact that certain parcels of branch chinchona barks or prunings which were sent home in 1873 fetched from 2 *s.* to 3 *s.* 6 *d.* per lb. in the open market.

5. The history of these branch barks, so far as we can gather, is as follows:—
Eleven cases of branch bark of the *C. Succirubra* from the Neddivuttum and Pykara plantations were included in the exports of 1873. This bark weighed, according to invoice lists, 1,765 lbs., but in the sale accounts quoted by Mr. McIvor in Government Order,

No. 759, of 22nd June 1873, only nine cases of branch red bark, weighing 1,327 lbs., are referred to, the prices of which were as below:—

				s.	d.
7 cases,	972½ lbs.,	sold at	- - -	2	3
1 case,	194 „	„	- - -	2	2
1 „	161½ „	„	- - -	2	–

V. de Government Order, No. 955, dated 8th September 1873.

Mr. Broughton's analysis of samples of this branch bark showed it to be of superior quality to the ordinary run of prunings supplied to his manufactory. He found that the total alkaloids averaged 3·58 per cent. of quite dry bark, of which 1·33 per cent. was quinine and quinidine, and 2·25 per cent. chinchonine and chinchonidine. In regard to the per-centage of pure sulphate of quinine "crystallised," this branch red bark gave more favourable results (0·81 per cent.) than certain samples of trunk bark from Pykara and Neddivuttum exported in the same consignment. Branch bark of this quality would be suitable for the manufacture of alkaloid, but there is no evidence before us to show that it was bought for manufacturing purposes.

6. In addition to the 11 cases of branch bark of the *C. Succirubra* sent to London in 1873, Mr. McIvor dispatched by the same opportunity 13 cases of branch bark of the *C. Officinalis* (crown bark). The gross weight of this branch crown bark is stated at 2,115½ lbs. Ten of the cases contained branch bark from the Dodabetta estates, and three cases contained branch crown bark from the Neddivuttum plantations, which is stated by Mr. McIvor to have been rejected by Mr. Broughton as useless for manufacturing purposes.

The prices realised for this branch crown bark were as follow:—

					s.	d.	
2 cases,	466 lbs.		from Dodabetta	-	3	6	per lb.
9 „	1,341½ „	6 „	Dodabetta	-	2	6	„
		3 „	Neddivuttum				
2 „	308 „	„	Dodabetta	-	2	4	„

7. In Government Order, 8th September 1873, No. 955, Mr. Broughton reports only one analysis of branch crown bark, which gives the total alkaloids as 0·91 per cent. This analysis, Mr. Broughton states to us, had reference to the branch crown bark which he objected to work up in his factory, and not to the produce of the Dodabetta estates; and he explains that the invoice lists of cases exported only reached him after the dispatch of the bark. On this point, however, there is a difference of opinion between Mr. McIvor and Mr. Broughton. The former believes that Mr. Broughton's analysis, showing 0·91 per cent. of alkaloid, referred to the Dodabetta produce; and he supports this view by quoting a letter from Mr. Broughton, dated 7th June 1873, in which the latter states: "I have the honour to state that the bark of *C. Officinalis* from Dodabetta plantations obtained from branches and double stems is of too poor a quality to be exported to England. I would recommend that the elder pieces of bark be picked out, and they only sent"

Mr. Broughton, however, informs us that, to the best of his recollection, samples of this Dodabetta branch bark were not analysed by him, and that the opinion he gave as above was founded on his general knowledge of the qualities of bark. There has evidently been some misunderstanding in regard to the analysis of this branch crown bark, and we allude to the subject here because the prices obtained for it seemed to be out of proportion to the alkaloidal value of the bark according to the one analysis given by Mr. Broughton. The selection of samples, so as to represent the average proportion of alkaloid in a case of bark, evidently requires to be arranged with the utmost care. It is not clear to us that the samples of branch crown bark from the Neddivuttum and Dodabetta estates were separately analysed by the Government Quinologist, as was the case with the other barks exported.

8. Mr. Broughton, in Government Order, No. 955, of 8th September 1873, states, with reference to the branch crown barks exported, "certain branch crown bark has been sent, contrary to my advice, given under the belief that, even if it sell for a good price, its quality will ultimately prejudice the reputation that Madras chinchona bark should seek to obtain in the market."

9. These parcels of bark brought an excellent price in the home market, ranging from 2*s.* 4*d.* to 3*s.* 6*d.* per lb,; but there is nothing in this fact to indicate that the branch bark was bought by alkaloid manufacturers. (The sale lists sent out by the Home Government are defective, in not furnishing the names of buyers of the several lots of bark; and, in future, we think that the fullest information of this nature should be furnished to the local officers for their guidance.)

10. We must state here, for the information of Government, that there is a steady demand in Europe for chinchona barks, irrespective of their value to the manufacturer of alkaloids. According to information before us, about 100,000 lbs. of bark are used annually in the United Kingdom by druggists, and probably five or six times that amount

by continental druggists. Bark of this character is bought for making tinctures, decoctions, essences, and other pharmacopœial preparations. The dealers value it according to its appearance, *i.e.*, the size of the quills, the character of the lichens on the surface, its colour, shape, and other peculiarities, and not according to its amount of alkaloid. The branch crown bark sent home in 1873 was probably bought altogether for druggists' use. Two of the cases, it will be observed, sold for 1*s.* and 1*s.* 2*d.* per lb. beyond the average prices,—a tolerably sure indication that the high price obtained was no measure of the value of the sample for the quinine manufactory.

11. It is important that this point should be clearly understood, that chinchona barks have a value of their own independently of their fitness for the quinine manufactory. How long dealers may be willing to pay high prices for barks of low alkaloid yielding value it is impossible to say. If the market is overstocked with bark fit only for druggists' use, the present high prices cannot be maintained. We notice in a late circular of drug sales that inferior barks have been sold as low as 4*d.* and 2*d.* per lb.—prices which would be unremunerative to the Indian grower of chinchona. The ultimate success of chinchona cultivation in India must depend upon our ability to produce a bark that shall yield a high proportion of alkaloid, suitable for extraction by quinine manufacturers, and not upon the production of low-class barks which are bought by druggists.

12. It will be remembered that in the first sales of Nilgiri barks, the parcels being small, dealers were guided by appearance rather than by chemical value. The mossed bark, rich in alkaloid, fetched only 2*s.* 3*d.* per lb., while the unmossed, the appearance of which commended itself to dealers, fetched 2*s.* 9*d.* and 2*s.* 10*d.* per lb. The buyers for manufacturing purposes are now acquainted with the appearance of mossed barks, and value them according to analysis. Barks containing a workable amount of alkaloid are valued according to their composition, while barks for druggists' use are esteemed on other considerations altogether. Bearing these facts in mind, we are not disposed to overestimate the circumstance that our crown branch barks sold at remunerative rates. We know that the prices of barks for druggists' use fluctuate in the London market from 4*d.* to 4*s.* per lb., according to the peculiarities of the samples. The Indian barks of this kind have mostly sold for remunerative prices up to the present time, and the quantities the Nilgiri plantations may be expected to yield will not, if thrown into the London market, in our opinion, affect it in any way, or fetch lower prices than hitherto. We think it right to add that, under the mossing system, the proportion of branch bark taken to trunk bark will yearly diminish. Last year it was about half of the total bark harvested. Mr. McIvor estimates that not more than 10,000 lbs. of branch bark will be available next year.

13. We come now to consider the cost of manufacturing alkaloids on the plantations.

14. The supply of green bark and outturn of alkaloids, as given by Mr. Broughton in his letter (Government Order, No. 408, of 1st April 1874), are as follow:—

	Green Bark used.		Alkaloid produced.	Per-centage of Yield of Green Bark.
	Lbs.		*Lbs.*	
1869-70 - -	17,793 - - - -		21½	·12
1870-71 - -	51,352 - - - -		127	·24
1871-72 - -	35,072	branch, 12,829 trunk, 22,243	100	·28
1872-73 -	80,289	branch 46,440 trunk 33,841	345	·43
1873-74 - -	91,773 - - - -		Results not completed.	

(Owing to some defect in manipulation, the lime precipitate of the bark supplied in 1873-74 has not yet been fully worked up. Up to the present time 168·12 lbs. of alkaloid have been obtained, and the estimate of the unworked quantities is 142 lbs., or a total outturn of 310·12 lbs. of amorphous alkaloid for the year.)

15. From these results we see that there has been a gradual improvement in the proceeds of manufacture in the four years for which the data are complete, from ·12 per cent. of alkaloid to ·43 per cent. in 1872-73. The results for 1873-74 do not show quite so well as those of the former year; but this appears to have been due partly to inferior bark, and partly to a modification of manufacture intended to prevent waste of alkaloids, but which, in practice, failed to secure this object.

16. The quality of the bark supplied to the factory in 1869-70 and in 1870-71 is not

stated. During these years the factory work was irregular, and often interrupted; but in 1871-72 and 1872-73 the quality of bark is noted below:—

	Branch.	Trunk.
	Lbs.	*Lbs.*
1871-72 - - - - -	12,829	22,243
1872-73 - - - - -	46,440	33,841
	59,269	56,084

From experiments conducted in the drying of bark, it would seem that trunk bark loses from 55 to 65 per cent. of water before it is fit for export, and branch bark from 60 to 70 per cent. of water. Calculating from means of samples reported on in the year 1873, we assume that 100 parts of green trunk bark would, when dry for export, diminish to 38 parts, and green branch bark from 100 to 34. Assuming these proportions to represent the average decrease by dryage, we find the quantity of commercially dry bark used in the factory during 1871-72 and 1872-73 as follows:—

	Lbs.
Dry trunk bark - - - - - - -	21,311
Dry branch bark - - - - - - -	20,151

17. The trunk bark, if sent into the London market, would have fetched from 2*s.* to 3*s.* per lb. But from figures before us we find that the cost of carriage, export, dock dues, charges, deductions, &c., for the better qualities of bark, vary from 6*d.* to 1*s.* per lb., and as only the net price of the bark can be a fair debit against the factory, we assume this on the average at 2*s.* or a rupee a pound of commercially dry bark.

18. In regard to the prunings, the analysis of each sample received by Mr. Broughton in 1872-73 showed that whereas the trunk bark used in the factory yielded about 5 per cent. of alkaloid to the weight of bark completely dried, the prunings, taking the average of 12 samples, yielded only 1·3 per cent. of total alkaloids in analysis. We have already indicated that the branch barks have a value independent of the amount of alkaloid they contain; but for manufacturing uses we are bound to consider their value in relation to their yield of alkaloids. In this aspect, if the trunk red barks sold for an average of 2*s.* 8*d.* per lb. in London, the manufacturers would be only able to afford 8*d.* or 10*d.* per lb. for branch bark of the quality used in the factory. Allowing for charges of export, &c. on these low-priced barks (averaging from 3*d.* to 5*d.* per lb.), we shall not be far wrong if we debit the factory with 6*d.* per lb. as the net value of the dry prunings used.

19. These prunings, we may add, in the present condition of the bark market, would have been disposed of to greater advantage if they had been shipped to Europe for other than manufacturing purposes. Our object in this place is merely to estimate the manufacturing value of the raw material consumed in the production of the rough mixed alkaloids.

We have, therefore—

	£.	*s.*	*d.*
21,311 lbs. dry trunk bark, at 2*s.* - - -	2,131	10	–
20,151 lbs. dry branch bark, at 6*d.* - - -	503	16	–
Total - - £.	2,635	6	–

20. These may be taken as approximate prices, after deducting all costs of transport and trade charges, and considering also the dubious quality for manufacturing purposes of much of the branch bark obtained by pruning the trees. We may, therefore, take 2,500*l.* as representing the actual manufacturing value to Government of bark supplied on the spot to the alkaloid factory in 1871-72 and 1872-73.

21. The actual outturn of mixed alkaloids from the bark used in these two years, 1871-72 and 1872-73, was 445½ lbs. The market value of the product is not known, but, as in the medical administration of this country, the rough mixed alkaloids are used, and have actually replaced about an equal weight of sulphate of quinine, which would otherwise have been bought and shipped to India on account of the State, we have some data for calculating the advantages or disadvantages of local manufacture.

22. The price of sulphate of quinine varies from month to month and year to year; but, according to recent price lists furnished by Mr. Howard, and allowing a moderate percentage

percentage (10 per cent.) for freight, insurance, and other charges of conveyance to this country, we may calculate the cost of landing the drug in our medical stores at 130*s.* per lb.* The value of 445½ lbs. of sulphate of quinine, therefore, at this rate would amount to 2,895*l.* 10*s.*, or about 395*l.* 10*s.* more than the net manufacturing value of the bark consumed in the production of 445½ lbs. of rough mixed alkaloids.

23. The cost of the alkaloid factory establishment for 1872-73, including subsequent expenses in working up the product of that year (345½ lbs.) is given, on Mr. Broughton's responsibility, as *Rs.* 2,823. 11 *a.* 9 *p.*; and it is only fair to assume that if the establishment had been in full work, the 100 lbs. of alkaloid made in 1871-72 would not have cost more in proportion, or about *Rs.* 8. 2 *a.* per lb. in manufacture. (It must be remembered that the factory was designed, with its present establishmant, to turn out about 800 lbs. of rough alkaloids per annum; but, so far, the bark supplies have not been in quantity sufficient to allow of the complete utilisation of the establishment.) The charges for manufacture of 445½ lbs. of mixed alkaloids have been, so far as we can ascertain, as follows:

	Rs.	*a.*	*p.*
1. Cost of working up 345½ lbs. of alkaloid in 1872-73 -	2,823	11	9
2. Cost of producing 100 lbs. in 1871-72, at the same proportion - - - - - - - - - -	812	8	–
3. Interest for two years on plant, buildings, &c. (cost 18,706 rupees), at 6 per cent. (about) - - -	2,200	–	–
4. Moiety of salary of skilled superintendent - - -	—		
TOTAL - - - *Rs.*	5,836	3	9

24. In these charges we have purposely omitted debiting to the factory account any portion of Mr. Broughton's salary. Our reasons for so doing are:—(1) that the factory has been only experimental; (2) that it has never been worked up to the estimated strength; and (3) that, according to Mr. Broughton's views, the process, though requiring trustworthy and vigilant supervision, does not require the attendance of a professional chemist. We may observe, also, that Mr. Broughton's appointment as Quinologist, and the salary appertaining to that appointment, have been already determined by Her Majesty's Government on considerations other than those connected with the local preparation of alkaloids for the use of the public service.

25. Omitting, therefore, any reference to the salary of the Goverment Quinologist, we see that the cost price of the bark consumed in the production of 445½ lbs. of alkaloid was about 2,500*l.*, and that the charges of manufacture brought the total expenditure up to 3,083*l.* 12*s.*, whereas we have seen that the same weight of sulphate of quinine might have been landed in our medical store depôt, Madras, for 2,895*l.* 10*s.* There has, therefore, been a slight loss in local manufacture, assuming that the mixed alkaloids have represented a consumption of an equal weight of sulphate of quinine. The results for 1873-74 will show a rather higher loss than this calculation gives.

26. But as, in point of fact, the mixed alkaloids produced in the local factory consist of chinchonidine, chinchonine, and quinine in varying amounts, combined with resin and uncrystallisable alkaloids, it is obvious that, in a commercial sense, an equal weight of this preparation is not of identical value with sulphate of quinine, which contains about 73 per cent. of the alkaloid "quinine."

27. If we compare the outturn of alkaloids with the prices at present charged for sulphates of chinchonidine and chinchonine, the disadvantage of local manufacture will be still more apparent. Mr. Howard's recent price-list quotes sulphate of chinchonidine at 40*s.* per lb., and, at this rate, assuming the drug to cost 50*s.* per lb., landed in Madras, 1,233 lbs. might have been bought for the sum which we calculate Government has expended in producing 445½ lbs. of mixed alkaloids. Or, if we look to the price of the cheaper salt, sulphate of chinchonine, quoted at 24*s.* per lb., and assume its value, landed in Madras, at 30*s.*, we see that Government might have purchased 2,055 lbs. of this preparation for the same sum that 445½ lbs. of mixed amorpheus alkaloids has cost.

28. The Secretary of State for India has expressed surprise that the cheaper alkaloids should be so little in demand in India, considering the high testimony to their therapeutical value borne by the Chinchona Commission, but the explanation is a very simple one. When the therapeutical value of these alkaloids had been established by the labours of the Chinchona Commission in 1868, indents were made on the Home Government for supplies of these drugs; but the prices charged in the case of chinchonidine and quinidine were actually higher than the current rates for sulphate of quinine; and when the facts

* The price of sulphate of quinine, according to the latest quotations, was somewhat in excess of this figure. (Initialled) *W. R. C.*

facts were brought to the notice of the head of the medical department, he, in the interests of Government, declined to send requisitions for the alkaloids which were not so well known or established in reputation as quinine. The prices of the several alkaloids, in 1868, are quoted in the margin, on the authority of the Medical Examiner of Accounts; and it will be seen that no advantage could accrue to Government, except in the case of chinchonine, from purchasing the alkaloids, which, it was hoped, would prove cheap substitutes for quinine.

		Rs
Sulphate of quinine -	per lb.	32
,, quinidine - -	,,	40
,, chinchonidine -	,,	40
,, chinchonine - -	,,	12

29. The sudden raising of the prices of chinchona alkaloids had the effect of completely arresting the demand for them by Indian medical officers, especially considering the cheapness of quinine at that period, and the manufacturers are themselves to blame for this result. Had they been content to keep the prices of hitherto unsaleable commodities in due proportion to the cost of quinine, there would have been a steady and continuous demand from India for the cheaper alkaloids; but they appear to have gone on the principle of "killing the goose that laid the golden eggs," and they succeeded temporarily in arresting the use of these medicines by putting prohibitive prices upon them. Subsequently, however, the manufacturers have seen fit to diminish the price of sulphate of chinchonidine by 100 per cent. of the charge made in 1868, so that if the price remains at about the present quotations of 40*s.* per lb., there is reason to suppose that the Indian Government might very largely avail itself of this cheap and efficacious alkaloid, in substitution of the more expensive sulphate of quinine.

30. The difficulty in assigning any commercial value to the amorphous alkaloids produced on the Nilgiri estates lies in the fact (1) of their uncertain composition, and (2) the varying proportions of quinine, chinchonidine, and chinchonine contained in them. From some specimens Mr. Broughton has obtained 45 per cent. of mixed crystalline sulphates of quinine and chinchonidine, while other specimens have yielded from 60 to 70 per cent. of crystalline sulphates. If we assume that the rough impure amorphous alkaloids contain, on the average, in five parts, one of crystallisable quinine, two of chinchonidine, one of chinchonine, and one of uncrystallisable residue, we should have, in 445 lbs. of mixed alkaloids, as follows:—

	£. *s.* *d.*
89 lbs. quinine, reckoned as sulphate (about 117 lbs.), at 130*s.* - - - - - - - - -	760 10 –
89 lbs. chinchonine (117 lbs. sulphate), at 30*s.* - -	133 10 –
178 lbs. chinchonidine, or 243 lbs. of sulphate, at 50*s.* -	589 10 –
89 lbs. of uncrystallisable residue (nominal value) - -	—
Total commercial Value - - - £.	1,483 10 –

31. The commercial value of the mixed alkaloids, therefore, even assuming the most favourable calculations of their proportions and quantities, is seen to be less than one-half the value of the raw material and manufacturing charges, the value being less than 1,500*l.*, and the cost rather above 3,000*l.*

32. Mr. Howard holds out hopes that the sulphate of chinchonidine—an alkaloid which is very largely produced in the red barks grown in India—may in time be produced so as to sell in this country for one rupee per ounce. We have no doubt that a medicine of known and certain composition such as this is, resembling sulphate of quinine in taste, form, and appearance, would be preferred by the majority of practitioners to the amorphous alkaloids, which are always varying in composition, and which have no physical resemblance to the ordinary quinine-salts. We have already shown that, according to present prices of raw material, the Government can purchase nearly three times the amount of this salt for the cost of the same amount of rough mixed alkaloids; and while the price of chinchonidine remains low, according to the latest quotations, it is abundantly clear that Government cannot continue to manufacture locally at a profit.

33. In this inference, from the facts before us, we must not overlook the difficulties that have been surmounted by Mr. Broughton in the preparation of the active febrifuge alkaloids of the bark. His original instructions were, that he should, "through his investigations, enable Her Majesty's Government to arrive at a decision with respect to the cheapest and best method of preparing the febrifuge for use among the labouring classes of the natives of India, and for the use of hospitals and troops in India."

34. In his letter, dated 1st December 1873, Mr. Broughton has entered most fully into the details of his process of manufacture of the amorphous alkaloids. We need not repeat the details of procedure in this place. It is sufficient to record that the manufacture is so conducted that no single process in it admits of simplification. The process has been designed throughout to suit the circumstances of the country, where the appliances are necessarily rude and the labour unskilled. With a more perfect laboratory, machinery, and modern appliances, it is admitted that better results might have been attained, but at a cost scarcely commensurate with the outlay. Mr. Broughton's arrangements for the alcoholic extraction of alkaloid from the lime-precipitate are especially deserving of notice, for

their simplicity, ingenuity, and efficiency. Samples of the exhausted lime-precipitate were tested, and found to be absolutely free from alkaloid. The waste of alcohol is theoretically nil, and practically no more than 3 per cent.

35. But, notwithstanding the obvious care and studied simplicity in the appliances used for the extraction of alkaloids, Mr. Broughton records, in his experience of the year 1872-73, that whereas he estimated by analysis of samples that the bark supplied to him in that year would have yielded 538 lbs. of mixed amorphous alkaloids, the actual yield was only 345¼ lbs., or 35·6 per cent. below the estimated amount; in other words, more than one-third of the total alkaloids contained in the bark were lost in the process of extraction. All manufacturers are practically aware of the difficulty of obtaining, on a large scale, the same results as a small experimental analysis in the laboratory affords; but the loss of more than one-third of the total alkaloids appears to us to be much too high for profitable working. Owing to the reticence of commercial manufacturers of quinine on all subjects connected with the secrets of their trade, it is not practicable to state what the ordinary loss of alkaloid is, but there can be no doubt that there is an appreciable loss under the most favourable circumstances of manufacture.

36. The loss of alkaloid occurs in various ways. In the first place, from examination of specimens of exhausted bark, it is certain that the whole of the alkaloid is not extracted in the various boilings. A specimen of spent bark examined for us by Mr. Broughton yielded 0·08 per cent. of alkaloid. Then, again, there is a slight loss in the lime-precipitation, as the alkaloids are sparingly soluble in limewater. In grinding the lime-precipitate and amorphous alkaloids, as finally precipitated after their extraction by alcohol, there is a further loss; but probably the greater portion of the loss occurs from the carelessness of the coolies in spilling the fresh bark, decoctions, precipitates, &c. Much of the loss is preventible, as we may briefly indicate.

(*a.*) Mr. Broughton has always dwelt upon the advantages of operating upon green bark, as it is said to part more readily with its alkaloids. The European manufacturers, however, have necessarily to operate on dried bark, which is reduced to a powder. In the Neddivuttum factory the bark is put into the boilers, just as received from the estate, in long strips, without any preliminary crushing. In practice, it is found that a small portion of the alkaloid remains unextracted after four or five boilings in dilute acid. It seems to us that, if fresh bark be used, it should be torn up or crushed by passing it through rollers with cog-teeth, so as to lacerate the cellular tissue of the bark, and thus allow the acid to penetrate it more freely. If this were done, it seems probable that more alkaloid would be extracted with fewer boilings, and with a smaller consumption of fuel.

(*b.*) The mechanical arrangements for pressing the bark, and separating the dissolved alkaloids from it, appear to us to be imperfect, and capable of improvement. An apparatus, something on the principle of the cider press, as used in the West of England, would probably be more effectual in squeezing the bark dry.

(*c.*) In the arrangements for dissolving the alkaloids by alcoholic percolation from the lime-precipitate, there is unnecessary waste of heat. Each percolator is now fed by a separate fire, whereas by a system of flues one or two fires would supply heat for the whole number. Mr. Broughton alludes to the cost of fuel, and the difficulty of procuring wood, but a re-arrangement of the heating apparatus would economise fuel and lessen expense on this account.

(*d.*) Suitably constructed mills for grinding the lime-precipitate and amorphous alkaloid would lessen waste. At present the common domestic grain-mill is used, and a good deal of the finer particles of lime-precipitate and of the finally precipitated alkaloids fly off as dust, which cannot be re-collected.

37. The various improvements suggested would cost money in the way of machinery and skilled labour, and it is questionable how far the increased yield of alkaloid would compensate for the outlay; but the experience of European manufacturers of alkaloids seems to be in favour of great nicety of manipulation, aided by all the resources that modern mechanical and chemical science can afford.

38. In recording the present failure to manipulate our chinchona barks locally at a profit, we must point out that Mr. Broughton has never been in the position that a commercial manufacturer would have been in, had he undertaken the local production of alkaloids. Mr. Broughton has had no control over the quantity and quality of the bark brought to the factory. He has had to work with small or large prunings, trunk bark, bark of sickly or decayed trees, just as it has been convenient for the superintendent of the plantations, exercising a due regard for the conservancy of the estates, to supply. In the early years of the plantations it is a necessary consequence that much of the bark should be young, and of little value for manufacture. We are informed, however, that by working the plantations on the mossing system, the proportion of trunk bark available will very much exceed the amount of inferior prunings, and that in future there will be no difficulty in supplying the factory with bark of a quality that is ordinarily used in European manufactories. The yield of alkaloid from green bark, in the four years

of manufacture, has increased from ·12 per cent. to ·43, or nearly fourfold. This increase of yield is probably due in part to better quality of bark supplied, and probably in part, also, to the more effectual methods of extracting the alkaloids. Mr. Broughton has further had the disadvantage of being obliged to work up green bark at certain seasons of the year only, and of working chiefly with the one species of bark (*succirubra*), which the commercial manufacturers all allow to be the most difficult to work.

39. A commercial manufacturer, on the other hand, would always exercise the privilege of selecting his bark, using only such qualities as experience and analysis would indicate to yield a profitable result. He would distribute his operations so as to give employment to his factory establishment throughout the year, and by these and other measures he would seek to reduce the cost of production to a minimum. As a matter of fact, the laboratory establishment at Neddivuttum has never been worked up to its full power, partly owing to the inferior quality of the prunings supplied, which give all the labour and expense attending the manipulation of the best barks, but with one-fourth or less results, and partly owing to the inability of the plantations, in their immature condition, to supply enough bark to work up 600 lbs. of alkaloid annually.

40. The manufacture of chinchona alkaloids for the whole civilised world is a monopoly in the hands of about a dozen European firms. It is but reasonable to suppose that years of practice in this particular business have given rise to improvements in method of procedure, which, to a large extent, determine the question of profit or loss. It is understood that the methods of working in quinine factories are secrets guarded with jealous care. In the instance of one eminent British firm, we are informed that the partners are under agreement never to admit a stranger to witness the process of manufacture. Mr. H. J. Howard states that "the apparatus used is costly, and the staff highly paid;" but this is the extent of the information he affords on the subject of manufacture. It is understood that the plant and machinery of the Messrs. Howard have cost upwards of 100,000*l*, and it must be obvious that, with their great facilities for making the most of the bark they use, the rude and simple appliances of our local factory cannot possibly compete.

41. Mr. Broughton's method of working, however, has been published to the world in all its details. His experimental manufacture has been initiated and pursued under many disadvantages peculiar to India. There has been no costly apparatus or highly-trained staff, and the processes he has indicated may be pursued by almost any person of moderate intelligence after a few weeks of training. The principal items of cost are the salaries of the superintendent and coolies. All the ingredients used in the factory, with the exception of sulphuric acid and caustic soda, are obtained in the country, and the cost of acid, soda, and alcohol seems to be small in comparison with the work done. The one great disadvantage in local manufacture, according to past experience, is the considerable waste (amounting to more than one-third) of alkaloids known to be present in the barks. Further experience and improved appliances will tend to diminish waste of alkaloid, so that in time the theoretical and practical yields will probably more closely approximate. Considering all the difficulties of manufacture in this country, we do not think the results have been altogether unsatisfactory, though, as we have already shown, the experiment has not been a commercial success.

42. From the report on manufacture of alkaloids in Java (in G. O., No. 55, of 14th January 1874), under the direction of Mr. Moens, the quinologist of the Dutch Government, it is important to note that similar results to our own have been recorded. It is stated that "the weight of alkaloid obtained each time was not in proportion to the real bulk of the bark experimented upon;" and, further, "we have not up to the present time been able to declare that there was any profit in local manipulation of chinchona refuse, and it is very doubtful whether we could work out good chinchona bark with profit, as it has up to the present commanded such high prices in Europe that, taking labour and expense of manipulating into account, we could not possibly produce more value in alkaloids. Without an extensive and complete establishment, the fabrication of alkaloids will certainly remain costly and defective, and this is the opinion also of Dr. Jobst, the great quinine manufacturer of Stuttgardt. French manufacturers also have tried without success to prepare alkaloids in America, at places producing chinchona, with profit."

43. The circumstances attending the French experiment in South America are not accurately known to us; but we understand that Messrs. Delondre, the great French manufacturers of quinine, some years ago sent out skilled assistants and *all needful appliances* to work up bark in the country. The experiment was not successful, but we have no data before us explaining the causes of failure. In Java the result of attempts to work up inferior barks was so unsatisfactory that the manufacturing operations have been discontinued, partly, however, because the eight plantations are so distant from each other, that eight separate factory establishments would be necessary to work up the fresh barks.

44. The Java reporter, however, adds, with reference to the manufacture of alkaloids from the *C. succirubra*: "Rough mixed alkaloids will be much more easily prepared in mass in India than here, not only because the *succirubra* produces a large quantity of that article,

article, but also because, up to the present time, this bark is the least inquired after in the European market." From this report we learn that the authorities in Java are giving their attention to the cultivation of a species of *C. calisaya*, "which produces regularly from 5 to 10 per cent. of pure quinine, which is also easily and perfectly separated;" and that they are not cultivating on a large scale species of barks whose chief yield is the commercially inferior alkaloids of chinchonidine and chinchonine.

45. In considering the question of continuing the local production of rough alkaloids in this country, we have to take into account the fact that the Government plantations on the Nilgiris alone contain upwards of half-a-million of trees of the red bark species, which are valuable, not so much for their quinine-yielding properties, as for their rapid production of a bark yielding large per-centages of other alkaloids. While the present prices of bark are maintained, we do not think that the inferior alkaloids can be possibly produced in India at a profit; but all experts in such matters agree in thinking that present prices cannot be maintained when the supply of crown and calisaya barks from India and Java is sufficient in quantity to influence the home market. These barks, according to Mr. Howard and the Dutch authorities in Java, must, in future years, be the chief sources of quinine. It must, therefore, remain an open question whether the manipulation of the red barks should be conducted in India, or by home manufacturers on Government account. If, on account of the present high value of these barks in the home market, Government may see fit to suspend manufacturing operations in India, no harm will be done. Operations can be resumed whenever the prices of the raw material fall sufficiently to discourage exportation and to make local manufacture expedient; and in the consideration of this question there is a point of some importance, bearing upon the cost of bark for exportation. Mr. Broughton has in use all the buildings at Neddivuttum, except a thatched shed, and unless these can be placed at the disposal of Mr. McIvor for drying purposes, which Mr. Broughton says it is impossible to do so long as his process is at work, other buildings for drying must be raised at a considerable cost.

46. The next subject before us is the medicinal value of the rough mixed alkaloids, as supplied by Mr. Broughton to the Medical Store Department.

47. Carefully recorded trials of this preparation were made in 1869, and the results published in the "Madras Medical Journal" by Mr. Cornish. These results were almost wholly favourable to the use of the mixed alkaloids. The experiments were conducted especially in localities which were noted for their fever-generating qualities. Again, in his letter, No. 189, of 28th April 1874, Surgeon General Balfour gives the results of 1,882 cases of periodical fevers treated by the amorphous alkaloids in the Wynaad, Upper Godavery, &c., and the conclusion he has come to is "that amorphous chinchona alkaloids are a sure febrifuge, but little inferior to the European chinchona alkaloids," and that if the preparation supplied by Mr. Broughton "can be sold at one rupee per ounce, or a cheaper rate, it is extremely desirable that it should be manufactured in larger quantities." (Unfortunately, there is no hope, while prices of bark continue as they are now, that the alkaloids could be profitably sold at one rupee per ounce, the actual cost of production in 1872-73 being nearly four rupees per ounce).

48. In our opinion there can be no reasonable doubt, apart from all prejudice and preconceived opinions, that the amorphous alkaloids, which contain all the active febrifuge principles present in chinchona-barks, are efficacious and useful in hospital and dispensary practice, quite equal, in the great majority of cases, to the purified chinchona-salts supplied to us by home manufacturers; but for many reasons we believe their chief employment must be limited to public hospitals and charities, and that the preparation is one that will take a long time before the native public will estimate at its true value.

49. The preparation is sent into our store depôts in the form of a yellowish-buff or brown powder, in no way resembling the quinine-salts of commerce. It differs also in taste and in ready solubility, and although these are minor objections to the use of a cheap febrifuge (if one can be prepared) in hospitals or public institutions, they are objections of a nature to interfere very seriously with the popularity of the remedy amongst the native public who buy for themselves.

50. In the judgment of the medical profession the great objections to the use of the mixed alkaloids will be the uncertain composition of the mixture. If, for instance, the bark used in the manufacture is rich is quinine, the amorphous alkaloids will consist chiefly of it; but if chinchonidine or chinchonine predominate, then the mixture will partake most largely of the qualities of those alkaloids. There is no stability in the preparation, because the barks sent into the factory are constantly varying in their alkaloidal value. This might, to some extent, be obviated by working regularly with the better quality of the red trunk bark, in which the proportions of alkaloid are more constant; but the objection as it stands is not a mere fanciful one. A specimen of crystalline sulphates in Mr. Broughton's laboratory, when tested for quinine, showed that alkaloid to be entirely absent. Other specimens of amorphous alkaloid showed quinine to be present in fair amount; but it is obvious that a preparation which is constantly varying in regard to the relative proportions of the several alkaloids is not of a character to inspire confidence on the part of prescribers. Medical officers in India, as a rule, do not question the therapeutical value of the chinchona alkaloids allied to

quinine; but they have a preference for knowing the exact composition of any mixture of the alkaloids.

51. And as regards the native public, for whose special benefit a cheap form of febrifuge is desiderated, we must bear in mind the fact that sulphate of quinine is a medicine which is known and finds a sale in every bazaar in the country. The people have every confidence in the crystalline salts of quinine; but it seems extremely unlikely, with their fancies and prejudices, that the brown-looking powder of the rough mixed alkaloids will ever be regarded as identical with the quinine of which they have had experience.

Fancies and tastes are all-powerful in regard to therapeutical preparations, and when the native public are concerned these fancies and tastes cannot be overlooked.

52. The name given to the mixed alkaloids by the late head of the Medical Department, Dr. W. McKenzie, C.B., has been objected to in the public papers, and with some show of reason. The term "amorphous quinine" might have led some persons unacquainted with the nature of the preparation to suppose that the mixture consisted entirely of quinine in an amorphous state. But in regard to the actual nature of the preparation there has been no disguise or concealment. The term "amorphous chinchona alkaloids" would, no doubt, have more correctly described its composition, though it would not be so readily understood by the natives of India.

53. Government are probably aware that the alkaloid "quinine" was discovered only in the year 1820, and that for 150 years prior to this date the chinchona barks in their natural state were employed in Europe for the cure of fever. In 1845 the alkaloid "chinchonidine" was discovered, and in 1849 "quinidine." Up to the years 1853 or 1854, all the sulphates of quinine of commerce consisted of the mixed alkaloids, just as they existed in the various barks. The tests now employed to ascertain the purity of quinine only came into use on the publication of a new British Pharmacopœia in 1854. The framers of the Pharmacopœia at this period had no experience of the therapeutical qualities of the alkaloids quinidine, chinchonidine, and chinchonine; and they adopted tests for the quinine of commerce which virtually compelled the manufacturers to separate them at great labour and expense, and with the result of enormous waste of febrifuge material. This action of the framers of the Pharmacopœia has tended more than anything else to the maintenance of high prices of quinine, because the manufacturers have had thrown back upon their hands enormous quantities of alkaloids (almost identical in chemical constitution and behaviour with quinine), which, being repudiated as unauthorised or unsanctioned by the Pharmacopœia, become, in a great measure, unsaleable to the medical profession.

54. It will scarcely be credited that the last edition of the British Pharmacopœia (1867), while giving a wholly impracticable formula for the manufacture of sulphate of quinine, and tests to ascertain the purity of that salt and its freedom from the other alkaloids, is altogether silent in regard to the mode of preparation or uses of quinidine, chinchonidine, or chinchonine. The medical profession, in fact, to this day have no authority or sanction to employ these alkaloids. But since the official issue of the last edition of the British Pharmacopœia, there has been accumulated in India such a mass of evidence bearing on the question of the therapeutical value of these alkaloids that their official admission into the authorised code of remedial agents is merely a question of time. Already, according to Mr. Howard, the salts of chinchonidine are making their way in the estimation of the profession, and especially for hospital use, and, being only half the price of quinine, are in demand. We understand, moreover, that a large foreign firm intend, in future, to manufacture mixed sulphates of chinchona alkaloids in the proportion in which they exist in bark; and we have no doubt that the more clearly this question of the therapeutical value of the mixed alkaloids is understood by the medical profession, the sooner will they demand to be supplied with the febrifuge alkaloids in the proportion that they have been combined in the barks by nature, and the more determinedly will they risk the pedantic efforts of the compilers of the Pharmacopœia to deprive them of a plentiful supply of one of the most valuable febrifuges the world has ever produced.

55. The evil of this attempt to separate the associated alkaloids from quinine is not so apparant in countries where the tests for quinine are well understood; but it has had the effect of throwing upon manufacturers' hands a great quantity of alkaloid that is practically unsaleable, and therefore unused. Honest manufacturers, who know the worth of these alkaloids, call them by their proper names, and endeavour to induce medical men to pronounce dispassionately on their merits; but there are other producers not so scrupulous, and the foreign markets of India and China are occasionally flooded with something that professes to be "quinie sulphas," but which, in some cases, is a salt of chinchonine, and in others no chinchona alkaloid at all. Only a few months ago a medical man in Madras made a public complaint that, having prescribed quinine for a patient, he found that the mixture dispensed on his prescription by one of the best druggists in the town contained no quinine, and that the druggist's stock of "quinine" consisted entirely of a salt of "chinchonine."

56. Indian experience has sufficiently demonstrated that there is nothing in the therapeutical or physiological action of the various chinchona alkaloids to justify the framers of the

the British Pharmacopœia in insisting upon the separation of quinine, and its preparation in a condition of purity. By this grave error, during the past twenty years the consumption of quinine has been limited, while thousands of pounds of associated alkaloids, equally valuable in a remedial sense, have been wasted, and the world at large has suffered, and none but a few unscrupulous manufacturers and dealers have benefited by the waste. The whole of the Indian evidence on the use of the associated alkaloids should be officially laid before the Royal College of Physicians of London, with a request that the influence of that august body may be brought to bear to obtain a recognition of mixed chinchona alkaloids as a pharmacopœial preparation. These several chinchona alkaloids may be isolated as chemical curiosities; but for real practical therapeutics, the experience of the profession from the year 1820 to 1854, and the Indian experience of the value of the separated alkaloids, all testify that the labour and expense incurred in such separation is unnecessary, and only calculated to keep up the prices of remedies which the philanthropist would desire to cheapen for the benefit of the whole human race.

57. While, therefore, in the public service of this country there is no necessity to incur expense in the isolation of chinchona alkaloids, it must be borne in mind that the public (apart from the medical profession) have become so accustomed to the use of crystalline preparations of chinchona alkaloid that it would be a work of time to popularise a preparation of them which stops short of the crystalline form.

58. In our opinion, if local manufacture is to be carried on at all, an attempt should be made to obtain crystalline salts of chinchona alkaloids. For the public service these salts need not be "bleached," as the commercial manufacturers issue them; but we are certain that the medical officers of the Government establishments would prefer to use mixed sulphates to the present amorphous powder. Any uncrystallisable residue in this manufacture might be usefully employed in hospital practice for the treatment of mild fevers, or as a tonic. Mr. Broughton is doubtful whether the preparation of the mixed sulphates could be economically conducted in this country. He would require some addition to his manufacturing plant, and in regard to this question, generally, he will be requested to state his views for the information of Government. We are of opinion that, if it be determined to try experimentally the production of mixed crystalline salts of chinchona alkaloids, the inferior bark suited only to druggists' use should not be worked, but that the factory should be supplied with the best quality of red bark for this object.

59. The manufacturing operations during 1873-74 have not been so satisfactory as in the former year. The amorphous alkaloids, when sent into the medical stores, were found to cake and run into a sticky mass, so that it could not be utilised, except by solution in an acid. The cause, Mr. Broughton explains, was an error in manufacture. To obviate waste of alkaloid, he adopted the plan of concentrating the bark-decoctions to one-sixth of their bulk before adding lime to precipitate the alkaloid. In this process of concentration the decoctions were boiled in the copper boilers, and, as the fluid evaporated, some portions of alkaloid caked or collected at the bottom of the boiler, and became overheated, and changed in its constitution so as to become uncrystallisable. The error has been rectified by stopping the concentration of the fluids at one-third of their original bulk, but much of the product of the year 1873-74 has been changed in form, and Mr. Broughton has proposed to issue the quantity thus deteriorated in solution. As, however, this mode of dealing with the product would most likely shake the confidence of medical officers in the value of amorphous alkaloids, the Sanitary Commissioner suggests that Mr. Broughton had better be instructed to recover all the crystalline alkaloid he can get from the mass now in the factory, and issue it as "unbleached sulphate," rather than attempt to induce medical officers to use it in solution. Some loss is unavoidable, but as it seems probable that the concentrated solution proposed by Mr. Broughton would remain to ornament provincial dispensary shelves, we think it more to the advantage of the public service that the product should be sent out in such a form that medical men will have no hesitation in using it.

60. We have now expressed our views in regard to the two questions submitted for our opinion; but before concluding this report it is necessary that we should refer to the original estimates of the cost of local production of alkaloids, to show how the Government has been led to believe that a cheap alkaloidal febrifuge for the people of this country was possible.

61. In Government Order, No. 249, of 7th February 1871, Mr. Broughton gave estimates of the yearly expenses for the local production of 800 lbs. of mixed alkaloids, and the information then afforded led Government to believe that the rough mixed alkaloids could be produced for about one rupee per ounce. On referring to this estimate, however, we find that Mr. Broughton, as far as his actual results are concerned, has been quite within the limits of cost there assigned, except in regard to one important particular, *i.e.*, the value of the bark.

62. With regard to the value of the bark, Mr. Broughton stated: "I am informed by Mr. McIvor that the cost *on the spot* of red bark will range from 4 *d.* to 6 *d.* a lb. I adopt the higher price in the estimate, and reckon its mean yield at the low one of 4 per cent." With these data Mr. Broughton estimated that one pound of alkaloid

might be produced for *Rs.* 14. 6. 7, or, adding 5 per cent. on cost of plant, for about 16 rupees a lb.

63. We have examined Mr. McIvor, with a view of learning how he arrived at the opinion that dry bark delivered on the spot would only cost Government from 4 *d.* to 6 *d.* per lb. He explains that his estimate of cost of production had reference only to the expenses of cultivation and collection; that he did not take into account the original outlay incurred by Government in planting the estates; and that he is not prepared to state what the actual cost of production is, including every source of outlay. It is clear, therefore, that the original estimate on which Government hoped to be able to manufacture a cheap febrifuge was an erroneous one.

64. It will be observed that instead of debiting the factory with 6 *d.* per lb. all round for bark supplied, we have adopted that rate only for inferior branch bark, and have charged the present net value of 2 *s.* for the trunk-bark. This, in regard to about three-fourths of the outturn of alkaloid, shows a ratio of 300 per cent. for raw material above the price originally estimated. The average yield of the bark supplied was also less than the estimated 4 per cent. Under these circumstances, it is sufficiently obvious why the actual cost of the alkaloid should be nearer four rupees than one rupee per ounce.

65. The views expressed by the Secretary of State have throughout been clear and consistent in regard to the Government experiment of chinchona culture—*i. e.*, that it was not to be regarded as a mere mercantile venture, but that the more important result of affording an abundant supply of febrifuge for Her Majesty's Indian subjects was to be considered paramount. Later expressions of opinion of the local Government would seem to indicate that the commercial aspects of the experiment are regarded as of primary importance.

66. Combinations of business and philanthropy are rarely successful, and, in regard to the supply of a cheap febrifuge to the people of India, this can only be possible when the raw material for alkaloid manufacture shall be so abundantly produced as to diminish its commercial value. The question of local manufacture of alkaloids is one of no permanent importance, because, so long as barks yield high prices, the more economical processes and better appliances of home manufacturers will enable them to compete successfully with local manufacturers. The value of raw material in the open market must always determine the cost of chinchona alkaloids.

67. There is one subject beyond the limits of our instructions on which we desire to offer a few remarks. In the course of our examination of the Government plantations at Neddivuttum we were much struck with the robust growth, as compared with established species of the same age, and exposed to similar conditions of soil and climate, of [illegible] seedlings resulting from hybridisation. Plants, such as we describe in a young plantation of *C. succirubra*, had attained double the height and lateral expansion of the young red barks, and gave every indication of robust health and great vigour of constitution. The hybridisation of the several species of chinchona is, perhaps, the most interesting and promising feature in connection with this great experiment. In their native country it is well known the various species of chinchonæ flourish in different localities hundreds or even thousands of miles apart, where the opportunities of cross-fertilisation of the flowers are rare or wanting. But in the Government plantations we have growing side by side the grey barks of Peru, the crown barks of Condaminea, the Calisayas of Bolivia, and the red barks of Loxa, and the result is now seen in the different habits and characteristics of the seedling plants raised on the estates.

68. The fact of the readiness of the various species of chinchona to receive fertilisation from a neighbouring plant is now abundantly proved, and we would desire to offer a few suggestions for consideration, showing how this natural peculiarity of the plant may be utilised in the artificial production of new varieties that shall be superior to any we at present possess in perfect adaptation to our soil and climate and in alkaloid [illegible] properties. The field of inquiry we refer to is one of vast proportions, and will require to be pursued patiently perhaps for many years to come; but anyone acquainted with the results of scientific horticulture as applied to the specific improvement of particular plants must be well aware that the judicious crossing and selection of the various species offers the greatest promise of eventual success, and that by patiently following this path Government may be enabled to produce a chinchona plant that shall be perfectly fitted to supply the population with the greatest quantity of febrifuge in the least possible lapse of time.

69. Mr. McIvor some years ago showed the importance of this phenomenon of hybridisation, and indicated the direction in which it might lead. Mr. Broughton also, in his contribution to the Linnæan Society, has shown that the chinchonæ are dimorphous, and are preferentially impregnated from separate trees. We now learn from Mr. McIvor that he has raised seedlings from artificially-fertilised seeds, and that he has crossed the Calisayas with robust hybrid species. The extraordinary yield of alkaloid of the *C. Angustifolia Pubescens* and some other varieties of seedlings show the direction in which the future experimental culture of the Government may be profitably turned. But we would advise

advise that the whole question of artificial hybridisation of promising species should be carefully worked out by the Superintendent and Quinologist in intimate communication.

70. Every distinct variety of plant should be noted by the Superintendent, and examined in different stages of its growth by the Quinologist, and the results recorded; and a careful public record should also be kept of every experiment in cross-fertilisation. The original instructions of the Secretary of State that the superintendent of the plantations and the Government Quinologist should work together in intimate communication cannot be too strongly insisted upon, as regards all the great scientific questions connected with the improvement of the chinchonæ for yield of alkaloid. We regret to observe that there is not at present that cordiality and harmony in the working of these public officials (both eminent in their several spheres) which we think conducive to the best interests of Government; and we notice the subject simply because we are anxious that these gentlemen should, in the interests of the State, unite to shed new lustre on their scientific reputations by a patient and thorough investigation of the qualities of artificially or naturally produced new varieties of the febrifuge-yielding plants.

71. In conclusion, we may briefly summarise the main results of our inquiry:—

(1.) The cost-price of mixed alkaloid issued by Mr. Broughton for use in the Medical Department, compared with current prices of bark, is somewhat in excess of the present price of sulphate of quinine, more than double the cost of sulphate of chinchonidine, and rather more than four times the cost of sulphate of chinchonine. The calculations do not include any portion of the salary of the Government Quinologist.

(2.) The original estimates on which Government commenced manufacturing operations were fallacious as regards the value of the raw material used. The cost to Goverment of dry bark was assumed at 6 *d.* per lb. without any foundation in fact.

(3.) The results of manufacture show a progressive improvement in yield of alkaloid up to the end of 1872–73. (The results for 1873–74 have, to some extent, been vitiated by an error in the manufacturing arrangements, since detected and rectified.)

(4.) There is still a considerable difference between the *estimated* and *actual* yield of alkaloids (more than one-third).

(5.) The processes of manufacture are simple, and the appliances rough. Better results may be anticipated with modifications suggested, and by working with a better quality of bark.

(6.) As regards the medicinal value of the amorphous alkaloids, there is ample testimony in favour of their efficacy in curing fevers; but the remedy being in strange and novel form is more adapted for hospitals and public institutions than for sale to the native public, who are already familiar with the properties and appearance of quinine-salts manufactured in Europe.

(7.) The manufacture, it is suggested, should be carried one stage further (to the production of crystalline sulphates), if it is thought desirable in the present condition of the bark market to continue local operations.

(8.) The hybridisation of species of chinchona is a phenomenon that brings us to the threshold of a new department of inquiry and research, which might be profitably entered upon by the scientific officers entrusted by Government with the progress of the experimental culture of the chinchonas.

(9.) The cordial co-operation of these public officials is essential to successful issues.

Enclosure 8, in No. 40.

MINUTE by the Honourable *J. D. Sim*, C.S.I.

IN his letter, dated 14th March last, No. 22, the Commissioner of the Neilgherries drew the attention of Government to the fact that some branch crown-bark, which h been considered not worth working up in the Neilgherry Factory, and which Mr. Broughton had deprecated sending to England as likely to injure the reputation of Neilgherry bark in the home market, had there realised prices ranging from 2 *s.* to 3 *s.* 6 *d.* per pound.

2. This naturally suggested doubts as to the working of the factory; and, as the best means of arriving at a satisfactory conclusion on so important a point, the Government deputed the Sanitary Commissioner, Mr. Cornish, and the Commissioner of the Neilgherries, Mr. Cockerell, to investigate the subject on Mr. Broughton's return from leave, and to report specially on the cost and the medicinal value of the "amorphous quinine" manufactured by that gentleman.

Government Ord
22 June 187[illegible], N
759, paragraph 1

3. The Committee met at Ootacamund last month, visited the factory at Neddivuttum, and examined Mr. Broughton and Mr. McIvor. The result of their inquiries is contained in the report now before us.

4. The committee show clearly that, on the most favourable calculation, we are paying twice as much for our "amorphous quinine" as it is worth. The 445 lbs. manufactured in 1871-72 and 1872-73 cost us about 3,000 *l.*, and are worth 1,500 *l.* The results of 1873-74 are not given; and in the current year, as we know, a mistake in one of the processes has led to the loss of a considerable quantity.

5. But not only is the cost of manufacture thus excessive, but the article produced is of inferior quality. Of the efficacy of the mixed alkaloids as a febrifuge there can be no doubt, but the drug as prepared and issued is of uncertain composition: sometimes it is rich in quinine, at others chinchonidine and chinchonine predominate. This is obviously a very serious objection, and the form in which the preparation is issued is also inconvenient.

6. Under these circumstances, it is obvious that the manufacture should at once be abandoned. There seems scarcely any reason to expect any material improvement to compensate for the great waste of alkaloids, or to render it desirable for the Government to establish a public manufactory. Similar attempts have failed in Java and America, and the Government may well leave the matter to private agency. Should circumstances hereafter render it desirable to revive the attempt to manufacture, this can easily be done; meanwhile, by closing the experiment a considerable saving will be effected, and new buildings need not be constructed at Neddivuttum, as otherwise they must be, for drying the bark as harvested.

7. Mr. Broughton has now formally resigned his appointment, in terms and on grounds that would have necessitated its acceptance, even if his manufacture had been a success, instead of a failure. Mr. Broughton's qualifications as an analytical chemist are undoubtedly of a high order, but his usefulness as a public officer has been marred by his lack of other necessary qualifications. By the Government he has uniformly been treated with the utmost consideration, and no one can read the report of the Commissioners without seeing that, so far from having any bias against him, the reverse is really the case. Mr. Broughton, however, cannot brook even an honest difference of opinion, or the slightest semblance of authority over him, and I am driven to the conclusion that his usefulness to the Government has ceased.

8. I do not think there is any necessity now for a chemist, certainly not for such a heavy expenditure as Mr. Broughton's employment entails. The whole of our bark will now be sent to the Secretary of State, and samples can be selected at the India Office from each consignment as well as sent from hence, and arrangements might be effected with Mr. Howard and Dr. De Vrij for the analysis of these at considerably less cost than the employment of a chemist in this country will entail, while we shall have the advantage of analysis by two independent individuals. I should deprecate Mr. Broughton having anything to do with our bark, his animus against both commissioner and superintendent being self-evident.

9. Mr. Broughton has been allowed such independence that we do not know what work he has on hand. He should be informed that no further manufacture is to be undertaken, and he should be desired to state what other work he is engaged upon, when it will be finished, and whether he wishes to leave before his six months' notice expires. The factory buildings should all be made over to the commissioner, and the bungalow now occupied by Mr. Broughton should be constituted the residence of the Superintendent of the Government Gardens, whose present dwelling is very inconveniently situated, and needs repair and enlargement.

10. The Commissioner must be instructed to send the whole of the bark to England, with samples, and the fullest information regarding each consignment.

11. We must now ask the Secretary of State to endeavour to arrange with Messrs. Howard or other suitable persons for the manufacture from our Succirubra bark of chinchonidine sulphates for use in this country, as suggested by Mr. Howard a short while ago, or, as suggested by Mr. Cornish, a combination of the different alkaloids.

12. We must request the Secretary of State's attention to paragraphs 53-57 of the report.

13. The superintendent of the plantations has paid due attention to the raising of new species by hybridising, and it is in this direction that, in my judgment, any extension of our operations should be carried on. In the annual report special notice should be made of new varieties.

14. The committee properly attach great importance to cordial co-operation between the superintendent of the plantations and the quinologist. The only way to attain this very necessary and desirable object is to restrict each to his own special work; the quinologist should no more be allowed to meddle with purely horticultural matters than the superintendent with the operations of the factory. There was no lack of harmony until Mr. Broughton went out of his way to assail Mr. McIvor on the question of coppicing *versus* mossing.

19 December 1874.

(No. 130.)

MINUTE by His Excellency the Commander in Chief.

THE report by the Commissioner of the Nilgiris and the Sanitary Commissioner on their inquiry into the working of the Neddivuttum Factory, and on the medicinal value of its products is most exhaustive, and places these matters before us in the clearest light.

2. The Hon. J. D. Sim's Minute touches upon every point of interest, and I have nothing to do but to express entire concurrence in the views he expresses.

3. The thanks of Government should, I think, be offered to Mr. Cockerell and Mr. Cornish for their very able and impartial report.

4. As regards Mr. Broughton, we can have no hesitation in accepting the resignation he tenders in such uncourteous terms.

20 December 1874.

(No. 131.)

MINUTE by His Excellency the Governor.

THIS well-considered and exhaustive report shows conclusively that the manufacture of "amorphous quinine" in this Presidency is carried on at a very serious loss to the public revenue; that we might have imported for use in this country an amount, fully equal to that of the "amorphous quinine" which we have manufactured, of an article which is, for all practical purposes, very far superior to it, and at a rather less cost. And this, although the salary of the "quinologist," which is a very serious item in the expense of our manufacture, has been excluded from the estimate of that expense, nor does it appear that there is any prospect, such as can safely be relied upon, of material improvement in this respect. To continue the experiment would, I have little doubt, lead only to a still further waste of public money; and I would order the immediate suspension of the manufacturing operations, the buildings being utilised, and machinery disposed of to the best advantage. Mr. Broughton's resignation must be accepted; and the question must be decided in what manner he is to be replaced. It is evident that, with the suppression of the manufacture, the necessity for the appointment of a highly-paid official will no longer exist; and, for my own part, I should suppose that, for the future, functions, in the nature of those of a "quinologist," are altogether unnecessary. The properties and value of the various barks are now known; and what we have to do for the future is to send the produce of our plantations home for manipulation there in the best condition which may be consistent with remunerative production. The papers must, of course, be sent to the Secretary of State, and, until we receive his instructions, no irrevocable action can be taken in the matter. I trust that the result will be that this branch of commerce into which, setting aside general principles, Government has entered, will be in no further danger of financial failure.

24 December 1874.

(No. 132.)

MINUTE by the Hon. *W. Robinson*, C.S.I.

THE report is exhaustive and conclusive; but I think that these papers should go to the Secretary of State before we finally decide to abandon local manufacture. I see, too, that in Bengal they are about to try local manufacture, and the result of our experiment should be communicated to that Government.

I fear that there is nothing for it but to accept the notice of resignation on the part of Mr. Broughton, but I greatly regret it. At the same time, I do not think that we should be without independent local chemical advice in the matter of the chinchona experiment. Possibly, we might utilise the quinologist of Bengal (Mr. Wood).

2. The thanks of Government are due to the Commissioner and Dr. Cornish.

3. I agree to the arrangement proposed by Mr. Sim in regard to the house in the gardens.

27 December 1874.

ORDER of the Madras Government thereon, 11 February 1875.

IN his letter, dated 14th March last (No. 22), the Commissioner of the Nilgiris drew the attention of Government to the fact that some branch crown bark, which had been considered not worth working up in the Nilgiri Factory, and which Mr. Broughton had deprecated sending to England as likely to injure the reputation of Nilgiri bark in the home market, had there realised prices varying from 2 *s.* to 3 *s.* 6 *d.* per pound.

Government Order, 22nd June 1874, No. 759, paragraph 15.

2. This naturally suggested doubts as to the working of the factory; and, as the best means of arriving at a satisfactory conclusion on so important a point, the Government deputed the Sanitary Commissioner, Mr. Cornish, and the Commissioners of the Nilgiris, Mr. Cockerell, to investigate the subject on Mr. Broughton's return from leave, and report specially on the cost and medicinal value of the "amorphous quinine" manufactured by that gentleman.

3. The Committee accordingly having met, visited the factory at Neddivuttum, and examined Mr. Broughton and Mr. McIvor, submit the result of their inquiries in the report recorded above.

4. The committee show that, on the most favourable calculation, the Government are paying twice as much for the "amorphous quinine" as it is worth. The 445 lbs. manufactured in 1871–72 and 1872–73 cost about 3,000 *l.*, and are worth 1,500 *l.* The results of 1873–74 are not given, and in the current year, as explained, a mistake in one of the processes has led to the loss of a considerable quantity.

5. Further, not only is the cost of manufacture thus excessive, but the article produced is of inferior quality. Of the efficacy of the mixed alkaloids as a febrifuge there can be no doubt, but the drug, as prepared and issued, is of uncertain composition. Sometimes it is rich in quinine; at others, chinchonidine and chinchonine predominate. This is obviously a very serious objection, and the form in which the preparation is issued is also inconvenient.

6. Under these circumstances it is obvious that the manufacture should at once be abandoned. There seems scarcely any reason to expect any material improvement to compensate for the great waste of alkaloids, or to render it desirable for the Government to establish a public manufactory. Similar attempts have failed in Java and America. Should circumstances hereafter render it desirable to revive the attempt to manufacture, this can easily be done. Meanwhile, by closing the experiment, a considerable saving will be effected, and new buildings need not be constructed at Neddivuttum for drying the bark as harvested.

7. Mr. Broughton has now formally resigned his appointment, and the question of filling up his place will be referred for the decision of the Secretary of State. The Governor in Council is of opinion that, with the suppression of the manufacture the necessity for the appointment of a highly-paid official will no longer exist; and as the properties and values of the various barks are now known, functions in the nature of those of a "quinologist" may be regarded as unnecessary. The whole of the bark will now be sent to the Secretary of State, and samples can be selected at the India Office from each consignment, as well as sent from hence, and arrangements effected with Mr. Howard and Dr. De Vriz for the analysis of those at considerably less cost than the employment of a chemist in this country will entail. There will also be the advantage of analysis by two independent individuals.

8. Mr. Broughton will be informed that no further manufacture is to be undertaken, and he will be desired to state what other work he is engaged upon, when it will be finished, and whether he wishes to leave before his six months' notice expires. The factory buildings will all eventually be made over to the Commissioner, and the bungalow now occupied by Mr. Broughton constituted the residence of the Superintendent of the Government Gardens, whose present dwelling is very inconveniently situated and needs repair and enlargement.

9. The Commissioner will be instructed, in sending the bark to England, to submit the fullest information regarding each consignment and sample.

10. The Secretary of State will be moved to endeavour to arrange with Messrs. Howard, or other suitable persons, for the manufacture from the Nilgiri succirubra bark of cinchonidine sulphates for use in this country, as suggested by Mr. Howard a short while ago, or, as suggested by Mr. Cornish, a combination of the different alkaloids.

11. The particular attention of the Secretary of State will be drawn to paragraphs 9 and 53—57 of the Report.

12. The superintendent of the plantations has paid due attention to the raising of new species by hybridising, and it is in this direction that any extension of operations should be carried on. In the annual reports special notice should be made of new varieties.

13. The Committee properly attach great importance to cordial co-operation between the superintendent of the plantations and the quinologist; but at present no further orders on this point are necessary. If the appointment of quinologist is revived, the subject will be again noticed.

14. The thanks of Government are due to the Commissioner and Mr. Cornish for their very lucid and valuable report.

15. The Government are not aware to what expressions of opinion the Committee allude to in paragraph 65 of their Report. The object throughout has been to avoid trenching upon the commercial interests involved in the cultivation of chinchona. To prove that such culture could be made profitable, and then to bring the febrifuge within reach of the masses, were the chief objects aimed at.

— No. 41. —

(No. 3—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Marquis, Fort George, 24 March 1875.

We have the honour to advise your Lordship of the transmission to the India Office of 278 bales of chinchona bark from the Government Plantations on the Nilgiris, containing in all 28,659½ lbs. nett. Of these, 172 bales were sent by the S.S. *Cathay*, which left this port on the 16th March 1875, and the remaining 106 bales will be forwarded by the S S. *Malwa*, which leaves on the 29th idem.

2. The papers on the subject, including Mr. McIvor's detailed invoice for the 278 bales and Bill of Lading for the 172 bales sent by the *Cathay*, are herewith forwarded. Proceedings of Government, 24th March 1875.

2. Your Lordship will perceive that the freight is to be paid in England.

We have, &c.
(signed *Hobart*, &c.

From the Superintendent, Government Chinchona Plantations, to the Acting Commissioner of the Nilgiris, dated Ootacamund, 9th March 1875.

I have the honour to inform you that, with the approval of the Commissioner, I have despatched to Mr. J. H. DeSalis, the Agent of the P. & O. S. N. Company, Madras, 278 bales of chinchona bark, containing 28,659½ lbs. net,* as per details in the invoice enclosed. This bark is consigned to the Secretary of State for India, and will leave Madras by the *Cathay* on the 15th instant. To avoid delay I have asked Mr. DeSalis to forward the Bill of Lading direct to the Secretary to Government, Revenue Department, Madras, for transmission to the Secretary of State for India, and to effect an insurance on the bark for 4,000 *l.* The freight, at the rate of 2 *l.* 5 *s.* per ton of fifty cubic feet, to be paid in England.

*

	lbs.
Unmossed crown bark	12,172
Mossed „ „	3,480½
Renewed „ „	100
Unmossed red „	3,790
Mossed „ „	4,200
Renewed „ „	4,917
Nett	28,659½

— No. 42. —

Report on the Number, Distribution, and condition of Chinchona Plants on the Nilgiris for the Half Year ending 31st January 1875.

No. of Species.	Botanical Names.	Commercial Names.	No. of Plants.	Value per lb. of dry Bark in the London Market.
				s. d. to *s. d.*
1	C. Succirubra	Red bark	1,215,963	2 6 to 8 9
2	C. Calisaya	Yellow bark	54,881	2 1 „ 9 –
	C. Calisaya var. Frutex			
	C. Calisaya var Vera			
3	C. Officinalis	—	—	—
	C. Officinalis var Condamenia	Original loxa bark	1,183,159	2 10 „ 7 –
	C. Officinalis var. Bonplandiana	Select crown bark	87,509	2 10 „ 7 –
	C. Officinalis var Crispa	Fine crown bark	4,355	2 10 „ 5 6
4	C. Lancifolia	Pitayo bark	279	1 8 „ 2 10
5	C. Nitida	Genuine grey bark	2,786	1 8 „ 2 9
6	C. species without name	Fine grey bark	8,500	1 8 „ 2 10
7	C. Micrantha	Grey bark	46,730	1 8 „ 2 9
8	C. Peruviana	Finest grey bark	3,389	1 8 „ 2 10
9	C. Pahudiana	Unknown	425	Unknown.
10	C. Lanceolata-leaved variety of C. Officinalis.		19,885	ditto.
11	C. Pitayo, raised from imported seeds.		26,656	ditto.
12	C. Pitayo, plants brought out by Dr. Simpson.		76	ditto.
		Total Number of Plants	2,654,593	

TABLE showing the Growth of the different Species of Plants planted out in the Plantations for the Half Year ending 31st January 1875.

No. of Plants.	Species.	Where planted.	When planted.	Maximum Growth.	Average Growth.	Height of the Tallest Tree.	Girth near the Ground.
				Inches.	*Inches.*	*Feet.*	*Inches.*
12	C. Succirubra - -	Neddivuttum -	30 Sept. 1862	21	6¼	33½	28¼
12	C. Micrantha - -	- ditto - -	- ditto -	—	—	—	—
12	C. Officinalis - -	Dodabetta - -	30 Sept. 1863	5	4	26	18¼

TABLE showing the Propagation and Distribution of Plants and Seeds during the Half Year ending 31st January 1875.

DATE.	Total Number of Plants Propagated.	Total Number of Plants Permanently Planted out.	Total Number of Plants Distributed to Private Individuals.	Total Quantity of Seeds Distributed.
				oz.
August 1874 - - - - -	1,320	- - -	1,100	2
September - - - - -	780	- - -	116	1½
October - - - - -	740	- - -	- - -	1½
November - - - - -	1,460	- - -	- - -	–½
December - - - - -	840	—	—	—
January 1875 - - - -	420	- - -	- - -	5½
TOTAL - - -	5,560	- - -	1,216	11
Previously - - - -	2,649,033	1,190,458	234,531	469½
GRAND TOTAL - - -	2,654,593	1,190,458	235,747	480½

REMARKS.

The number of plants propagated during the past half year is 5,560, viz., 4,800 plants of *C. Angustifolia* (var. Lanceolata), and 760 of *C. Pitayensis*.

The number of plants permanently planted out in the plantations remains the same as was shown in previous half-yearly report, viz., 1,190,458.

1,216 chinchona plants have been issued to the planters in Wynaad, and 11 oz. of chinchona seed supplied to the public.

4,210 lbs. of chinchona trunk bark, and 81,561 lbs. of branch bark have been supplied to the Government quinologist for the manufacture of amorphous quinine from April 1874 to January 1875.

334½ lbs. of green tea leaf have been supplied to Major Jennings.

The 12 *C. Succirubra* trees in Table II. have been barked, and consequently the measurement of their girth is decreased. The *C. Micrantha* trees were coppiced during the last monsoon.

Ootacamund, 1 March 1875.

— No. 43. —

(No. 10—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Marquis, Fort St. George, 6 April 1875.

IN reply to the question conveyed in your Lordship's letter, No. 3, of the 28th January 1875, we have the honour to state that the supply of bark used in 1871 was ordered to be obtained by the mossing process, because the Government quinologist, though advocating the superior merits of coppicing, was of opinion that his system could not be put into practice for two years from that time.

2. Detailed experiments are now on foot in view to a final settlement of the merits of the two systems. Pending this, we are of necessity obliged to use the mossing process; for, should the coppicing method prove in the long run the less advantageous, we should, by using it during the tentative period, commit damage which would take much time to set right. The use of the mossing process, if eventually found to be undesirable, will carry with it no such irreparable damage.

We have, &c.
(signed) *Hobart*, &c.

— No. 44. —

(No. 23—Revenue.)

From the Government of Madras to the Secretary of State for India.

My Lord Marquis, Ootacamund, 23 July 1875.

ADVERTING to the correspondence marginally noted, relative to two recent consignments of chinchona bark, per steam ships "Cathay" and "Malwa," we have the honour to forward the accompanying Papers,* from which your Lordship will perceive that the freight upon these consignments is 4 *l.* 5 *s.* per ton, not 4 *l.* 10 *s.*, as erroneously stated in the bills of lading.

Secretary of State, 24th March 1875, No. 8, Miscellaneous.
To Under Secretary of State, 2nd April 1875, No. 18.
* Proceedings of Government, 20th April 1875.
Proceedings of Government, 6th July 1875.

We have, &c.
(signed) *W. Robinson*, &c.

Enclosure in No. 44.

From the Commissioner of the Nilgiris to the Secretary to Government, Revenue Department, Fort St. George, dated Ootacamund, 13th April 1875.

IN the letter of Mr. M'Ivor in Government Order, Revenue Department, 24th March 1875, No. 480, on the subject of chinchona bark, announcing the Despatch to the Secretary of State for India of certain chinchona bark, it is stated that the freight is 2 *l.* 5 *s.* per ton, which is an error; the sum is 4 *l.* 5 *s.* per ton of 50 cubic feet.

ORDER of the Madras Government thereon, 20th April 1875.

IT is observed that the two bills of lading for the consignment of chinchona bark in question, received from the agent of the Peninsular and Oriental Steam Navigation Company, give the freight as 4 *l.* 10 *s.* per 50 cubic feet, not 4 *l.* 5 *s.*, as stated in the foregoing letter. These documents will now be forwarded to the Commissioner of the Nilgiris, with the request that he will be good enough to return them at an early date, with any remarks he and Mr. M'Ivor may have to offer, in respect to the amounts entered therein on account of "Freight" and "Additional Freight."

— No. 45. —

REPORT on the Number, Distribution, and Condition of Plants in the Government Chinchona Plantations on the Nilgiris for the half-year ending July 1875.

No. of Species.	Botanical Names.	Commercial Names.	No. of Plants.	Value per lb. of dry Bark in the London Market.
				s. d. *s. d.*
1	C. Succirubra - - - -	Red bark - -	1,215,963	2 6 to 8 9
2	C. Calisaya - - - -	Yellow bark - -	54,881	2 1 „ 9 –
	C. Calisaya var. Frutex - -			
	C. Calisaya var. Vera - -			
3	C. Officinalis - - - -	—	—	—
	C. Officinalis var. Condamenia -	Original loxa bark -	1,183,159	2 10 „ 7 –
	C. Officinalis var. Bonplandiana	Select crown bark -	87,509	2 10 „ 7 –
	C. Officinalis var. Crispa - -	Fine crown bark -	4,355	2 10 „ 5 6
4	C. Lancifolia - - - -	Pitayo bark - -	279	1 8 „ 2 9
5	C. Nitida - - - -	Genuine grey bark -	2,786	1 8 „ 2 10
6	C. species without name - -	Fine grey bark -	8,500	1 8 „ 2 10
7	C. Micrantha - - - -	Grey bark - -	46,730	1 8 „ 2 9
8	C. Peruviana - - - -	Finest grey bark -	3,389	1 8 „ 2 10
9	C. Pahudiana - - - -	Unknown - -	425	Unknown.
10	C. Lanceolata-leaved variety of C. Officinalis.	- - -	23,075	- ditto.
11	C. Pitayo, raised from imported seed.	- - -	28,296	- ditto.
12	C. Pitayo, plants brought out by Dr. Simpson.	- - -	76	- ditto.
		TOTAL Number of Plants - - -	2,659,423	

TABLE showing the Growth of the different Species of Plants planted out in the Plantations for the half-year ending 31st July 1875.

No. of Plants.	Species.	Where Planted.	When Planted.	Maximum Growth.	Average Growth.	Height of the Tallest Tree.	Girth near the Ground.
				Inches.	*Inches.*	*Feet.*	*Inches.*
12	C. Succirubra - -	Neddivuttum -	30 Sept. 1862	21	6¼	33½	28½
12	C. officinalis - -	Dodabetta - -	30 Sept. 1863	5	2¾	26¼	18¾

TABLE showing the Propagation and Distribution of Plants and Seeds during the half-year ending 31st July 1875.

DATE.	Total Number of Plants Propagated.	Total Number permanently Planted out.	Total Number of Plants distributed to Private Individuals.	Total Quantity of Seeds distributed.
				Oz.
February 1875 - - - -	—	—	- - -	—
March - - - - - -	1,140	- - -	- - -	2
April - - - - - -	640	- - -	- - -	2½
May - - - - - -	1,250	- - -	- - -	—
June - - - - - -	- - -	- - -	11,500	16
July - - - - - -	1,800	- - -	43,200	2½
TOTAL - - -	4,830	- - -	54,700	23
Previously - - -	2,654,593	1,190,458	235,747	480¼
GRAND TOTAL - - -	2,659,423	1,190,458	290,447	503¼

REMARKS.

The number of plants propagated during the past half-year is 4,830, viz., 3,190 plants of *C. Angustifolia* (var. *Lanceolata*) and 1,640 of *C. Pitayensis*.

The number of plants permanently planted in the plantations remains the same as shown in the previous half-yearly report, viz., 1,190,458.

54,700 chinchona plants have been issued to the planters in Wynaad, and 23 oz. of chinchona seed supplied to the public gratuitously.

709 lbs. of green tea-leaf has been supplied to Major Jennings.

28,659 lbs. of chinchona dry bark has been shipped to England for sale in the London market.

Ootacamund, 20 August 1875.