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Government of Madras.

Revenue DEPARTMENT.

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Dated 11- 4- 1874.

Not to be folded or roughly handled

Proceedings of the Madras Government, Revenue Department,
11*th April* 1874.

Read the following papers:—

No. 60. From J. R. COCKERELL, Esq., Commissioner of the Nilgiris, to C. G. MASTER, Esq., Acting Secretary to Government, Revenue Department, dated Ootacamund, 13th August 1873, No. 37.

I HAVE the honour to submit a letter to my address from the Superintendent of Cinchona Plantations in reply to G. O., No. 549, dated 28th May 1873.

2. The Government order, which is an order on a mossing report submitted by the Government Quinologist, calls the attention of the Commissioner and of Mr. McIvor to a statement made by Mr. Broughton, "that 85 per cent. of 2,000 mossed trees have failed to renew their bark." Mr. McIvor, in the present communication, states that the trees in question are "a mass of verdure, and the luxuriance of their growth is unsurpassed." He proposes to take renewed bark from them in October. He asserts that non-renewal of bark in mossed trees on the Government plantations is unknown, but that renewal is sometimes delayed by injury done to the cambium layer on the first stripping, and that this was the case in respect of the 2,000 trees.

3. Mr. McIvor reports that an experiment in coppicing satisfactory to Mr. Broughton is being carried out in compliance with paragraph 3 of the Government order.

4. With regard to paragraph 4 of the order, directing that no further mossing shall be undertaken until the results of the above coppicing experiment are known, I am about to report to Government in another communication in which I shall explain that the coppicing experiment will take years to bring to a conclusion, and that, in the meanwhile, unless the unmossed trees on the plantations, about 24,000 in number, are stripped and mossed, the bark on them will deteriorate, and loss to Government will accrue. To this, I shall add the statement that mossing will not interfere with coppicing if the latter system is eventually exclusively practised, because mossed trees are not injured by mossing or rendered by that process in any way unfit to be coppiced.

5. Mr. McIvor, in the present letter, combats Mr. Broughton's views on coppicing, and argues, from Mr. Broughton's own data, that mossed bark is incontestably superior to natural and coppiced barks. I advocate the opinion expressed by Mr. McIvor.

6. Mr. McIvor forwards, with his letter, a series of mossed natural and coppiced barks. His object is to show the superior thickness of the former bark.

ENCLOSURE No. 1.

From W. G. McIVOR, Esq., Superintendent of the Government Cinchona Plantations, to J. R. COCKERELL, Esq., Commissioner of the Nilgiris, dated Ootacamund, 9th August 1873, No. 47.

I HAVE the honour to acknowledge your endorsement, conveying Proceedings of Government, dated 28th May 1873, No. 549.

2. With reference to paragraph 5 of the Proceedings, I beg to inform you that the Succirubra trees selected by you and Mr. Broughton and myself in April last on our visit to the Neddivuttum plantations were duly coppiced on the following 30th May. The trees were fifty-eight in number. They stood in four rows, and were selected on account of their size and vigorous growth. They were the finest trees to be found. The largest measured thirty-seven feet two inches in height. The trees afforded 809 lbs. of wet trunk bark equal to 286½ lbs. dry bark, or 4·93 lbs. of dry bark per tree. The trees were all ten years and eight months old. The shoots

were left standing on the stool of each tree. The condition of these shoots is described in a detailed table attached to this communication. Fifty-eight trees in the four rows adjoining the block thus coppiced were duly mossed. This process was completed on the 25th June last. The tallest of these mossed trees was found to be thirty feet. Prior to mossing 301 lbs. of wet trunk bark, equal to 106 lbs. dry bark, were taken from the trees, giving on an average 1·83 lbs. of dry bark per tree. In April or May 1874 a second harvest of natural bark will be taken from these trees. A report of the quantity of bark then obtained will be submitted.

3. Thus the comparison between coppicing and mossing is now being made. Mr. Broughton was of opinion that the number of trees selected on the above occasion would enable a sufficient comparison to be indicated, and I offered no opposition; but I cannot here omit to express my belief that, if the coppicing were carried out on a larger number than fifty-eight trees, the result would be less favourable to the coppicing system. The surface of all land is uneven, and on hill slopes especially so. In the hollows there is a deposit of alluvial soil on which plants thrive. On the ridges, on the other hand, the soil is poor and abraded; and here trees grow less luxuriantly and less easily. Accordingly a large area would give, in my judgment, a fairer selection of trees, and the yield by coppicing would be less per tree than on fifty-eight trees specially selected for their size and rich growth.

4. This comparison between the two systems will, I need not say, take some years to complete. I fear that, when complete, it will not entirely set all questions at rest, as the fifty-eight trees were older than trees which would have already afforded bark by mossing. Bark peals best on the first occasion from trees eight years old. In February and March 1871, I took mossed bark from 1,000 red-bark trees of this age. In May last, I had stripped 3,744 lbs. of dry bark from these trees, giving an average of 3·75 lbs. per tree. Next spring, these trees will yield 1,200 lbs. of dry bark, and a further harvest of about 1,600 lbs. will be available in the succeeding spring, and so on every year, the quantity given on each occasion being larger than in the preceding one,

5. At paragraph 2 of the G. O., it is stated: "Sufficient information is not as yet available as to certainty of a re-production of bark after a tree has been stripped, and the statement 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."

6. With reference to this remark, I have to state that I was at Neddivuttum with Mr. Broughton on the 19th ultimo; that that gentleman then indicated the patch of trees he referred to, and, as I was anxious to learn what was really meant by 85 per cent. having failed to renew the bark, I suggested to Mr. Broughton we should examine the trees together. This was not done, but I myself examined the patch carefully. The trees, at the present time, are a mass of verdure, and the luxuriance of their growth unsurpassed. I propose to take bark from them in October. As to any failure to renew, there is no failure not only in this patch, but in any of the 30,000 trees which have been subjected to the mossing process. In the patch of 2,000 trees, there are trees on which the bark is not perfect, but this is not owing to any defect in the mossing process, but to the fact that the trees were stripped by unskilled workmen, who, in some cases, injured the cambium layer. In these cases, the bark has been slow to renew, but it is renewing. All experience hitherto acquired shows that bark invariably renews. It renews easily and early when the cambium is untouched. In cases where the cambium is injured the renewal proceeds, but the process is slower. In respect of universal renewal, there is no difference whatever between the *red* and *crown* barks.

7. I have now disposed of the subjects specially referred to me; but, as the question is important, and Government have to decide the best method of harvesting bark, I trust I may be excused for detailing a few facts bearing on the various subjects discussed by Mr. Broughton.

8. In the report under notice, Mr. Broughton comes to the conclusion that mossing, when applied to crown barks, "promises success." That these barks renewed under moss are of "fine quality." That mossing the natural barks increases the value "in the older trees at least 9*d*. per lb. and in the younger about 8*d*." The following remarks, therefore, exclusively apply to the red barks or *C. succirubra*, which Mr. Broughton concludes are not improved by mossing.

9. Mr. Broughton's report apparently deals with the comparative merits of mossing when applied to Cinchona bark; but he really passes over all the important facts on which the merits of the mossing process uepend. He, also, fails to notice the very unsatisfactory results obtained from coppicing, even when applied to small clumps of a few selected fine trees in sheltered localities. Before proceeding, I will explain in what mossing and coppicing consists, confining my remarks exclusively to such facts as have been demonstrated by experience, and are, therefore, beyond dispute.

10. At paragraph 5 of your letter, you correctly describe coppicing as "felling a tree six inches from the ground, and leaving the shoots springing from the stool." Prior to Mr. Broughton's arrival in India, the advantage of this system had been fully considered, and experiments begun to test its value, which, although limited in extent, nevertheless showed conclusively that the system could not be profitably practised. Further discussion of the system would not have taken place, had Mr. Broughton not fallen into the error of mistaking for three-year old shoots from coppiced trees, the standing stems of certain trees with double stems, one of which had been removed in December 1866 and January 1867. The bark on these standing stems was, when analysed, eight years old bark (the trees being of that age), and no difference exists between bark on trees with double and single stems. Mr. Broughton fell into the error of taking this bark as three-year old shoot bark, it being actually bark of the finest quality from a stem of eight years standing. The extracts below from Mr. Broughton's letter, dated 31st August 1870, paragraphs 9, 10, and 11, in G. O., 7th February 1871, No. 249, detail the analysis of this bark.* From the error pointed out, this analysis does not bear on the subject of coppicing at all. As to the shoots growing from such trees as have been hitherto coppiced, they are correctly described in your letter in G. O., No. 126, dated 30th January 1873, paragraph 5, as at the end of seven years being weak and sickly with bark when dried of the thickness of blotting paper. I am personally strongly of opinion that such bark would not pay the cost of collecting, and I cannot discern any reason for supposing it worse than would be the bark on any coppiced trees whatsoever of the same age. I am not aware that Mr. Broughton has analysed any barks from *bona fide* coppiced trees.

11. Mr. Broughton, at paragraph 36, states: "It is greatly to be regretted that comparative experiments have not been carried out in coppicing the Cinchona trees;" and again at paragraph 40: "Nearly the whole of the Cinchona 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." Mr. Broughton has not given his data for the latter conclusion. In my report for last year, I brought to notice that "of our oldest red-bark trees (about 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

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* "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
Cinchonidine and Cinchonine	4·97
Pure sulphate of quinine obtained crystallized	1·14
Pure sulphate of Cinchonidine obtained crystallized	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."

* * * *

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 larger 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."

12. I deem it here necessary to describe, in full detail, my views as to the inferiority of the coppicing system. In my opinion, a Cinchona tree only assumes a clothing of bark from which alkaloids can be taken with profit at the end of its fifth year. In the three following years, the secretion progressively increases, and, in the eighth year, the bark becomes fit for the market. Thus, in the latter year of growth, a tree only affords bark which has been ripening for three years. Now, if such a tree is stripped of bark, a renewed bark will be secreted in a period ranging from twelve to twenty-four months, taking the renewed bark as removable at either of the two periods. In the former case, the qualities as regards alkaloids will be equal to natural bark from a nine-year old tree; and in the latter case to bark from a tree which has been standing eight years and twenty-two months, or to bark of a tree of ten years of age. I leave out of calculation altogether the superiority of renewed to natural bark. On the other hand, coppice this tree at eight years. The shoots in the following year will be worth nothing, and will not, as far as experience has carried us, yield bark again in eight years. The general result, if my data are correct, is that, if a tree is coppiced, there is at once destroyed the elaboration, which is the result of four years' growth,—that elaboration, which begins only after a tree has been four years in the ground, and which increases in intensity year after year subsequently, but which, cut short by coppicing, has to be laboriously set up again in the course of a fresh four years. Thus, by coppicing, there is lost, in my view, in every case a period of four years.

13. There is another important inferiority in the coppicing system, which should not be overlooked. Experience, as far as it has reached, shows that the bark on coppiced trees is less valuable than the bark on the original tree. The Bengal Government is at this moment sending Home coppiced barks from Darjeeling. They fetch 5*d.* to 1*s.* 4*d.* a lb. in the London market; whereas our original and mossed barks have never fetched less than 2*s.* 2½*d.*, and our last parcel fetched in part 2*s.* 10*d.* per lb.

14. Again, coppicing can only be done on immature trees, and the bark on such trees is thin. I cannot say precisely the latest age at which it is safe to coppice Cinchona. But the thicker the tree, the greater the risk of coppicing. Coppices in England are of shoots small in diameter. No coppicing of thick trunks occurs on the Nilgiris. Experience, as far as it has gone, seems to indicate that, even with Cinchona trees so young as eight years, it is safer to leave a shoot springing from the stool than to coppice the main stem *and* the shoots.

15. Finally, as regards the cost of taking the bark, the supposition appears to be it is cheaper to strip coppiced trees. The reverse is the fact. Thin barks adhere more closely to the stem and are more difficult to peel off than thick barks. Coppiced trees always have thinner barks than natural trees. On the other hand, renewed mossed bark is very much thicker than natural bark. The conclusion is that weight for weight it must be less costly to take renewed bark than coppiced bark.

16. I observe that you stated in your letter in G. O., No. 549, dated 29th May 1873, that a mossed tree of ten years old should give 10 lbs. of bark against 7 lbs. in a coppiced tree. The estimate is extremely low. One thousand mossed trees, the bark of which was first taken in February and March 1871, when the trees were eight years old, have given 3,744 lbs. of dry bark up to date. 240 trees coppiced by Mr. Broughton, of which 200 trees were eight years old and 40 trees five and-a-half years old, only gave 255 lbs. of dry stem bark.

17. I will now turn to the mossing system. That system, as far as I am aware, has never been fully described. The process is as follows:—A labourer proceeds to an eight-year old tree, and, reaching up as far as he can, makes a horizontal incision of the required width. From either end of this incision he runs a vertical incision to the ground, and then carefully raising with his knife the bark at the horizontal incision until he can seize it with his fingers he strips off the bark to the ground and cuts it off. The strip of bark then presents the appearance of a more or less long piece of ribbon. Supposing the tree to be 28 inches in circumference, the labourer will take nine of the above ribbons, each 1½ inch wide. He will leave thus after the tree has been stripped other nine ribbons still adhering to the tree, each somewhat broader than the stripped ribbon, and at intervals apart occupied by the spaces to which the stripped ribbons adhered. As soon as he has removed his strips, the labourer will proceed to moss the trunk all round, tying on the moss with some fibre. The decorticated intervals will thus be excluded from light and air, and this point is one of the capital points in the system. The mere exclusion of light and air from a stem partially bared of bark acts in two ways: it enables a healing process to be rapidly set up in the same way as a plaster does in the case of a wound in an animal organism; and it has this further curious effect, it increases the secretion of quinine in the bark renewed under its protection. This increase of quinine is expressly admitted by Mr. Broughton in all his reports. At the end of six or twelve months, the bands of bark left untouched at the first stripping are removed, and the intervals they occupied on the trunk are mossed. At the end of twenty-two months on an average, the spaces the ribbons originally taken occupied are found to be covered with renewed bark *much thicker* than the natural bark of the same age, and this renewed bark can be removed and a fresh process of renewal again be fostered by moss. In another six or twelve months, the renewed bark of the natural ribbons left at the first stripping can be taken, and so on, harvests are obtainable from the trunk alternately from the spaces left at the first stripping and the spaces left by the second stripping. Experience hitherto does not show any limit to the taking of these alternate harvests from a tree. Of course, it is understood that at every stripping the ribbons taken are longer than at the preceding stripping, because the tree has each year increased in height and in bulk, and, therefore, the top of every ribbon consists of natural bark and the lower part of renewed bark.

18. Thus, I have entered into the whole question of mossing and coppicing. It remains to make some remarks on the superiority of renewed mossed bark over natural bark in regard to the alkaloid contents. Mr. Broughton admits the superiority in crown barks, but seems to deny it in Succirubra or red barks. I shall address myself, therefore, to the latter barks. I adhere to my opinion that renewed bark *is always of better quality than natural bark*, whatsoever the age of the tree.

19. Mr. Broughton seems to consider that the quality of renewed bark depends on the age of the tree. I take an opposite view. At paragraph 32 of my report of 1864-65 on the Cinchona plantations, I noticed that the alkaloids in our barks then increased "at the rate of about 2 per cent. per annum," and observed that "it cannot be supposed that the barks can continue to increase in this ratio. A period must occur at which the maximum quantity of alkaloids are contained in the bark, and after this there will be, in all probability, a period of deterioration." I consider that it is the *age* of the *bark* that determines the quantity of alkaloids, and not the *age* of the *trees.*

20. The trees cut in the forests on the *Andes* vary from 20 to 100 years old. They contain an average of about half per cent. of quinine sulphates against our progressive average rising as high as 11 per cent. Now why should South American bark be less rich in quinine than Nilgiri bark. Want of cultivation may have something to do with the matter, but the chief cause I attribute to the age of the bark. I shall endeavour to fortify this conclusion by quotations from analysis made by Mr. Broughton himself.

21. Mr. Broughton admits that on a Succirubra tree up to eight years old, renewed red bark is decidedly better than natural bark; that is to say, he allows that bark on a tree up to this age, which has only formed in the course of eighteen to twenty months, is better than bark which has waxed throughout the life of the tree. The conclusion to be drawn from this fact appears to be that bark so long as it remains in a loosely aggregated cellular condition is in the proper state for receiving and storing alkaloids. As the bark grows older and woody fibre re-places cellular tissue, the alkaloids already in the bark appear to turn into resin and gum or colouring matter,

and the bark secretes no fresh alkaloids. The result is, the bark for medicinal purposes deteriorates with age. At what stage in the progress of growth this deterioration commences I am not able to state with accuracy; but my general impression is that bark is best at from eighteen months to two years old. I refer, of course, to renewed bark. Natural bark is, I consider, best at eight years old. I have already observed that, commercially speaking, it begins to secrete available alkaloids only in the fifth year of the growth of the tree. In the case of natural bark, therefore, the bark would be best in eight years, though rather thin.

22. Mr. Broughton appears to be of opinion that at the age of ten years the advantage of mossing in *C. succirubra* is not marked. He writes, at paragraph 23 of his report, speaking of renewed red bark three years under moss: " Compared with the natural bark of trees growing near.

" *C. succirubra*, ten years old.	Renewed three years under Moss.	Natural.
Total alkaloids...	6·12	6·12
Quinine...	3·37	1·50
Cinchonidine and Cinchonine ..	2·75	4·62
Quinine sulphate obtained crystallized	2·27	0·85
Cinchoindine	2·91	3·11

" It, therefore, appears that three years' mossing does not improve the renewed bark." The table, however, would seem to show precisely the opposite conclusion drawn by Mr. Broughton. It shows, in this instance, that the renewed and natural bark both contained the same quantity of alkaloids; but that in crystallized sulphates the renewed bark was much the richer of the two. No one knows better than Mr Broughton that the value of bark depends on the quinine it contains, and not on the quantity of other alkaloids, which are comparatively worthless. In the table the bark analysed gives the mossed bark as containing 2·27 against 0·85 of quinine. I may state that, at present market rates, every one per cent. of crystallized quinine sulphate in the bark increases the value of the bark by 10*d.*, and of every one per cent. of Cinchonidine by 4*d.* per lb. The bark referred to in the table at these rates would be worth—the renewed mossed bark 2*s.* 10½*d.* per lb., and the natural bark only 1*s.* 10½*d.* per lb.

23. And this is not the only superiority that mossed bark exhibits. Mr. Broughton tells us, at paragraph 33 of his report, that " the renewed barks are exhausted of their alkaloids with greater ease than the natural barks," and that " they form crystallized sulphates with greater ease than the natural barks." Thus, the assumption on this point is that it is cheaper to extract from mossed bark. Given accordingly mossed bark richer in quinine and more easily treated than natural bark, and you have in it the qualities favourable to the profit of the manufacturer. The only qualities the manufacturer seeks to secure.

24. I have only further to point out that every one of the analyses in Mr. Broughton's report are of the same character. They all indicate a conclusion at variance with the conclusion adopted by Mr. Broughton. They all show that renewed mossed bark from our oldest Succirubra trees is more rich in quinine that natural bark, and, therefore, more valuable for sale in the market. They show, indeed, that the increase in quinine is not only doubled by mossing, but trebled, and, in some cases, quadrupled.

25. Another error into which Mr. Broughton has fallen in support of the conclusion above noted is at paragraph 38, where he says: " The amount of total alkaloids, which red bark renewed under moss contained, was, by Mr. Howard's analyses in 1865, about 6·37 per cent." I beg to bring to notice the fact that Mr. Howard made two analyses of renewed bark in that year; the result of both analyses and the age of the barks are quoted at foot, by which it will be observed that Mr. Howard in the one analysis obtained 7·70 per cent., and in the other 9·72 per cent. of total alkaloids. I mention these results, because, when correctly given, they are equally as contradictory, to Mr. Broughton's conclusions as his own results.

26. I think it well, in conclusion, to submit a series of specimens of barks showing that, in all cases, the renewed mossed is much thicker than the natural bark. Mr. Broughton, from expressions in his report, conveys the idea that it is generally thinner, though this cannot be his meaning.

" No. 2.—Renewed bark of 1 year and 5 months growth—	
Crystallized sulphate	5·00
Alkaloid soluble in ether	0·90
Cinchonine	1·80
	7·70
" No. 3.—Renewed bark of 1 year's growth—	
Crystallized sulphate	2·72
Alkaloid soluble in alcohol	7·00
	9·72

Particulars of 58 *Trees coppiced on the* 1st *Denison Plantation at Neddivuttum on the* 30th *May* 1873.

Row No. 1.	FT.	IN.	IN.
1. No sucker		......	
2. 3 suckers	11	2	5¾
3. No plant		......	
4. ,,		......	
5. Not cut		......	
6. 2 suckers	15	4	7¼
7. 2 ,,	10	4	5
8. 3 ,,	12	0	6
9. 2 ,,	4	10½	2¼
10. 3 ,,	7	0	4
11. No plant		......	
12. 2 suckers	8	8	5½
13. 1 ,, Seedling along side.	6	11	3
14. No sucker		......	
15. ,,		......	
16. Sprouting		......	
17. No sucker		......	
18. 1 ,,	5	0	2¼
19. No ,,		......	

Row No. 2.	FT.	IN.	IN.
1. 1 sucker	12	0	5¾
2. 3 suckers	7	2	3
3. Sprouting		......	
4. No sucker		......	
5. 4 suckers	8	10	4
6. 3 ,,	9	8	4
7. 1 sucker	4	3	2½
8. Condamenia		......	
9. 1 sucker	12	1	6½
10. 1 ,,	7	9	7¼
11. 5 suckers	8	8	4
12. 1 sucker	10	9	7
13. No ,,		......	
14. 1 ,,	8	3	4
15. 3 suckers	12	8	4¾
16. 2 ,,	12	1	5
17. Cut before		......	

Row No. 3.	FT.	IN.	IN.
1. 3 suckers	8	3	3¾
2. 1 sucker	2	9	1¼
3. No ,,		......	
4. No ,,		......	
5. 1 ,,	3	10	3
6. Condamenia		......	
7. 4 suckers	8	9	5
8. 1 sucker	8	4	4
9. No ,,		......	
10. 1 ,,	7	3	4
11. Condamenia		......	
12. 11 suckers	11	8	6
13. 1 sucker	8	8	5
14. No ,,		......	
15. 1 ,,	5	10	3
16. No ,,		......	

Row No. 4.	FT.	IN.	IN.
1. 1 sucker	8	7	5
2. No ,,		......	
3. No ,,		......	
4. 5 ,,	12	4	6
5. Micrantha		......	
6. 1 sucker	12	0	7
7. 5 suckers	14	0	6½
8. 5 ,,	7	0	4½
9. 1 sucker	5	9	4
10. No ,,		......	
11. 3 suckers	9	0	4
12. 3 ,,	8	10	5
13. 3 ,,	10	0	4¾
14. No sucker		......	
15. 1 ,,	8	6	5¾

REMARKS.—Where more than one sucker is mentioned, the measurement of the largest taken. Rows numbered going *from* bungalow.

(Signed) W. G. McIVOR,
Superintendent, Government Cinchona Plantations.

Referred for the remarks of the Government Quinologist, which, it is requested, may be submitted at the earliest practicable date.

28th August 1873.

(Signed) R. A. DALYELL,
Acting Secretary to Government.

No. 61. From J. BROUGHTON, Esq., Government Quinologist, to the Hon. R. A. DALYELL, Acting Secretary to Government, Revenue Department, dated Ootacamund, 9th September 1873.

I have had the honour to receive a letter, dated 9th August 1873, from the Superintendent of the Cinchona Plantations to the Commissioner of the Nilgiris, having an endorsement by yourself, according to which Government are good enough to allow me to make remarks on the statements in the letter.

2. I would first premise in that my report* on the mossing process I have been conscious of no bias in the matter, and have endeavoured to be as just in my conclusions as the information I possess allowed. I express myself in paragraph 40 as anticipating success in the application of mossing to *C. officinalis*, but stated in paragraph 39 that "I am not inclined to look sanguinely on the effects of mossing the trees of *C. succirubra.*" I state, as a reason for my conclusions, the stoppage of growth more or less produced by taking the bark of living trees, and the frequent cases in which the bark taken fails to completely renew.

3. I have never condemned the mossing process applied to any species, although the Commissioner of the Nilgiris erroneously implies, in paragraph 3 of his letter attached to G. O., No. 549, of 29th May 1873, that I have done so. My report effectively refutes this if it be read.

4. In justification of my fears of the frequent failure of renewal of the bark cropped, I mention in paragraph 35: "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." "I may mention that, in consequence of G. O., 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 the bark. I find, by observation, that seventeen out of twenty 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."

5. In paragraph 6 of Mr. McIvor's letter now under remark, he states: "With reference to this remark, I have to state that I was at Neddivuttum on the 19th ultimo; that that gentleman (Mr. Broughton) then indicated the patch of trees he referred to, and, as I was anxious to learn what was really meant by 85 per cent. having failed to renew the bark, I suggested to Mr. Broughton we should examine the trees together. This was not done, but I myself examined the patch carefully. The trees, at the present time, are a mass of verdure, and the luxuriance of their growth are unsurpassed. I propose to take bark from them in October. As to any failure to renew, there is no failure not only in this patch, but in any of the 30,000 trees which have been subjected to the mossing process. In the patch of 2,000 trees, there are trees on which the bark is not perfect; but this is not owing to any defect in the mossing process, but to the fact that the trees were stripped by unskilful workmen, who, in some cases, injured the cambium layer."

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* Attached to G. O., No. 549, of 29th May 1873.

6. In reference to this statement, I am compelled to remark that no suggestion was ever made, or hinted to me, that we should examine the trees together, or I would have accompanied Mr. McIvor with pleasure.

7. With regard to the renewal of the bark, which Mr. McIvor states is without failure, I would suggest that the fact leading to so great a difference of our respective statements should be inspected by some gentleman, who has had a trifling gardening experience. During the one year and eleven months, which has elapsed since the taking of the bark, it is true that the bark has somewhat closed in from the edges of the wound, but sufficient wood remains uncovered to substantiate the accuracy of my statement made in February last. In a fortnight's time, the weather, though now abominable, will be fine at Neddivuttum, and a journey thither on horseback will be a pleasant one.

8. If the case be found as I have stated, I would suggest that an examination also be made of 100 each of the two ages of trees which form the subject of the mossing experiment, in order that the certainty of the renewal of bark may be ascertained by the inspection. The whole observation may be made in the space of two hours.

9. In paragraph 10, Mr. McIvor states that I fell into the mistake of taking bark of a duplicate stemmed tree, one of whose stems had been removed, for a coppice shoot. I have not made so careless an error. This I have been able to demonstrate by repeating the analysis of a coppiced shoot, nearly three years of age, from a tree cut down in its fourth year on the Balmadies estate in the Ouchterlony Valley on the 3rd January 1871. I would, of course, have preferred to have taken the bark from the Government plantation, but none was available. Subjoined is the analysis, compared with the one I originally adduced in letter attached to G. O., No. 249, of 7th February 1871, paragraph 9:—

	Analysis of coppiced Shoots made September 2nd, 1873, two years eight months old.	Analysis originally quoted made March 30th, 1870, three years two months old.
Total alkaloids	4·62	6·34
Quinine	1·45	1·37
Cinchonidine and Cinchonine	3·17	4·97

As this experiment is performed at a season when the amount of alkaloid in the bark is at its lowest, a correction must, of course, be made. A reference to the diagram representing the influence of the seasons (Cinchona Return, 1870, page 241) will show that on March 30th the bark contains 1·25 per cent. more alkaloid than on September 2nd, when the trees are seven years of age. Adding

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* Balmadies Estate,
Guyud, P.O.,
September 3rd, 1873.

Dear Broughton,—I send you, as you request, the bark of a coppice shoot of *C. succirubra*, which you saw on this "Balmadies" plantation, the original tree of which was cut down on 3rd January 1871.

Yours sincerely,
W. Cotton-Rohde.

1·25 to 4·62, the sum amounts to 5·87 per cent., which thus corroborates the accuracy of my former statement as closely as could be expected under the somewhat different conditions of its performance, and that the bark of the coppiced shoot is at least six months younger than that with which it is compared.

10. The evidence adduced above furnishes the whole of the information we possess about coppicing. It has not been further tried. After repeated representations to Government, I have been able to get but 200 red bark trees cut down in 1871, and 58 in 1873; also 50 crown bark trees in 1873, though it is the most obvious plan of cropping. The excessive "bleeding" undergone by these shows that an unfavourable season has been selected for the felling, and that it is hardly a complete experiment. Against this 30,000 trees have had their bark taken and mossed, though no statement of the expense of mossing has been submitted, or any mention of the expense of repairing and renewing the same, or of the increase of cost entailed by the necessity of removing and renewing the moss at the taking of the bark. I have no personal interest in any mode of cropping, and now that I have fulfilled my duty in representing the necessity of certain proceedings, I do not propose to reiterate, and will confine myself to such reporting on results which falls within my province.

11. My previous training and experience have led me to deal with facts, and I have no skill for special pleading or speculative argument. I will point out but a few of the mis-statements in the letter of the Superintendent of the plantations in the cases where they attack my own conclusions. In paragraph 11, he objects to my statement that the greater part of the trees of the plantations being mossed that there will be now no trees left for a trial of coppicing. He points out very accurately that half of the oldest trees are still untouched. The circumstance being, as I have constantly stated to him, that the finest trees on the plantation, in my opinion, ought to be excluded from all experimental treatment, and should be kept untouched to their fullest development, and thus they were tacitly excluded in my statement.

12. In paragraph 17, Mr. McIvor states: "The mere exclusion of light and air from a stem partially bared of bark acts in two ways: it enables a healing process to be rapidly set up in the same way as a plaster does in the case of a wound in an animal organism; and it has this further curious effect, it increases the secretion of quinine in the bark renewed under its protection." Now, as a simple matter evident on observation, loose moss cannot exclude air, though it does light, nor is the increased amount of quinine produced in the renewed bark at all a consequence of the action of moss. Bark that naturally renews without its application, as I have repeatedly stated (Cinchona Return, 1870, page 242), has the qualities of mossed renewed bark, from the simple reason that quinine is the alkaloid first formed in young tissues. Moss has no influence on the quality of the bark, except that it prevents a certain waste of alkaloid by its exclusion of light.

13. In paragraph 22, the matter quoted is entirely mis-stated by being separated from its context. The object of the experiment stated therein was to ascertain whether renewed bark under moss for three years would show any improvement over that under moss for twenty months, and the analysis shows that no improvement is apparent, and as I, therefore, state.

14. If I am wrong in placing a smaller stress on the improvement in quality in the renewed mossed bark than it deserves, my injustice will be shortly apparent in the difference of price it fetches in the Home market. Until that appears, I submit, the matter should stand as I express it.

15. The other statements and citations of Mr. McIvor are susceptible of reply; but, as I see nothing else that throws a suspicion of error or unfairness on my report, I re-affirm the conclusions of the same. The prophetic portions with reference to coppicing, of course, I am unable to corroborate or contradict.

No. 62. From Surgeon-Major G. BIDIE, M.B., Superintendent, Government Central Museum, to the Secretary to Government, Revenue Department, dated Madras, 15th November 1873, No. 194.

WITH reference to your demi-official, dated 26th September, I have the honour to submit, for the information of the Right Honourable the Governor in Council, the following remarks regarding the Government Cinchona plantations. I have confined my observations exclusively to the subjects prescribed to me, and have endeavoured to render the report as practical as possible. Before detailing the results of my inspection, I take the liberty of placing on record that everything which I saw on the estates gave me a very high impression of the ability, care, and energy of the two officers, who have been chiefly instrumental in bringing the Cinchona experiment on the Nilgiris to its present promising condition.

2. *Number of each Species cultivated.*—At the close of the past official year, there were 1,170,029 * Cinchona trees under culture, and they occupied an area of 1,222 acres. The following figures give the number of trees of each variety of bark:—

Crown barks	514,839
Red ,, ...	579,938
Yellow ,, ...	33,850
Grey ,, ...	28,759
Other species	12,643
	1,170,029

The above commercial terms are, for practical purposes, sufficiently distinctive of the several kinds of Cinchona on the estates, but the number of species and varieties which they embrace is very extensive and apparently increasing; for not only do young plants show a tendency to depart from the typical characteristics of the parent, but hybrids are being constantly produced. In fact, the varieties seen here lead to the suspicion that many of the forms, which have been raised to the rank of species, are nothing more than varieties. With the view of elucidating this point, I would beg to suggest that good dried specimens, in duplicate, of each variety be sent to the Herbarium of the Madras Museum, with the view of one set being ultimately conveyed to Europe for comparison with typical specimens in other collections.

3. *Comparative Growth of the different Kinds of Cinchona. Red Barks.*—The red barks (*Cinchona succirubra*) are by far the fastest growing, and show, in

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* These figures are obtained from Mr. McIvor's reports.

accordance with their natural habit, the most decided tendency to develop into large trees. They do not, however, thrive well in high or exposed situations or in grass land, and there are, in No. 1 Denison, the Napier, and Hooker estates, considerable patches, which might, with advantage, be abandoned. In these portions, owing either to great exposure or bad soil, the plants have assumed a bushy appearance, and give no prospect of ever getting much larger. These plots, no doubt, give the estates a more compact appearance; but no private planter would spend money on such unpromising trees. I would, therefore, recommend that these inferior plots be abandoned, and the recorded acreage and number of plants reduced accordingly. The oldest red bark trees were planted in 1862, and some of these have attained a considerable size. I measured the one which is considered the largest of that year's planting, and recorded the following results:—

Girth, 1 foot above the ground...	26 inches.
,, 6 feet above ,, ...	21 ,,
Height (about)	32 feet.

These dimensions are, however, considerably above the general average. Of ten trees taken at random in the 1862 lot, the following were the mean measurements:—

Girth, 1 foot above ground	19·3 inches.
,, 6 feet above ,, ...	15 ,,
Height (about)	25 feet.

The whole of these trees had been mossed, and there were no unmossed red bark trees of the same year's planting in the vicinity to compare with them. The next oldest of the red bark trees were planted in 1863, and have not been mossed. They cover the western slopes of the ravine in which the 1862 trees are growing. They can thus be readily contrasted with the somewhat older trees, which have undergone several mossings; and certainly appearances are decidedly in favour of the younger unmossed trees, the foliage being darker and more luxuriant, and the growing points longer and more vigorous. In another part of the Neddivuttum plantation, I took the dimensions of some red barks which had been planted in 1865. Ten mossed and ten unmossed trees were measured, and the following are the means of these measurements:—

Mossed.

Girth, at 1 foot above ground	15·4 inches.
,, at 6 feet ,, ,, ...	10·725 ,,
Height (about)	19·2 feet.

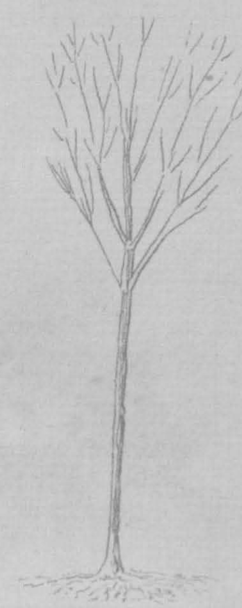
Unmossed.

Girth, 1 foot above ground	15 3 inches.
,, 6 feet above ,, ...	10·45 ,,
Height	20·5

So far as mere dimensions of stem go, there is but little difference between the mossed and unmossed trees; but, taking a bird's-eye view of the trees, the most casual observer cannot fail to notice the superior luxuriance of the unmossed.

4. In all the older parts of the plantations, the red bark plants are much too crowded. This is no doubt an advantage as regards mossing, as the dense expanse

of foliage overhead excludes the sun, and causes the lower branches to drop off. In other words, the trees prune themselves, and the branches, instead of spreading laterally, assume more or less the direction shown in the margin. At the same time, the stems get *spindly*, and there will not be the same amount of root-development as in trees less crowded and more freely exposed. The Cinchona, too, is chiefly a surface feeder, and there is reason to believe that all those trees which were propagated from cuttings, of which there is a very large number, will be found particularly deficient in descending roots. I should, therefore, in case of a severe storm, feel uneasy regarding the risk to the more crowded portions of the red bark plantations, as, if once the wind were to gain admission by prostrating a few trees, the damage might be very serious. The peril, too, will get greater the larger the trees become. Mr. McIvor will be best able to judge as to whether the plots can be safely thinned out at the present stage of their growth; I should say the risk of thinning now would be infinitely less than that to which the trees will be exposed in case of a storm if permitted to remain in their present crowded state. Moreover, the trees can never attain their natural dimensions of stem while so crowded, and the branches can rarely reach a size which will yield useful bark. It need hardly be added that, if it be decided to thin out the plantations now, the trees, which are removed, will yield a considerable immediate revenue.



5. The total number of red barks planted out in the several plantations is 579,938, and, taken as a whole, the trees are in a flourishing condition. From a commercial point of view, the red barks are, of course, less valuable than some of the other species; for, although yielding a comparatively large amount of alkaloids, they give but little quinine,—the only one of any great value in the English market. Experience in India, however, leads to the conclusion that the other Cinchona alkaloids are nearly, if not quite, as valuable, from a therapeutical point of view, as quinine; and, as the plantations were established chiefly for the benevolent purpose of supplying a cheap febrifuge to the fever-stricken poor of the country, it seems to me fortunate that we possess so much of this very productive, rapid-growing, and easily-cultivated species. No better proof of the red bark having found a congenial abode in its new quarters could be found than the fact that vigorous seedlings spring up in thousands under the old trees.

6. *Crown Barks.*—The crown barks (*Cinchona officinalis* and several varieties) are much slower growing than the red, and never attain so large a size. They also naturally grow at a greater elevation than the former species, and will thrive on grass land, and are not so easily injured by exposure to high winds. Still they

grow best in *shola land* where there is generally more or less shelter and good soil. In very exposed situations, where they encounter the full force of the south-west monsoon, they get stunted and covered with a dense crop of lichens, while the outer layers of the bark perish, crack, and ultimately fall off.

7. The oldest crown barks on the Government estates have been ten years planted out, and the largest of these is not more than twenty-four feet high, while the majority are much less and small in girth. The private planter, who has put down this species, will, therefore, have to wait a long time, certainly from eight to ten years at least, before getting any regular return from crown barks; but this will ultimately be compensated for by the superior value of the bark. As a rule, the crown barks yield a smaller amount of total alkaloids than the red barks; but then the proportion of crystallizable quinine in the crown barks is generally considerable, whereas in the red barks it is comparatively small. These peculiarities give to the former a high commercial value, whereas it seems highly probable that the red barks, when their deficiency in quinine is known, will become nearly unsaleable in the English market. This, as already remarked, is, however, a matter of little importance so far as the interests of Government are concerned, as, for general medicinal purposes, the one series of alkaloids are about as efficacious as the other. If the amorphous preparation now made on the plantations could only be sold for eight or ten Annas an ounce, so as to place it within the reach of the very poor of the population, the consumption would be very large, and the boon to fever-stricken districts simply inestimable.

8. The crown barks do not cover the ground so rapidly as the red species, and they have not, therefore, as a rule, begun to interfere with each other in their lateral development. In some situations, however, they are beginning to get crowded, and, if not thinned out, are likely to get weedy. In many places, the trees have a dwarfed appearance, the stems being short, very thick at the base, and tapering rapidly. Such stems are not likely to increase much in size. There are, also, considerable patches, more especially on the exposed ridges and slopes of the Dodabetta plantations, where the plants have a bushy appearance, and give no prospect of ever becoming trees. I think, therefore, the Superintendent might, with propriety, consider whether it is worthwhile keeping up such unpromising plots. The mossed crown barks, owing to the removal of their lower branches and the faded hue of their foliage, present, on taking a bird's-eye view of an estate, a very inferior appearance compared with trees that have not been barked. I also observed in both the red and crown barks, which had been mossed, a tendency to produce an unusual amount of flower and seed,—a peculiarity very common in plants which may have had their vitality reduced in any way.

9. *Yellow Barks.*—The yellow barks (*Cinchona calisaya* and varieties) have not been planted in such numbers as the kinds abovementioned, there being only 33,850 yellow barks on the Government estates. Of these, except a few planted in 1863 and, 1864 the majority are comparatively young, having been put out between 1867 and 1872. The yellow barks have a stronger family likeness to the crown than to the red barks; but they are more compact and bushy in appearance than the crown. A patch of the plants on the lower part of the Kilgraston estate looks very well, but, from some obscure cause, yellow barks are apt to die off after

attaining a considerable size. This is a subject demanding very careful investigation, as the *Cinchona calisaya* is one of our most valuable species. I could see nothing special locally to account for the mortality, but would advise that some of the plants be tried in moist sheltered situations at as low an elevation as may be available on the Government estates. The attention of the Superintendent might also, with advantage, be specially directed to this subject, as, from his well-known skill and experience in the culture of Cinchonas, Mr. McIvor is more likely than any one else to discover the cause of, and the remedy for, the mysterious manner in which the plants sometimes die off.

10. *Grey Barks* (*C. Nitida, C. Micrantha, C. Peruviana*, etc).—Of the grey barks 28,759 have been planted out. From a commercial point of view, the grey barks are of little value, as they usually yield little or no quinine, and are very poor in the other alkaloids. The grey bark trees on the Government estates are by no means luxuriant, and, seeing they are comparatively so worthless, they might all, except a few to be kept as botanical specimens, be grubbed up as soon as they have reached maturity, and more valuable species be planted out instead. The bark could, of course, be utilized in Mr. Broughton's factory.

11. *Other Species.*—The chief of these are the *Cinchona angustifolia* and *Cinchona Pitayensis*. The plants of these are still young, and have made little progress, but look healthy.

12. *General Remarks on the Appearance of the Trees.*—The plantations, as a whole, are looking very well, and the culture of the Cinchonas in Southern India may so far be regarded as a perfect success. The estates are fast becoming very valuable property, and it now only remains to realize more fully the main object for which they were begun, viz., to provide a cheap febrifuge for the poor.

13. *Harvesting the Bark. Mossing Process.*—As this ingenious system of harvesting the bark has now been, for some time, in operation, its merits and demerits may be fairly discussed. I shall first briefly describe the process as it was exhibited to me, the plants operated on having been seven-year old red barks on the Kilgraston estate. From these, one crop of bark had been removed one year prior to my visit, and the remaining strips, consisting of portions of the original bark which had thus been one year under moss, were removed in my presence. When the mossing process is in operation, the coolies are divided into gangs consisting of five men each, viz., two *barkers*, two *mossers*, and one man to split and roll up balls of bast to secure the moss on the denuded stem. The process commences by the barkers attacking a stem with their knives, and removing the bark in strips from 2 to 2½ inches wide, and from a point as high up as they can conveniently reach down to the bottom of the stem. In doing this, they first make two perpendicular cuts through the bark, so as to define the width of the strip, and then with the back of the knife, used as a lever, they gently separate the bark from the wood all along the tracks of the cuts. When this has been done and the bark removed, the exposed surface of the wood is seen to be covered with a layer of gelatinous like substance, the cambium, which consists of active young cells from which future additions to the wood and bark are derived. It is of great importance that the cambium layer should not be injured by the knife, or allowed to dry, or be exposed to the sun, as, if injured in any of these ways, the

bark will fail to renew. It is plain, therefore, that the removal of the bark by this method is a process which requires some skill and considerable care, and to conduct it successfully well-trained men are necessary, as has been pointed out by Mr. McIvor. But to return to the barking. As soon as the strips of bark have been removed by the two barkers, the two mossers begin work. One man taking up a small bundle of the soft tree-moss, which has been previously collected, wraps it round the stem, commencing about six inches above the upper extremity of the newly denuded surfaces. The second mosser then takes a ball of bast and passing this round and round the moss secures it to the tree. As soon as the first portion is thus tied on, another bundle is applied, and so on, from above downwards, till the whole of the barked portion of the tree is completely enveloped in a soft moist covering.

14. While the mossing process was being exhibited to me, I timed the men, and found that ten could only, although doing their very utmost, get through ten small trees in one hour. Of course, if the trees were large, and the men had to work from ladders, the results, as to outturn of work, would be greatly less. The cost of barking and mossing is, therefore, considerable. At the rate at which the above experiment was executed, the stripping and mossing would, in the first instance, cost about 1½ Annas per tree, and, if we allow ½ Anna more for repairs, the total cost per tree would be about 2 Annas. On the other hand, the green bark of the ten trees, which I saw stripped, weighed exactly 23½ lbs., say that this on exsiccation yields 10 lbs. of dry bark (which it will hardly do), then on each pound of dry bark there is a charge of 2 Annas for stripping and mossing alone. The above calculation has reference only to Neddivuttum where the moss is comparatively abundant, but at Dodabetta, where it has to be brought from long distances, the cost must be at least twice as much.

15. The harvesting of the bark in the manner described above, viz., by partial removal, is not altogether a new one, as will be seen from the following extract from Howard's "Illustrations of the Nueva Quinologia of Pavon," page 3 of Article Cinchona Uritusinga:—"It may not be out of place to mention also here a curious practice by which the inhabitants of Loja flatter themselves that they secure economical bark-cutting. They cut off (Don Riofrio told me) the whole of the bark of the trunk of a small tree, leaving only one broad strip, so as not to destroy the tree which gradually re-places its loss; and the second time of cutting the bark is called *Cascarillas resecadas*, and esteemed as of superior quality. This practice appears to be as old as the time of Ruiz, as I find it mentioned in a manuscript of his in the British Museum." This, so far as the simple removal of the bark and leaving a strip is concerned, is almost identical with Mr. McIvor's process, the chief advantage of which is that by the immediate application of a soft moist covering of moss to the decorticated stem the young growing cells of the cambium are protected from light and atmospheric influences, likely to interfere with their development and the elaboration of the alkaloids.

16. That such a covering is not absolutely necessary for the renewal of the bark is, however, shown by the quotation given above, and by the following experiment, which has been carried out on the Dodabetta estate on crown-bark trees. In

June 1873, some of these were stripped and no moss applied, and I examined fifteen of this lot on the 9th October, and found as follows:—

On 5 trees bark renewing perfectly.
,, 4 ,, ,, ,, well.
,, 5 ,, ,, ,, fairly.
,, 1 ,, ,, ,, imperfectly.

Considering the recent date at which the trees had been barked, the above results would compare very favourably with a similar number of mossed trees. The renewal of the bark in this experiment took place in exactly the same way as would have been the case in a mossed tree, and the only conditions necessary to secure success are that the cambium layer shall not be injured, and that the operation of stripping be carried out in damp weather, so that the delicate cambium cells may not be injured by exposure. But little attention has been paid to bark renewed without the protection of moss. From the few analyses of such made by Mr. Broughton, it appears that while there is no appreciable increase of total alkaloids, there is a very decided increase in the amount of quinine.*

17. *Physiological Effects of Stripping and Mossing.*—It is hardly necessary to say that the removal of a large portion of the bark of a young and growing tree cannot fail to affect its growth in various ways. In the economy of the plant, the inner bark is the great channel through which the sap, after being elaborated in the leaves, passes downwards to supply materials for the formation of new wood, bark, and the numerous products found in vegetable tissues. When a portion of bark, therefore, is removed from a stem, the descending current of nutrient sap is interfered with, and, if a complete ring of bark be removed, there will be an arrest in the development of wood below the ring, and the tree may perish. The partial removal of the bark in the mossing process does not entirely arrest the formation of new wood, as the strips of bark left uninjured enable the tree to carry on a modified circulation. But, although the formation of wood is not entirely arrested, the new tissue is apt to be deposited in diminished amount at the places where the bark has been stripped off, and thus we get a somewhat diminished and irregularly shaped stem, the deformities of which are, of course, likely to be increased by successive barkings. And, further, if, by any chance, the cambium layer is destroyed, there will, at the part of the stem thus injured, be a complete arrest of wood-development, and not only so but the wood on the exposed surface may actually perish. The specimen marked A (sent under a separate cover) is a horizontal section of a stem, which was barked in 1871, and illustrates the irregularity in the formation of the annual zones of wood to which I have alluded, and also shows the results of barking when the cambium layer has been destroyed. It will be observed that the wood in the depressions on the margin of this section, that is, in the places which were denuded of bark and cambium, is more or less decayed, and that the tree has been endeavouring to cover up these dead portions by bridging the gaps with processes of young wood advancing from the sides of the wounds. It need hardly be said that such a stem is not, and never can be, a sound and healthy one; indeed, there is every prospect in a soft-wooded tree like the *Cinchona succirubra* of its becoming quite hollow as it gets older. Stems in such an extremely mutilated condi-

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*Paragraph 34 of letter in G. O., No. 2,453, of 22nd September 1868.

tion as this specimen are, however, quite exceptional, and this section has been brought forward merely in illustration of the preceding remarks.

18. At the same time, there can be no doubt that, under the barking and mossing process, there will always be a certain percentage of more or less complete failures,—cases in which entire strips, or portions of strips, of bark will fail to renew immediately, and thus leave wounds which will be covered up by the slow cicatrising process illustrated in Specimen A. Thus, in the case of the 2,000 *Cinchona succirubra* trees referred to in paragraph 2 of G. O., No. 549, of 29th May 1873, there can be no doubt that a very large percentage of these have failed to renew by the "first intention," which they should do in the mossing process, and are now closing up by slow cicatrisation from the sides of the wound. When inspecting this portion of the estate, I stripped 20 trees of their covering of moss in one place and 20 in another, and amongst the 40 trees thus taken at random and examined there were 33 failures, more or less complete, or a percentage of 82·5 in which the bark had not completely grown again after a lapse of two years. Indeed, everything I saw while making my observations impressed me with the fact that the mossing process to be successful must be carefully performed by skilled labour, rigidly supervised by a European Superintendent.

19. I have already alluded to the fact that trees under the mossing process look much less vigorous and healthy than others which have never been touched. There are several reasons for this, the chief of which are the removal of all the lower branches, and the check or shock communicated by the removal of the bark. The removal of the branches takes place either naturally, owing to the trees being too crowded, or is done purposely to facilitate the mossing process. In either case, the result is that the tree is deprived of a large amount of its foliage, and thus becomes less capable of rapid stem-development, and less likely to strengthen its position by the lateral and downward extension of roots. Altogether there can be no doubt that a mossed tree, owing to the various unnatural conditions that it has to endure, is never likely to attain its normal size, or to have a perfectly sound and healthy stem; and it certainly runs a much greater risk of dying prematurely than a tree which has not been subjected to mossing.

20. When the process was first introduced on the estates, it was believed that a period of eighteen months would be sufficient for the renewal of the bark; but experience has shown that two years are barely sufficient. My own opinion is that the oftener the process is repeated on a tree, the slower will its bark renew. Of course, the protraction of the period of renewal affects, from an economical point of view, the value of the process, and I would recommend that accurate returns be obtained, showing the period that has been required for the complete renewal of the bark on all trees that were stripped for the first time, say from eighteen to thirty months ago, and trees that were barked for the second time during the same period. The return should include both crown and red barks. It will also be desirable to ascertain accurately the average yield of bark (*a*) in trees stripped for the first time, (*b*) of renewed bark in trees stripped for the second and third time.

21. During recent years of our experience of the mossing process, it has been anticipated by some that, although there is a stage in the Cinchona at which the amount of alkaloid in the natural bark is stationary or perhaps diminishing, the renewed bark will continue throughout the life of the tree to possess the remarkable richness exhibited in the bark of young trees renewed under moss. In arriving at any conclusion on this important point, we must, of course, be guided entirely by the results of the analyses conducted by the Government Quinologist.* So far there do not show any noteworthy gain in the quantity of alkaloids in the renewed bark of the older *Cinchona succirubra* trees, and we must, therefore, conclude that, when this species reaches the age at which the amount of alkaloids in the natural bark is stationary, the mossing process ceases to have any marked influence on increasing the alkaloids in renewed bark. With regard to the crown-barks, the evidence on this point is more favourable; but as the quality of this bark is always variable, and as the trees may not as yet have arrived at that age at which the alkaloids in the natural bark will cease to increase, it seems desirable to continue the analyses of the bark of the oldest crown-bark trees from time to time.

22. And here another question arises, as various facts appear to me to point to the conclusion that mossing does not increase the alkaloids by exerting a fostering influence on the process by which they are eliminated from the crude sap, but that the increase is possibly obtained at the expense of the original bark. In other words, it seems probable that the amount of alkaloids in the portions of original bark remaining on a mossed tree will have their alkaloids diminished to an extent proportionate to the increase manifested in the renewed bark. I anticipate this, because the active reparative process going on in the bark that is being renewed is likely to attract to it strong currents of formative materials; so that not only may the greater portion of the new alkaloid elements in the circulation be appropriated by the bark which is being renewed, but it may also receive additions from old deposits in the original bark on the upper parts of the stem, etc. This would not probably account for the whole of the increase; but nevertheless the question is an interesting and important one, and should, I think, be investigated by Mr. Broughton.

23. On the whole, the mossing process has as yet been fairly successful. It must be recollected, however, that it has hitherto been applied to young and vigorous trees, and that, although they have not suffered very much from the barking process, it is hardly to be expected that we can go on year after year for any length of time denuding a tree in this way without diminishing its vigour and shortening its existence. I look upon the mossing process, therefore, as still only in the experimental stage, but believe that the critical period has begun, which will enable us to pronounce absolutely on its value. As its merits have already been sufficiently explained to Government, I have deemed it advisable to dwell chiefly on its weak points with the view of the whole question being thoroughly sifted. The issues at stake, so far as Government are concerned, are very great, and private planters naturally look to the Government plantations for information as to the best and most economical method of harvesting their bark.

24. *Coppicing.*—So far we may be said to have had no experience whatever of this method of harvesting the bark, as the few experiments which have been made have been on too small a scale, and not conducted in a manner likely to throw

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* Paragraphs 17 and 23 of letter in G. O., No. 549, of 29th May 1873.

much light on the subject. The oldest coppiced trees are some red barks which were cut down in 1866. I was not able to find the whole of these, but those which I saw had not done well. This is hardly to be wondered at, as, in the first place, some of the trees were immediately over the scarp of a road,—a bad situation for coppiced trees,—and, in the next place, too many shoots had been left to grow up from the stumps. The next coppicing experiment was made in 1871, 240 *C. succirubra* trees having been cut down in that year. Of these, 40 are on the Kilgraston estate, and form a single row, flanked on each side by tall neighbours; while the 200 are on the Denison estate, and constitute a plot which has been completely cleared. As regards the 40 trees on the Kilgraston estate, they can hardly be said to have had fair play, as their neighbours have so completely shaded them as to deprive them, to a considerable extent, of the necessary light and air. Too many shoots have also been allowed to spring up from the stools, and these shoots, owing to the dense shade, were observed, in many instances, to be too feeble to stand erect. No opinion as to coppicing can be deduced from this part of the experiment. The 200 coppiced trees on the Denison estate have done better, all the stools, with a very few exceptions, having survived, and the shoots have grown fairly, and are looking healthy.

25. Another coppicing experiment was carried out in June 1873, 58 red bark trees having been cut down, while a similar number of contiguous trees, of the same species and age, were barked and mossed with the view of the results of the two systems being rigidly contrasted. I must say at once that this trial is on much too paltry a scale, and that the coppiced trees were cut at an unfortunate period of the year, as, being then full of sap, they, of course, bled profusely, and thus ran a great risk of dying, or having their vitality more or less permanently impaired. Owing to the short time that had elapsed since this experiment was instituted, it was quite useless for any practical deductions; but I may remark that all the stools had either thrown up shoots or gave promise of doing so. The same remarks apply to a small coppicing experiment on crown barks on the Dodabetta estate, these trees having also been cut in June 1873.

26. It will thus be seen that the coppicing experiments have not been of a character to allow of any definite opinion being given as to this system of harvesting the bark. To permit of this, they will require to be on a much more extensive scale, and conducted in a somewhat different manner. Considering the long and trying dry season which the plants have to endure from December to March on the Government estates, and that the Cinchonas are surface feeders, it will not be judicious to clear away the whole of the trees in any plot in a single season. Such a measure would subject the stools to such an amount of sun and drought that, in all probability, a large percentage of them would perish, while those left would most likely throw out comparatively feeble shoots.

27. I would, therefore, recommend that only every second row of trees be cut down in the first instance, and that the standing row be left untouched until the young shoots have attained some size. Experience will determine how long the standing trees should be left intact to nurse the young shoots. In the operation of coppicing, great care is required not to injure, in the slightest degree, the bark which remains on the stool, and the stem should be cut across not more than one

inch above the surface of the ground. All the stools which I saw at Neddivuttum were generally a foot or more high, but a low cut stool has advantages which it is needless to specify here. Of course, if a shoot, as sometimes happens, is found naturally growing within a foot or so of the base of the stem, when the tree is coppiced, then the cut may be made higher so as to save the shoot. Another point of great importance is that when the stools begin to throw out shoots, all these, save one or two of the most vigorous, should be carefully removed. If two have been left, then, as a rule, at the end of a year one should be cut away so as finally to leave but one.

28. The question as to the period of the year at which the trees should be coppiced is one of considerable difficulty, and has yet to be determined by actual experiment. The trees hitherto coppiced have bled so profusely as almost to forbid a repetition of any such experiment; but I feel sure the proper season will be found somewhere between October and March, when the trees are partially at rest. I would, therefore, recommend that, as a coppicing experiment, not fewer than 3,000 or 4,000 trees be cut down, and that every second row be left standing, so as to protect the roots of the stools from drought until the young shoots, which they throw out, have acquired some size. If this be done, and the other conditions, which I have pointed out, be also attended to, there is every reasonable prospect of the experiment being successful and affording the necessary data for arriving at a definite opinion as to the applicability of the coppicing system for harvesting Cinchona bark. It need hardly be said that an accurate diary should be kept of everything, horticultural and economical, connected with this trial, so that there may be no necessity for any further experiments of the kind. If coppicing be ultimately adopted as the better method of harvesting the bark, the plantations should be worked on the plan adopted in oak coppices, which yields an annual supply of bark. One advantage of the coppicing system would be, that it would afford an abundant supply of fire-wood for the factory at Neddivuttum,—a matter of great importance, as junglewood is now getting scarce.

29. In the instructions received from Government, I was directed to give my opinion as to the respective merits of the "mossing" and "coppicing" systems of treating the trees; but it will be seen that, at present, there are not sufficient materials to permit of a satisfactory comparison. The mossing system has had a fair trial, and so far has answered fairly; but, as I have already observed, the experiment has not yet passed through the crucial stage, and there are yet various facts regarding it to be worked out and collected, which must be before any one trying to arrive at a final conclusion as to its merits. As to the coppicing system, it is to be regretted that experiments of a more extensive character were not instituted at an earlier date, for, as matters now stand, some years must elapse before a final opinion can be pronounced on this method of working the estates. It may be mentioned here that private planters have not all waited to obtain information from Government experience as regards coppicing. In Bengal, this system is exclusively employed in harvesting the bark, and on the Nilgiris one planter has tried it with results which are so far satisfactory. In conclusion, I have to record my thanks to Mr. Broughton and Mr. McIvor for the courtesy with which they received me, and the ready manner in which they supplied me with information. I was also

much indebted to the Assistant Superintendent at Neddivuttum for attention and assistance in various ways.

No. 63. From J. BROUGHTON, Esq., B.S.L., F.C.S., Government Quinologist, to D. F. CARMICHAEL, Esq., Secretary to Government, Revenue Department, Fort St. George, dated Ootacamund, 4th March 1874.

IN a G. O., No. 3,068, of 9th December 1868, and G. O., No. 426, of 19th February 1869, a number of trees, amounting to 7,000, were directed to be treated by the mossing process of Mr. McIvor as a full experiment to determine the merits of this plan of cropping. This was done at my suggestion, and the number of trees to be thus treated was proposed by the Superintendent of the plantations and myself. The directions were accordingly carried out.

2. In paragraph 10 of my letter of 21st August (attached to G. O., No. 249, of 7th February 1871), I propose that a considerable number of trees should be cut down in order to test the results of coppicing, side by side, with the plan of mossing. This proposal was reiterated by the Commissioner of the Nilgiris in a letter, dated 15th March 1871 (attached to G. O., No. 701, of 19th April 1871), and, in reply, Government order that this should be done. But only about 200 trees were felled in fulfilment of this Government order, and the experiment of coppicing was carried out in an incomplete manner.

3. In G. O., No. 1,213, of 13th July 1871, Government order that the bark supplied to my manufactory should be obtained under the mossing process. This was done at the suggestion of the Commissioner of the Nilgiris. The reasons for this are unknown to me, as Government did not do me the honour of consulting me in the matter. The Superintendent of the plantations, in the same paper, at that time coincides with me in recommending partial coppicing. The experiment to determine the merits of mossing was then under trial.

4. I had the honour to forward in a letter, dated 25th November 1872 (attached to G. O., No. 1,646, of 6th December 1872), a recommendation that the plan of coppicing should be more fully tried, and proposed that 10,000 trees should be felled. I pointed out the practical inconvenience that resulted in manufacture by the bark being only supplied during the season favourable for mossing. This letter was referred to Mr. Cockerell, the Commissioner of the Nilgiris, and the Superintendent of the plantations for report. Though the matter appeared to me of some importance, I have never had the honour to receive any further reply to my letter.

5. On the 11th February 1873, I had the honour to report on the results obtained with the experimental mossing of the 7,000 trees (letter attached to G. O., No. 549, of 29th May 1873). I expressed myself with caution concerning this, my opinion being favourable with the trees of *C. officinalis*, but not so with *C. succirubra*. There is no sentence in my report to justify the phrase employed by the Commissioner of the Nilgiris in paragraph 3 of his letter, in which he speaks of my "condemnation" of mossing red barks. As my letter mentioned in paragraph 4 had been referred to him, I was much surprised to find also in paragraph 14 of his letter the following passage:—

"In conclusion, I venture to remark on the complaint of Mr. Broughton that the coppicing sanctioned in G. O., 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."

I respectfully submit that this remark tends further to the confusion of fact. The statements in paragraphs 10 and 11 are also to me very surprising, as I have never met with a tree of the peculiarities of yield mentioned. Though his statements are obviously mainly speculative, they appear, by paragraph 2 of G. O., No. 549, of 29th May 1873, to have determined the opinion of Government.

6. In paragraph 4 of same Government order, Government, however, direct that no more trees should be mossed. But, again in paragraph 1 of G. O., No. 952, of 5th September 1873, Government direct that three-fourths of the trees available should be mossed.

7. The Commissioner of the Nilgiris and the Superintendent of the plantations have at various times contradicted my statements, and at others explained my meanings. The Government have, with much fairness, referred to the facts of the plantations themselves to corroborate or contradict my assertions. But, though I cannot doubt of the result of this reference, I have not yet received the honour of an acknowledgment of the truthfulness of my statements.

8. The foregoing statements are made in order to detail, with some accuracy, the history of the subject. I had no prejudice of my own on the question, and in my report confined myself to stating facts. These latter, if true, will ultimately meet and overcome opinions incompatible with them. It has been with this conviction that I have, on few occasions, reiterated a recommendation or statement I have once made, even in the ordinary case of an opposite opinion to mine determining the decisions of Government.

9. I have now the honour to report on some further facts connected with the profit of the method of cropping by allowing the renewal of bark under moss. These have been ascertained at the suggestion of Dr. Bidie, Curator of the Madras Museum. This gentleman had an impression that the alkaloid in the renewing bark might possibly be derived from the old untouched bark of the same tree. This had also occurred to me, but certain analyses I had made, and had the honour of communicating to Government in paragraph 45 of a report appearing in Proceedings of Government, Revenue Department, No. 268, of 22nd February 1870, appeared to render the supposition unlikely. These analyses were made of naturally renewed bark without any protective, and it was found that at the early stages of the renewal the alkaloid in the renewing bark differed greatly from that of the old untouched bark. But, as this did not contradict the transference of *some* part of the alkaloids, I decided to investigate the point.

10. In order to do this, it was necessary to compare the untouched bark of trees with the remaining untouched bark of trees, part of whose bark had been some months taken, and was in process of renewal. But, as much of this latter was covered with moss, which itself might cause alteration of yield, it was necessary that I should examine the untouched bark above the moss, though, in this case, the

hypothetical transference, if existing, would probably take place in a less degree. The trees were chosen with much care, the same variety being closely selected, and trees of the same height were taken. The specimens were taken off at accurately measured equal heights on the trees. In order to remove the possible error arising from the individuality of single plants, several trees were taken for the comparison.

11. In the following table, I communicate the results :—

1*st*—Tree of *C. officinalis*, which had been partially barked seven months, in comparison with untouched trees.

	Upper Bark of Trees renewing Bark under Moss.	Bark of similar untouched Trees.
Total alkaloids	1·51	3·25
Quinine...	1·41	2 22
Cinchonidine and Cinchonine...	0·10	1·03

2*nd.*—Similar experiment performed with 14 trees of *Crispa* var. of *officinalis.*

	Upper Bark of Trees renewing Bark under Moss.	Bark of similar untouched Trees.
Total alkaloids...	1·84	2·67
Quinine...	0·93	2·31
Cinchonidine and Cinchonine...	0 91	0·36

3*rd.*—Trees of *C. succirubra*, eight years old, bark of which had been taken a year, compared with bark of equal height on untouched trees.

	Untouched Bark taken from barked Trees.	Bark from equal Height of untouched Trees.
Total alkaloids...	5 29	6 34
Quinine and Quinicine	1·46	3·14
Cinchonidine and Cinchonine	3·83	3·20

4*th.*—Tree of *C. succirubra*, of same age as those of second age, employed for mossing experiment, bark of which had been taken about seven months, compared with bark taken from equal height on untouched trees.

	Untouched Bark taken from barked Trees.	Bark from equal Height of untouched Trees.
Total alkaloids...	3·70	4·80
Quinine and Quinicine	1·82	1·70
Cinchonidine and Cinchonine	1·88	3·10

5*th.*—Trees of oldest Cinchona, bark of which had been taken about December 1871, being portion of the experimental number.

	Untouched Bark taken from barked Trees.	Bark from equal Height of untouched Trees.
Total alkaloids...	3·68	5·56
Quinine and Quinicine	0·81	1·26
Cinchonidine and Cinchonine	2·87	4·30

12. The above results were obtained without a single contradictory exception, and appeared quite conclusive. A corroborative experiment was, however, made in order to confirm what I consider to be a most important and significant result. For this purpose the upper bark of trees of *C. succirubra*, which had had their bark partially taken and the trunks mossed six weeks, was compared with that of untouched trees. In this case as the transference of alkaloids had not time to take place into the cellular growth, which would subsequently form the renewed bark, and, therefore, scarcely any difference in the amount of alkaloids was perceptible in the two specimens,—a fact which fully confirms the important result obtained in the analyses cited above.

13. Thus it is quite clear that much of the alkaloid in the renewed bark is obtained at the expense of the old bark remaining on the tree, whose value it consequently reduces. As this transference of alkaloid could scarcely produce its maximum effect in the bark, which was in these experiments necessarily taken from the upper bark of the trees, it is doubtless usually more considerable than the analyses indicate. This result also fully explains a circumstance which has long puzzled me, viz., the comparatively inferior yield of late obtained on analyses of the barks supplied to manufactory, which were taken from partially decorticated and mossed trees. In all the above experiments, it was found that the specimen of bark from the decorticated trees contained less moisture, rose with difficulty from the stem, and had a less healthy appearance than that from untouched trees.

14. I stated on the 11th February 1873 that the results I obtained with the experiments on the mossing of *C. officinalis* augured favourably for this plan of cropping with that species. But the circumstance that three years have elapsed before the renewed bark can be cropped now much modifies my opinion. The fact of the transference of alkaloid from the untouched into the renewing bark is one which still more strongly points in the same direction.

15. I have no hesitation now in condemning the plan of mossing, whose merits I have throughout endeavoured to fairly consider. It is worthy of remark that, though I have been unsuccessful in my attempts to obtain a fair experiment of the obvious plan of coppicing on the Government plantations, it is under favourable trial on private ones. As I have confidence in the results I have formerly stated and in those I now communicate, I do not propose to discuss the matter beyond stating my opinions, and the facts on which they are founded. The responsibility for the ultimate effects of disregarding the teaching of the latter can scarcely rest on me if I fairly point them out.

16. I arranged with the late Commissioner of the Nilgiris that the expense of mossing should be considered by him in his remarks on my report on the chemical results. Though an important part of the question, it has, since his death, been but slightly adverted to.

No. 64. ORDER THEREON, 11th April 1874, No. 434.

Miscellaneous.

THE correspondence now before Government refers principally to a difference of opinion between the Superintendent Government Cinchona Plantations and the Government Quinologist as to the comparative merits of harvesting the bark by the "Mossing" and "Coppicing" systems.

2. Both these gentlemen have stated their opinions at length, and it is not the present intention of His Excellency the Governor in Council to examine

minutely their statements, because it appears to him plain that, owing to circumstances unnecessary to recapitulate, the "Coppicing" system has not as yet had the trial which the Government intended.

3. As the subject is one of the greatest importance, the Government took advantage of the presence of Dr. Bidie at Ootacamund to obtain the views of a competent judge upon the matter at issue, and they are much indebted to him for the interesting report which he has submitted.

4. The Governor in Council quite concurs with Dr. Bidie that there are not yet sufficient materials to admit of a satisfactory comparison between the two systems. Both must be prosecuted till all doubts are removed. The number of trees already mossed will afford ample means for completing the experiment as regards the "Mossing" system. It is also desirable to carry out further the experiments mentioned in paragraph 16 of Dr. Bidie's report relating to the renewal of bark without moss. Some hundred trees might thus be treated. It will be interesting to know the value of barks renewed in this way. As to the "Coppicing," it is the wish of His Excellency that the Commissioner should arrange with the Superintendent Government Cinchona Plantations for the experiment indicated in paragraphs 26 to 28 of the report being carried out in as thorough and effectual a manner as possible. The number of trees to be thus dealt with need not, in the first instance, exceed the 6,000 referred to in G. O., 5th September 1873, No. 952.

5. In regard to other matters alluded to by Dr. Bidie, His Excellency the Governor in Council desires that Mr. McIvor will attend to the suggestion in paragraph 2 for the transmission of dried specimens of each variety of Cinchona to the Madras Museum. The proposals to abandon inferior plots (paragraphs 3 and 8), to thin out the red barks (paragraph 4) and crown barks (paragraph 8), to investigate the causes of the premature decay of *C. calisaya* (paragraph 9), and to abandon the grey-bark cultivation (paragraph 10), will also meet with careful attention at the Superintendent's hands.

6. It is of great importance also in the conduct of the "Mossing" experiment that accurate returns of the nature indicated in paragraph 20 should be recorded, and the Superintendent's particular attention should be drawn to this, as well as to the necessity for showing the *expense* of the process.

7. The Commissioner will communicate to Mr. Broughton copy of G. O., 30th January 1873, No. 126, Revenue Department, as he appears to have omitted to do so before.

(True Extract.)

(Signed) C. G. MASTER,
Acting Secretary to Government.

To the Commissioner of the Nilgiris.
,, G. Bidie, Esq., M.B.
,, the Government Quinologist.
,, the Board of Revenue.

Exd. F. R. Bantleman.

Govt. of {1874} Madras.

REVENUE.

To

The COMMISSIONER of the
NILGIRIS,
&c., &c., &c.

Dated April 11th.

Recd. *Encl.*

G. O., 11th April 1874, No. 434.

APRIL.
Nos. 60—64.

Mossing and Coppicing Systems of harvesting Cinchona Bark.—Passing orders on papers relating to the —.

☆

CP 1947/74.

Govt. of 1874 Madras

REVENUE.

To

THE COMMISSIONER OF THE NILGIRIS,

&c., &c., &c.

Dated April 11th.

Recd. Encl.

G. O. 11th April 1874, No. 434.

APRIL.
Nos. 60—64.

Mossing and Coppicing Systems of harvesting Cinchona Bark.—Passing orders on papers relating to the —.

V O/R 1947/74.

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Ootacamund
4th March 1874

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From
Mr. J. Broughton B.A. F.C.S.
Government Quinologist
Ootacamund

To
D. F. Carmichael Esq.
Secretary to Government
Revenue Department
Fort St. George

Sir,

In G. O. No. 3058 of [illegible] Dec. 1866 and [illegible] No. 286 of [illegible] February [illegible] number of trees [illegible] were treated by the mossing process [illegible] experiments to determine [illegible] plan of coppicing. This was done at my suggestion and the number of trees [illegible] was proposed by the Superintendent of the Plantations and myself. The directions were accordingly carried out.

2 On para [illegible] of my [illegible] attached to G. O. No. [illegible] of 7th Feb. 1871 I proposed that a considerable [illegible] should be cut down [illegible] of coppicing side by side [illegible] The proposal was sanctioned [illegible] of the [illegible] attached to G. O. No. [illegible] 19 [illegible] by Government [illegible] done. But [illegible] in fulfilment of the [illegible]

coppicing was carried out in an incomplete manner.

3 In G.O. No. 1215 of 13th July 1871 Government [illegible] order that the bark supplied to my manufactory should be obtained under the mossing process. This was done at the suggestion of the Commissioner of the Nilgiris. The reasons for this are unknown to me, as Government did not do me the honour of consulting me in the matter. The Supt. of the Plantations on the same paper at that time concurred with me in recommending partial coppicing. The experiment to determine the merits of mossing was then under trial.

4 [illegible] letter dated 25th November 1872 (attached to G.O. No. 1640 of 6th December 1872) a recommendation that the plan of coppicing should be more fully tried and proposed that 10,000 trees [illegible] be felled. I pointed out the practical inconvenience that resulted in manufacture by the bark being only supplied during the season favourable for mossing. The letter was referred to Mr. Cockerell the Commissioner of the Nilgiris and the Supt. of the Plantations for report. Though the [illegible] [illegible]

have [illegible] reply to my letter of 11th February 1873 [illegible]

~~12th Jany~~ 11th February

further [illegible] the [illegible] 1873 I laid the

5 [illegible] report on the results obtained honour [illegible] experimental mossing of the 10,000 trees with the [illegible]

G.O. 30 January 1873 No. 126 R.D.

4) 31

trees. (Letter attached to G.O. No. 549 of 29 May 1873) I expressed myself with caution concerning this, my opinion being favourable with the true [illegible] of C. Officinalis but not so with C. Succirubra. There is no sentence in my report to justify the phrase employed by the Commissioner of the Nilgiris in para. 3 of his letter in which he speaks of my "condemnation of mossing red barks. [This employment of the fallacy ignoratio Elenchi though forensic, confuses the matter.] As my letter mentioned in para. 4 had been referred to him, I was much surprised to find also in para. 14 of his letter the following passage "In conclusion I venture to remark that the cop-"[illegible] the complaint of Mr. Broughton [illegible] dated 6th "picing sanctioned in G.O. No. 1640 dated 6th "December 1872 was not carried out, that "Mr. Broughton was the proper person to call "attention to the neglect of [illegible]." I respectfully submit that this remark tends further to the confusion of facts. The statements in paras 10 and 11 are also [illegible] very [illegible] of the pruning as I have never [illegible] though the peculiarities of yield mentioned [illegible] calculative statements are obviously [illegible] 29th May they appear to have [illegible] 1873 to have determined the [illegible] [illegible] for [illegible].

6. In [illegible] however direct that no more [illegible] mossed. But again in [illegible] of 5th September 1873, [illegible] the advice of a gentleman who [illegible] Cinchona three times,] [illegible]

omit

omit

of the trees available should be mossed.

[I have of course no right in any way to criticise the G.O. or any power to prevent its ultimate results.] omit

7. The Commissioner of the Nilgiris and the Superintendent of the Plantations [illegible] [illegible] at others explained any meaning. The Government have with much [illegible] to the facts of the plantations themselves to corroborate or contradict my [illegible]. But though I cannot doubt of the result of this reference I have not yet received the honour of an acknowledgement of the truthfulness of my statements.

As regards that part of it which alludes to barking & renewing bark [illegible]

8. The foregoing statements are made [illegible] to detail with some accuracy the history of the subject. I had no prejudice of my own on the question, and in my [illegible] confined myself to stating fact. [illegible] taken of time will ultimately [illegible] and overcome opinions in conformity with them. It has been with this [illegible] that I have on previous occasions [illegible] [illegible]

[illegible] case [illegible] [illegible] of Government.

9. I have now the honour to report [illegible] some [illegible] facts connected with the [illegible] method of cropping by allowing

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allowing the renewal of bark under moss. These have been ascertained at the suggestion of Dr Bidie Curator of the Madras Museum. This gentleman had an impression that the alkaloid in the renewing bark might possibly be derived from the old untouched bark of the same tree. This had also occurred to me, but certain analyses I had made and had the honour of communicating to Government in para. 45 of a report appearing in Proceedings of Govt Revenue Department No 268 [illegible] of 22d February 1870 appeared to render the supposition unlikely. These analyses were made of naturally renewed bark without any protective and it was found that at the early stages of the renewal the alkaloid in the renewing bark differed greatly from that of the old untouched bark. But as this did not contradict the transference of some part of the alkaloids I determined to investigate the point.

10. In order to do this it was necessary to compare the untouched bark [illegible] with the remaining untouched bark [illegible] part of whose bark had been [illegible] taken [illegible] as much of the bark was [illegible] with moss which itself might cause [illegible] it was necessary that [illegible] the untouched bark above [illegible] though in this case the hypothetical transference of [illegible] would probably take place in a less degree. The trees were chosen with

[illegible] the same variety being closely selected and trees of the same height were taken. The specimens were taken off at accurately measured equal heights on the trees. In order to remove the possible error arising from the individuality of single plants, several trees were taken for the comparison.

11. [illegible] the following table I communicate the results:— 1st Tree of C. Officinalis which had been partially barked 7 months in comparison with untouched trees.

	Upper bark of trees renewing bark under moss	Bark of similar untouched trees
Total alkaloids	1. 51	3. 25
Quinine	1. 41	2. 22
Cinchonidine et Cinchonine	0. 10	1. 03

2nd Similar experiment performed with 4 trees of C. [illegible] var. of Officinalis.

	Upper bark of trees renewing bark under moss	Bark of similar untouched trees
Total alkaloids	1. 84	2. 67
Quinine	0. 93	2. 31
Cinchonidine & Cinchonine	0. 91	0. 36

3rd Tree [illegible] C. Succirubra 8 years old bark of [illegible] bark [illegible]

	Untouched bark taken from barked trees	Bark from equal height of untouched trees
Total alkaloids	5. 29	6. 34
Quinine and quinicine	1. 46	3. 14
Cinchonidine & Cinchonine	3. 83	3. 20.

Tree

4th Tree of C. Succirubra of same age as those of second age employed for mossing experiment bark of which has been taken about 7 months compared with bark taken from equal height on untouched trees.

	Untouched bark taken from barked trees	Bark from equal height of untouched trees
Total alkaloids	3. 70	4. 80
Quinine and quinicine	1. 82	1. 70
Cinchonidine & Cinchonine	1. 88	3. 10

5th Trees of eldest cinchona, bark of which had been taken about December 1867 being portion of the experimental number.

	Untouched bark taken from barked trees	Bark from equal height of untouched trees
Total alkaloids	3. 68	5. 56
Quinine and quinicine	0. 81	1. 26
Cinchonidine & Cinchonine	2. 87	4. 30

12. The above results were obtained without a single contradictory exception and appeared quite conclusive. A corroborative experiment was however made in order to confirm what I consider to be a [illegible] and significant result. For this purpose the upper bark of trees of C. Succirubra which had their bark partially taken [illegible] mossed six weeks, was compared with that of untouched trees. In this [illegible] take [illegible] ference of alkaloids had [illegible] it would place in the cellular [illegible] beneath the

subsequently from the renewed bark and therefore scarcely any difference in the amount of alkaloids was perceptible in the two specimens: a fact which fully confirms the important result obtained in the analyses cited above.

13 Thus it is quite clear that much of the alkaloid in the renewed bark is obtained at the expense of the old bark remaining on the tree whose value it consequently reduces. As this transference of alkaloid could scarcely produce its maximum effect in the bark which was in these experiments necessarily taken from the upper bark of the trees, it is doubtless usually more considerable than the analyses indicate. This result also fully explains a circumstance which has long puzzled me, viz. the comparatively inferior yield of late obtained in analyses of the barks supplied to manufactory which were taken from partially decorticated and mossed trees. In all the above experiments it was found that the specimens of bark from the decorticated trees contained less moisture, were with difficulty [illegible] from the stem and had a less [illegible] [illegible] [illegible] together.

14 [illegible] effected on the ~~[illegible]~~ 11 Febry 1873 that the [illegible] I obtained with the experiments [illegible] the mossing of C. officinalis [illegible] any [illegible] favourably for this plan of cropping

cropping with that species. But the circumstance that three years have elapsed before the renewed bark can be cropped, now much modifies my opinion. The fact of the transference of alkaloid from the untouched into the renewing bark is one which still more strongly points in the same direction.

15 I have no hesitation now in condemning the plan of mossing whose merits I have throughout endeavoured to fairly consider. It is worthy of remark that though I have been unsuccessful in my attempts to obtain a fair experiment of the obvious plan of coppicing on the Government Plantations, it is under favourable trial on private ones. As I have confidence in the results I have formerly stated and in those I now communicate, I do not propose to discuss the matter beyond stating my opinions and the facts on which they are founded. The responsibility for the ultimate effect of disregarding the teaching of the latter can scarcely rest on me, if I fairly point them out.

16 I arranged with the late Commissioner of the Neilgiris that the expense of mossing should be considered by him in his [illegible] to my report on the Chemical [illegible]. This is an important part of the question which has [illegible] hitherto been but slightly [illegible].

I have the honour to be

Sir

Your most obedient Servant

John Broughton

Government Quinologist

Read the following papers

Commissioner's Office 1
Ootacamund 13th August 1873.

No 37 21

No

From

J. R. Cockerell Esquire
Commissioner
Nilgiris

To

The Secretary to Government
Revenue Department
Ootacamund

Sir

I have the honor to submit a letter to my address from the Superintendent of Cinchona Plantations in reply to Government Order No 549 dated 28th May 1873.

2. The Government Order — which is an Order on a Mossing Report submitted by the Government Quinologist, calls the attention of the Commissioner and of Mr McIvor to a statement made by Mr Broughton "that 85 per cent of 2000 mossed trees have failed to renew their bark." Mr McIvor in the present communication states that the trees in question are "a mass of verdure and the luxuriance of their growth is unsurpassed." He proposes to take renewed bark from them in October. He asserts that nonrenewal of bark in mossed trees on the Government Plantations is unknown but that renewal is sometimes delayed by injury done to the cambium layer on the first stripping and that this was the case in respect of the 2000 trees.

3.

3. Mr McIvor reports that an experiment in coppicing satisfactory to Mr Broughton is being carried out in compliance with Para 3 of the Government Order.

4. With regard to Para 4 of the Order directing that no further mossing shall be undertaken until the results of the above coppicing experiment are known. I am about to report to Government in another communication in which I shall explain that the coppicing experiment will take years to bring to a conclusion and that in the meanwhile unless the unmossed trees on the Plantations about 24,000 in number are stripped and mossed the bark on them will deteriorate and loss to Government will accrue. To this I shall add the statement that mossing will not interfere with coppicing, if the latter system is eventually exclusively practised, because mossed trees are not injured by mossing or rendered by that process in any way unfit to be coppiced.

5. Mr McIvor in the present letter combats Mr Broughton's views on coppicing and argues from Mr Broughton's own data that mossed bark is incontestably superior to natural and coppiced barks. I advocate the opinion expressed by Mr McIvor.

6. Mr McIvor forwards with his letter a series of mossed natural and coppiced Barks. His object is to show the superior thickness of the former Bark.

I

I have the honor to be
Sir
Your most obedt Servant

E. C. Cockerell
Commissioner.

No 47

Government Gardens 3
Ootacamund 9th August
45 1873

From,

W. G. McIvor Esqr
Supt. Govt Chinchona Plantations

To,

J. R. Cockerell Esqr
Commissioner of the Nilgiris
Ootacamund

Sir,

I have the honor to acknowledge your endorsement conveying Proceedings of Government dated 28th May 1873, No 549.

2 With reference to Para 5 of the Proceedings I beg to inform you that the Succirubra Trees selected by you and Mr Broughton and myself in April last on our visit to the Neddivuttum Plantations were duly coppiced on the following 30th May. The trees were 58 in number. They stood in four rows, and were selected on account of their size and vigorous growth. They were the finest trees to be found. The largest measured 37 feet 2 inches in height. The trees afforded 809 lbs of wet trunk bark equal to 286½ lbs dry bark or 4.93 lbs of dry bark per tree. The trees were all 10 years & 8 months old. The shoots were left standing on the stool of each tree. The condition of these shoots is described in a detailed table attached to this communication. Fifty eight trees in the 4 rows

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Recd 1873 Sept
No 2455
From The Commissioner
Nilgiris
To The Secretary to Govt
Revenue Dept
Ootacamund
Dated 13th August 1873
Received 14 " "
No 37 1849
Enclosures 2.
S.O. No 1434 – 11 Apl/74.
Cinchona

Submitting Mr McIvor's letter, in reply to G.O No 549 of 28 May 1873 on Mr Broughton's Mossing Report, with a series of mossed natural & coppiced Barks to show the superior thickness of the former.

Referred

Referred for the remarks of the Govt Quinologist which it is requested may be submitted at the earliest practicable date

H. Dalyell
Ag: Secy: to Govt

28th Augt 1873.

60.

C 9th April/74 R 10th April/74
C 17th Nov/73 – R 17 Mar/74 R.C.19

rows adjoining the block thus coppiced were duly mossed. This process was completed on the 25th June last. The tallest of these mossed trees was found to be 30 feet. Prior to moſsing 301 lbs of wet trunk bark equal to 106 lbs dry bark were taken from the trees giving on an average 1.83 lbs of dry bark per tree. In April or May 1874 a second harvest of natural bark will be taken from these trees. A report of the quantity of bark then obtained will be submitted.

3. Thus the comparison between coppicing and moſsing is now being made. Mr. Broughton was of opinion that the number of trees selected on the above occasion would enable a sufficient comparison to be indicated and I offered no opposition. but I cannot here omit to expreſs my belief that if the coppicing were carried out on a larger number than 58 trees the result would be leſs favorable to the coppicing system. The surface of all land is uneven and on hill slopes especially so. In the hollows there is a deposit of alluvial soil on which plants thrive. On the ridges on the other hand the soil is poor and abraded, and here trees grow less luxuriantly and less easily. Accordingly a large area would give in my judgment a fairer selection of trees, and the yield by coppicing would be less per tree than on 58 trees specially selected for their size and rich growth.

4 This comparison between the two systems will, I need not say, take some years to complete. I fear that when complete it will not entirely set all questions at rest as the 58 trees were older than trees which would have already afforded bark by mossing. Bark peels best on the first occasion from trees 8 years old. In February and March 1871 I took mossed bark from 1000 red bark trees of this age. In May last I had stripped 3744 lbs of dry bark from these trees giving an average of 3.75 lbs per tree. Next spring these trees will yield 1,200 lbs of dry bark and a further harvest of about 1,600 lbs will be available in the succeeding spring, and so on every year the quantity given on each occasion being larger than in the preceding one.

5 At Para 2 of the G. O. it is stated
"sufficient information is not as yet available
"as to certainty of a reproduction of bark after
"a tree has been stripped, and the statement
"made in Para 35 of Mr. Broughton's report
"that 85 % of a patch of 2000 trees had failed"
"in this respect is a matter which should receive the
"Commissioner's and Mr. McIvor's gravest
consideration

"consideration."

6 With reference to this remark I have to state that I was at Neddivattam with Mr. Broughton on the 19th ultimo. that that gentleman then indicated the patch of trees he referred to, and as I was anxious to learn what was really meant by 85% having failed to renew the bark, I suggested to Mr. Broughton we should examine the trees together. This was not done, but I myself examined the patch carefully. The trees at the present time are a mass of verdure and the luxuriance of their growth unsurpassed. I propose to take bark from them in October. As to any failure to renew, there is no failure not only in this patch, but in any of the 30,000 trees which have been subjected to the mossing process. In the patch of 2000 trees, there are trees on which the bark is not perfect, but this is not owing to any defect in the mossing process, but to the fact that the trees were stripped by unskilled workmen who in some cases injured the cambium layer. In these cases, the bark has been slow to renew, but it is renewing. All experience hitherto acquired shews that bark invariably renews. It renews easily and early when the cambium is untouched. In cases where the cambium

is

is injured the renewal proceeds, but the process is slower. In respect of universal renewal there is no difference whatever between the Red and Crown barks.

7 I have now disposed of the subjects specially referred to me, but as the question is important and Govt. have to decide the best method of harvesting bark, I trust I may be excused for detailing a few facts bearing on the various subjects discussed by Mr. Broughton.

8 In the report under notice Mr. Broughton comes to the conclusion that mossing when applied to Crown barks, "promises success". That these barks renewed under moss are of "fine quality". that mossing the natural barks increases the value "in the older trees at least 9d per lb and in "the younger about 8d." The following remarks therefore exclusively apply to the red barks or C. Succirubra which Mr. Broughton concludes are not improved by mossing.

9 Mr. Broughton's report apparently deals with the comparative merits of mossing when applied to Chinchona bark, but he really passes over all the important facts

on which the merits of the mossing process depend. He also fails to notice the very unsatisfactory results obtained from Coppicing even when applied to small clumps of a few selected fine trees in sheltered localities. Before proceeding I will explain in what mossing and coppicing consists, confining my remarks exclusively to such facts as have been demonstrated by experience and are therefore beyond dispute.

10 At Para 5 of your letter you correctly describe Coppicing as "felling a "tree 6 inches from the ground and leaving "the shoots springing from the stool." Prior to Mr. Broughton's arrival in India the advantage of this system had been fully considered and experiments begun to test its value, which although limited in extent nevertheless showed conclusively that the system could not be profitably practiced. Further discussion of the system would not have taken place had Mr. Broughton not fallen into the error of mistaking for 3 year old shoots from Coppiced trees; the standing stems of certain trees with double stems one of which had been removed in December 1866 and January 1867 – The

bark

bark on these standing stems was when analysed 8 years old bark (the trees being of that age) and no difference exists between bark on trees with double and single stems.

Mr. Broughton fell into the error of taking this bark as 3 year old shoot bark, it being actually bark of the finest quality from a stem of 8 years standing. The extracts below from Mr. Broughton's letter dated 31st August 1870, Paras 9, 10, and 11 in G. O. 7th February 1871 No. 249 detail the analysis of this bark.° From the error pointed out this analysis does not bear on the subject of coppicing at all. As

to

° "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
"Cinchonidine and cinchonine	4.97
"Pure Sulphate of quinine obtained crystallized	1.14
" " sulphate of cinchonidine obtained crystallized	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 com-"pared 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."

× × × × × ×

to the shoots growing from such trees as have been hitherto coppiced, they are correctly described in your letter in G. O. No. 126 dated 30th January 1873 Para 5 as at the end of 7 years being weak and sickly with bark when dried of the thickness of blotting paper. I am personally strongly of opinion that such bark would not pay the cost of collecting, and I cannot discern any reason for supposing it worse than would be the bark on any coppiced trees whatsoever of the same age. I am not aware that Mr Broughton has analysed any barks from bona fide coppiced trees.

11 Mr Broughton at Para 36 states, "it is greatly to be regretted that com:
:parative experiments have not been carried
"out in coppicing the Chinchona trees", and again at Para 40, "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 cop:
:picing can be fairly tried". Mr Broughton has not given his data for the latter conclusion. In my report for last year I brought to notice that, "of our oldest red bark trees
"(about 12,500) of the planting of 1862/63 there
"are fully one half unmossed, should the

"Govt consider it desirable in order to test the
"value of the 2 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 11th year of growth and of an age most
"favorable 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 favorable situations, and
"consequently do not give any idea of the
"result which would be obtained from a
"larger 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."

12 I deem it here necessary to de:
:scribe in full detail my views as to the
inferiority of the coppicing system. In my

opinion a Chinchona tree only assumes a clothing of bark from which alkaloids can be taken with profit at the end of its 5th year. In the three following years the secretion progressively increases and in the 8th year the bark becomes fit for the market. Thus in the latter year of growth a tree only affords bark which has been ripening for 3 years. Now if such a tree is stripped of bark a renewed bark will be secreted in a period ranging from 12 to 24 months. Taking the renewed bark as removable at either of the two periods; In the former case the qualities as regards alkaloids will be equal to natural bark from a nine year old tree, and in the latter case to bark from a tree which has been standing 8 years and 22 months, or to bark of a tree of 10 years of age. I leave out of calculation altogether the superiority of renewed to natural bark. On the other hand coppice this tree at 8 years. The shoots in the following year will be worth nothing and will not as far as experience has carried us yield bark again in eight years. The general result if my data are correct is that if a tree is coppiced there is at once destroyed the elaboration which is the

result

result of four years growth, that elaboration which begins only after a tree has been four years in the ground and which increases in intensity year after year subsequently, but which cut short by coppicing has to be laboriously set up again in the course of a fresh four years. Thus by coppicing there is lost in my view, in every case, a period of four years.

13 There is another important inferiority in the coppicing system which should not be overlooked. Experience as far as it has reached, shows that the bark on coppiced trees is less valuable than the bark on the original tree. The Bengal Government is at this moment sending Home coppiced barks from Darjeeling. They fetch 5^{d} to $1^{s}/4^{d}$ a ℔ in the London market whereas our original and mossed barks have never fetched less than 2/2½ and our last parcel fetched in part $2^{s}/10^{d}$ per ℔.

possibly, but did their original barks fetch prices equalling those of our original bark? Probably not!

14 Again. Coppicing can only be done on immature trees, and the bark on such trees is thin. I cannot say precisely the latest age at which it is safe to coppice Chinchona. But the thicker the tree, the greater the risk of coppicing.

coppices in England are of shoots small in diameter - no coppicing of thick trunks occurs On the Neilgherries experience as far as it has gone seems to indicate that even with Chinchona trees so young as 8 years it is safer to leave a shoot springing from the stool than to coppice the main stem and the shoots.

15 Finally as regards the cost of taking the bark the supposition appears to be it is cheaper to strip coppiced trees. The reverse is the fact. Thin barks adhere more closely to the stem and are more difficult to peel off than thick barks. Coppiced trees always have thinner barks than natural trees. On the other hand renewed mossed bark is very much thicker than natural bark. The conclusion is that weight for weight it must be less costly to take renewed bark than coppiced bark.

16 I observe that you stated in your letter in Government Order No. 549, dated 29th May 1873, that a mossed tree of 10 years old should give 10 lbs of bark against 7 lbs in a coppiced tree. The estimate is extremely

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low. One thousand mossed trees the bark of which was first taken in February & March 1871 when the trees were eight years old have given 3744 lbs of dry bark up to date. 240 trees coppiced by Mr. Broughton of which 200 trees were 8 years old and 40 trees 5½ years old only gave 255 lbs of dry stem bark.

17 I will now turn to the mossing system. That system as far as I am aware has never been fully described. The process is as follows:— A laborer proceeds to an eight year old tree and reaching up as far as he can, makes a horizontal incision of the required width, From either end of this incision he runs a vertical incision to the ground, and then carefully raising with his knife the bark at the horizontal incision until he can seize it with his fingers, he strips off the bark to the ground and cuts it off. The strip of bark then presents the appearance of a more or less long piece of ribbon. Supposing the tree to be 28 inches in circumference the laborer will take 9 of the above ribbons each 1½ inch wide. He will leave thus after the tree has been stripped other 9 ribbons still adhering to the

tree, each somewhat broader than the stripped ribbon and at intervals apart occupied by the spaces to which the stripped ribbons adhered. As soon as he has removed his strips the laborer will proceed to moss the trunk all round, tying on the moss with some fibre. The decorticated intervals will thus be excluded from light and air and this point is one of the capital points in the system. The mere exclusion of light and air from a stem partially bared of bark, acts in two ways. It enables a healing process to be rapidly set up in the same way as a plaster does in the case of a wound in an animal organism, and it has this further curious effect. It increases the secretion of Quinine in the bark renewed under its protection. This increase of quinine is expressly admitted by Mr Broughton in all his reports. At the end of 6 or 12 months the bands of bark left untouched at the first stripping are removed and the intervals they occupied on the trunk are mossed. At the end of 22 months on an average the spaces the ribbons originally taken, occupied, are found to be covered with renewed bark much

thicker

thicker than the natural bark of the same age, and this renewed bark can be removed and a fresh process of renewal again be fostered by mossing. In another 6 or 12 month the renewed bark of the natural ribbons lef at the first stripping can be taken and so on harvests are obtainable from the trunk alternately from the spaces left at the first stripping, and the spaces left by the 2d stripping. Experience hitherto does not show any limit to the taking of these alternat harvests from a tree. Of course it is understoo that at every stripping the ribbons taken are longer than at the preceding stripping, because the tree has each year increased in height and in bulk, and therefore the top of every ribbon consists of natural bark and the lower part of renewed bark.

Not unless the
labourer is
taller [illegible]
[illegible] that
on the 1st occasion
he reaches up
"as far as he can"
stood on earth, in a
[illegible] case a
step ladder or a
hundred other
[illegible] [illegible]
[illegible] from the
above [illegible]

18 Thus I have entered into the whole question of mossing and coppicing. It remains to make some remarks on the superiority of renewed mossed bark over natural bark in regard to the alkaloid contents. Mr Broughton admits the superiority in Crown Barks but seems to deny it in Succirubra or red barks. I

shall address myself therefore to the latter barks. I adhere to my opinion that renewed bark is always of better quality than natural bark whatsoever the age of the tree.

19 Mr Broughton seems to consider that the quality of renewed bark depends on the age of the tree. I take an opposite view. At Para 32 of my report of 1864/65 on the Chinchona plantations I noticed that the alkaloids in our barks then increased "at the rate of about 2 % per "annum", and observed that "it cannot be "supposed that the barks can continue "to increase in this ratio. A period must "occur at which the maximum quantity "of alkaloids are contained in the bark "and after this there will be in all probability "a period of deterioration." I consider that it is the age of the bark that determines the quantity of alkaloids and not the age of the trees.

20 The trees cut in the forests on the Andes vary from 20 to 100 years old. They contain an average of about 1/2 % of quinine sulphates against our progressive average rising as high as 11 %. Now why should

South american bark be less rich in quinine than Nilgiri bark. Want of cultivation may have something to do with the matter - but the chief cause I attribute to the age of the bark. I shall endeavor to fortify this conclusion by quotations from analysis made by Mr Broughton himself

21. Mr Broughton admits that on a Succirubra tree up to 8 years old, renewed red bark is decidedly better than natural bark. That is to say he allows that bark on a tree up to this age which has only formed in the course of 18 to 20 months is better than bark which has waxed throughout the life of the tree. The conclusion to be drawn from this fact appears to be that bark so long as it remains in a loosely aggregated cellular condition – is in the proper state for receiving and storing alkaloids. As the bark grows older and woody fibre replaces cellular tissue The alkaloids already in the bark appear to turn into resin and gum or coloring matter. and the bark secretes no fresh alkaloids. The result is the bark for medicinal purposes deteriorates with age. At what stage in the progress of growth this deterioration commences I am not able to state with accuracy, but my

general impression is that bark is best at from 18 months to 2 years old. I refer of course to renewed bark. Natural bark is I consider best at 8 years old. I have already observed that commercially speaking it begins to secrete available alkaloids only in the 5th year of the growth of the tree. In the case of natural bark therefore, the bark would be best in 8 years though rather thin.

22 Mr. Broughton appears to be of opinion that at the age of 10 years the advantage of mossing in C. Succirubra is not marked. He writes at Para 23 of his Report, speaking of renewed red bark 3 years under moss "compared with the "natural bark of trees growing near"

" C. Succirubra 10 years old	Renewed 3 years under moss	Natural
" Total alkaloids	6.12	6.12
" Quinine	3.37	1.50
" Cinchonidine & Cinchonine	2.75	4.62
" Quine Sulpht. obtained crystallized	2.27	0.85
" Cinchonidine	2.91	3.41

"It therefore appears that 3 years mossing does "not improve the renewed bark". The table however would seem to show precisely the opposite conclusion drawn by Mr. Broughton. It shews in this instance that the renewed and natural bark both contained the same quantity of alkaloids, but that in crystallized sulphates the renewed bark was much the richer of the two. No one knows better than Mr. Broughton that the value of bark depends on the quinine it contains and not on the quantity of other alkaloids which are comparatively worthless. In the table the bark analysed gives the mossed bark as containing 2.27 against 0.85 of quinine. I may state that at present market rates every one per cent of crystallized quinine sulphate in the bark increases the value of the bark by 10^{d}. and of every one per cent of cinchonidine by 4^{d} per ℔. The bark referred to in the Table at these rates would be worth – the renewed mossed bark $\overset{s}{2}.\ \overset{d}{10\tfrac{1}{2}}$ per ℔ and the natural bark only $\overset{s}{1}.\ \overset{d}{10\tfrac{1}{2}}$ per ℔.

23 And this is not the only

superiority that mossed bark exhibits. Mr Broughton tells us at Para 33 of his Report that "the renewed barks are exhausted of "their alkaloids with greater ease than the "natural barks" and that "they form crys="tallized sulphates with greater ease than "the natural barks". Thus the assumption on this point is that it is cheaper to extract from mossed bark. Given accordingly mossed bark richer in quinine and more easily treated than natural bark - and you have in it the qualities favorable to the profit of the manufacturer - The only qualities the manufacturer seeks to secure.

24 I have only further to point out that every one of the analyses in Mr Broughton's Report are of the same character. They all indicate a conclusion at variance with the conclusion adopted by Mr Broughton. They all shew that renewed mossed bark from our oldest Succirubra trees is more rich in quinine than natural bark and

therefore

therefore more valuable for sale in the market. They shew indeed that the increase in quinine is not only doubled by mossing, but trebled, and in some cases quadrupled.

25 Another error into which Mr Broughton has fallen in support of the con=clusion above noted is at Para 38 where he says, "the amount of total alkaloids which "Red Bark renewed under moss contained "was by Mr Howard's analysis in 1865 about "6.37 %". I beg to bring to notice the fact that Mr Howard made 2 analyses of renewed bark in that year, the result of both analyses and the age of the barks are quoted at foot by which it will be observed that Mr Howard in the one analysis obtained 7.70 %[″], and in the other 9.72 %[+] of total alkaloids. I mention these results because when correctly given they are equally as contradictory to Mr Broughton's conclusions as his own results.

26.

[″] No 2. Renewed bark of 1 year & 5 months growth.

Crystallized sulphate	5.00
Alkaloid soluble in ether	0.90
Chinchonine	1.80
	7.70

[+] No 3 Renewed bark of 1 years growth -

Crystallized sulphate	2.72
Alkaloid soluble in alcohol	7.00
	9.72

26. I think it well in conclusion to submit a series of specimens of barks shewing that in all cases the renewed mossed is much thicker than the natural bark. Mr Broughton from expressions in his report conveys the idea that it is generally thinner though this cannot be his meaning.

I have the honor to be
Sir,
Your most obedient Servant
W. G. McIvor
Supt. Govt. Chinchona Plants.

Particulars of 58 trees coppiced on the 1st Denison Plantation at Neddivattum on the 30th May 1873.

	Row No. 1	F.	I.	I.
1	no sucker	"		"
2	3 "	11.	2	5¾
3	no plant	"		"
4	"	"		"
5	not cut	"		"
6	2 suckers	15	4	7¼
7	2 "	10.	4	5
8	3 "	12	"	6
9	2 "	4.	10½	2¼
10	3 "	7	"	4
11	no plant	"		"
12	2 suckers	8 -	8	5½
13	1 " seedling along side	6.	11	3
14	no sucker	"		"
15	"	"		"
16	sprouting	"		"
17	no sucker	"		"
18	1 "	5	"	2¼
19	no "	"		"

No.	Row No. 2	F.	I.	I.
1	1 Sucker	12	"	5¾
2	3 "	7	2	3
3	Sprouting	"		"
4	No sucker	"		"
5	4 "	8.	10	4
6	3 "	9.	8	4
7	1 "	4.	3	2½
8	Condamenia	"		"
9	1 sucker	12	1	6½
10	1 "	7.	9	7¼
11	5 "	8.	8	4
12	1 "	10.	9	7
13	no "	"		"
14	1 "	8.	3	4
15	3 "	12.	8	4¾
16	2 "	12.	1	5
17	Cut before	"		"

	Row No. 3	F.	I.	I.
1	3 Suckers	8.	3	3¾
2	1 "	2.	9	1¼
3	no "	"		"
4	no "	"		"
5	1 "	3.	10	3
6	Condamenia	"		"
7	4 Suckers	8.	9	5
8	1 "	8.	4	4
9	no "	"		"
10	1 "	7	3	4
11	Condamenia	"		"
12	11 Suckers	11	8	6
13	1 "	8.	8	5
14	no "	"		"
15	1 "	5	10	3
16	no "	"		"

	Row No. 4	F.	I.	I.
1	1 Sucker	8.	7	5
2	no "	"		"
3	no "	"		"
4	5 "	12.	4	6
5	Micrantha	"		"
6	1 Sucker	12	"	7
7	5 "	14	"	6½
8	5 "	7	"	4½
9	1 "	5	9	4
10	No "	"		"
11	3 "	9	"	4
12	3 "	8 -	10	5
13	3 "	10	"	4¾
14	no "	"		"
15	1 "	8.	6	5¾

Remarks

Where more than one sucker is mentioned the measurement of the largest taken.
Rows numbered going from bungalow

W. G. McIvor
Supt. Govt. Chinchona Plant

R 2457/73.

Enclosure letter to Government No. 31 of 13th August 1873.

G.O. No. 434 - 11th ...

15
69

Ootacamund
9th September 1873

From Mr. J. Broughton
Government Quinologist

To
The Honble. R. A. Dalyell
Acting Secretary to Governmt.
Revenue Department
Ootacamund

Sir

I have had the honour to receive a letter dated 9th August 1873 from the Superintendent of the Cinchona plantations to the Commissioner of the Nilgiris, having an endorsement by yourself, according to which Government are good enough to allow me to make remarks on the statements in the letter.

2. I would first premise in that my report* on the mossing process I have been conscious of no bias in the matter, and have endeavoured to be as just in my conclusions as the information I possess allowed. [Personal interest in the subject, inconsistent with the advantage of the plantations I do not possess. I express myself in para. 40 as anticipating

* attached to G.O. No. 549 of 29th May 1873.

Omit

pating success in the application of mossing to C. Officinalis but stated in para. 39 that "I am not inclined to "look sanguinely on the effects of "mossing the trees of C. Succirubra". I state as a reason for my conclusions, the stoppage of growth more or less produced by taking the bark of living trees, and the frequent cases in which the bark taken fails to completely renew.

3. I have never condemned the mossing process applied to any species although the Commissioner of the Nilgiris erroneously implies in para. 3. of his letter attached to G. O. No 549 of 29th May 1873, that I have done so. My report effectively refutes this, if it be read.

4. In justification of my fears of the frequent failure of renewal of the bark cropped, I mention in para. 35 "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."

"sickly." I may mention that in consequence of G. O. No 1213. of 13th July 1871, "a very fine plot of 2000 trees of C. Succirubra had its bark taken and the "trunks mossed, the work being commenced on October 15th 1871 – a time "supposed to be favourable to the renewal of the bark. I find by observation "that 17 out of 20 trees, or 85 per cent "taken in various parts of the plot had "not renewed their bark. This plot of "course forms no part of the experiment, "though the result appears to me to be "significant."

5. In para. 6 of Mr McIvor's letter now under remark he states "with "reference to this remark I have to state "that I was at Neddivattum on the 19th "ultimo that that gentleman (Mr Broughton) "then indicated the patch of trees he referred to and as I was anxious to learn "what was really meant by 85 % having "failed to renew the bark, I suggested "to Mr Broughton we should examine "the trees together. This was not done "but I myself examined the patch carefully. The trees at the present time

"are a mass of verdure and the luxuriance of their growth are unsurpassed. I propose to take bark from them in October. As to any failure to renew there is no failure not only in this patch but in any of the 30,000 trees which have been subjected to the mossing process. In the patch of 2000 trees there are trees on which the bark is not perfect, but this is not owing to any defect in the mossing process, but to the fact that the trees were stripped by unskilful workmen who in some cases injured the cambium layer."

6. In reference to this statement I am compelled to remark that no suggestion was ever made, or hinted to me that we should examine the trees together, or I would have accompanied Mr. Mc. Ivor with pleasure.

7. With regard to the renewal of the bark which Mr. Mc. Ivor states is without failure I would suggest that the fact leading to so great a difference of our respective statements should be inspected by some gentleman who has had a trifling gardening experience. During the one year and eleven months which has elapsed since the taking of the bark it is true that the bark has somewhat closed in from the edges of the wound, but sufficient wood remains uncovered to substantiate the accuracy of my statement made in February last. In a fortnight's time the weather though now abominable, will be fine at Neddivattum and a journey thither on horseback will be a pleasant one.

8. If the case be found as I have stated I would suggest that an examination sd be made of 100 each of the two ages of trees which form the subject of the mossing experiment in order that the certainty of the renewal of bark may be ascertained by the inspection. The whole observation may be made in the space of two hours.

9. In para. 10 Mr. Mc. Ivor states that I fell into the mistake of taking bark of a duplicate stemmed

tree, one of whose stems had been removed, for a coppice shoot. I have not made so careless an error. This I have been able to demonstrate by repeating the analysis of a coppiced shoot nearly three years of age from a tree cut down in its fourth year on the Balmadies estate in the Ouchterlony Valley, on the 3d January* ~~Jan~~ 1871. I would of course have preferred to have taken the bark from the Government plantation, but none was available. Subjoined is the analysis, compared with the one I originally adduced in letter attached to G. O. No. 249 of February 7th 1871, para. 9.

	Analysis of Coppiced shoots made Sep. 2d 1873. 2 years 8 months old	Analysis originally quoted made March 30th 1870. 3 years 2 months old
Total Alkaloids	4. 62	6. 34
Quinine	1. 45	1. 37
Cinchonidine & Cinchonine	3. 17	4. 97

as this experiment is performed at a season when the amount of alkaloid in the bark is at its lowest, a correction must

Balnadies Estate
[illegible]ad. P. O.
Sep[illegible]
1872

Dear Broughton.

I send you as you request, the bark of a coppice shoot of C. Succi-rubra, which you saw on this "Balnadies" Plantation; the original tree of which was cut down on 3rd Jany. 1871 —

Yours sincerely

Wm. Cotton Rohde

---

must of course be made. A reference to the diagram representing the influence of the seasons (Cinchona return 1870, page 241) will shew that on March 30th the bark contains 1.25 % more alkaloid than on September 2d. when the trees are seven years of age. Adding 1.25 to 4.62 the sum amounts to 5.87 %, which thus corroborates the accuracy of my former statement, as closely as could be expected under the somewhat different conditions of its performance and that the bark of the coppiced shoot is at least six months younger than that with which it is compared.

10. The evidence adduced above furnishes the whole of the information we possess about coppicing. It has not been further tried. After repeated representations to Government I have been able to get but 200 red bark trees cut down 1871 and 58 in 1873, also 50 Crown bark trees in 1873, though it is the most obvious plan of cropping. The excessive "bleeding" undergone by these, shews that an unfavourable

season has been selected for the felling and that it is hardly a complete experiment. Against this 30,000 trees have had their bark taken and mossed, though no statement of the expense of mossing has been submitted or any mention of the expense of repairing and renewing the same, or of the increase of cost entailed by the necessity of removing and renewing the moss at the taking of the bark. I have no personal interest in any mode of cropping, and now that I have fulfilled my duty in representing the necessity of certain proceedings, I do not propose to reiterate, and will confine myself to such reporting on results which falls within my province.

11. My previous training and experience have led me to deal with facts, and I have no skill for special pleading, or speculative argument. I will point out but a few of the misstatements in the letter

of

of the Superintendent of the Plantations in the cases where they attack my own conclusions. In para. 11 he objects to my statement that the greater part of the trees of the plantations being mossed that there will be now no trees left for a trial of coppicing. He points out very accurately that half of the oldest trees are still untouched. The circumstance being, as I have constantly stated to him that the finest trees on the plantation in my opinion ought to be excluded from all experimental treatment and should be kept untouched to their fullest developement, and thus they were tacitly excluded in my statement.

12. In para. 17 Mr McIvor states "The mere exclusion of light "and air from a stem partially bared "of bark, acts in two ways. It enables "a healing process to be rapidly set up "in the same way as a plaster does in "the case of a wound in an animal "organism and it has this further curious effect. It increases the secretion

"of quinine in the bark renewed "under its protection." Now as a simple matter evident on observation, loose moss cannot exclude air, though it does light, nor is the increased amount of quinine produced in the renewed bark at all a consequence of the action of moss. Bark that naturally renews without its application as I have repeatedly stated (Cinchona return 1870, page 242) has the qualities of mossed renewed bark from the simple reason that quinine is an alkaloid first formed in young tissues. Moss has no influence on the quality of the bark, except that it prevents a certain waste of alkaloid by its exclusion of light.

13. In para. 22 the matter quoted is entirely misstated by being separated from its context. The object of the experiment stated therein was to ascertain whether renewed bark under moss for three years, would show any improvement over that under moss for twenty months and the analysis shews that no improvement is apparent and as I therefore state.

14. If I am wrong in placing a smaller stress on the improvement in quality in the renewed mossed bark than it deserves, my injustice will be shortly apparent in the difference of price it fetches in the Home market. Until that appears I submit the matter should stand as I express it.

15. The other statements and citations of Mr. McIvor are susceptable of reply, but as I see nothing else that throws a suspicion of error or unfairness on my report I reaffirm the conclusions of the same. The prophetic portions with reference to coppicing of course I am unable to corroborate or contradict.

I have the honour to be
Sir,
Your most Obedt. Servant

John Broughton.
Govt. Quinologist

G.O. 27 Sept/65 No 542-3
7 Feby — 71 — 87-91
30 Jany — 73 — 250-1
29 May — 221-2
10 July — 94-95
13 Sept — 98-99

Reve 1873 Sept

From No 2759

The Govt Quinologist
Ootacamund

To The Ag. Secretary to Govt
Revenue Department
Ootacamund

Dated 9th } Sep. 1873
Recd 10th }

G.O. No 434 – 11 apl/74.

Enclosures – One

Remarks on the Superintendent of Cinchona Plantations' letter of August 9th 1873.

61.

C 9th April/74. R 10th April/74

C 17 Nov/73 R. 17 Mar/74 R.C. 1

Rev 3687/73
Ag. D/11th March/74
Ln B. No. 62

Dr. Bidie's Report is most satisfactory on the whole as regards the kinds of Chinchona now growing. The two principal are the red barks (380,000) and Crown barks (518,000). The latter are the more productive of quinine — and therefore the more remunerative as Medical Science now stands. The former however produce the largest gross amount of Alcaloids and may as Science advances be found no less useful for the object in view — the production of a most cheap and effective febrifuge. The relative value of the two is not yet determined and needs the most careful observation & experiment. There can be no doubt that the Red bark seems to have found a suitable soil and climate for the spontaneous growth & is already most encouraging.

I examined the plantation with Dr. Bidie and quite concur in his observations about the effect of want of thinning – perhaps over planting – on the Red bark plantations. I observed in Mr. Rohde's Estate – where the trees had more room

N.B.
I beg my Hon'ble Colleagues attention to para 20 of Mr Broughton's letter of 22 Aug. 73 in Govt. Mrs: 3 Oct 73.
"In former reports I have stated abundant reasons for my belief that light is a con-

siderable agent in the final destruction of the alkaloids."

J. D. S.

+ Please see Mr. Howard to Sec. of State 16 Jan. of 72 No. II. in Home Despatch 10 of 1872. "I am glad to notice that the grey bark trees have been to some extent encouraged by Govt. as these trees furnish chinchonine in abundance & of a good quality, and this alkaloid is increasing so much in consumption

88

the remarkable contrast which a more natural treatment had produced. He had thinned out alternate rows. Over-growth was not so observable in the Crown-barks plantation as they are far less luxuriant.

The cultivation of the yellow bark appears precarious and still in an experimental stage; that of grey + bark should cease.

As regards harvesting the bark there can be no doubt that we have an admirable plan in operation – viz mossing – and that it has been successful so far cannot be denied. The question is, is it not more expensive – in

moss

mossing materials & Skilled labor - than need be - and more precarious - that is - Exhaustive to the tree and uncertain as regards Complete renewal of the bark - than will be found in the long run advantageous. The alternative is to Coppice.

I am inclined to Strike out the Exhaustive Effect and danger to the life of the tree from mossing from the Consideration. I doubt whether Cutting down is not a greater Check to growth and Equally hazardous - And I think that the decision must

---

that it will some day become important to have a readily available source to depend upon for its supply"

We have 28759 planted out -

J. D. S.

See also Secy. of States Despatch 8 Feby 72 No. 10

87

Eventually depend on Economical Considerations. I should therefore like far more accurate data as to the Cost of mossing &c with a view to deciding whether Coppicing (with its probably somewhat deficient yield) would not be more Economical. I would draw special attention to this point.

I would do as Mr Lein proposes

Mr Dalzell is of opinion that neither Mr McIvor nor Mr Broughton meant all they said and that both are right - under this qualification - in their respective

* assertions

the

assertions. This is comforting but I would not attempt a G. O on this basis but "lodge" the discussion between them if possible

28/2

Mr. Broughton's Report appears to me to raise most serious considerations. His condemnations of our present system of harvesting is sweeping and must attract attention

Apparently the renewal of bark which has been removed goes on at the cost of the yield of alkaloid from the bark which remains for further harvesting. We gain little if anything and have the cost of mossing &c in addition

It is obvious that the

This is all nonsense — practically & theoretically disproves the theory — besides which at the second operation of the mossing process all the older bark is taken — further it is, if true, only a transfer — not a loss. J.D.S.

the thing requires immediate and thorough investigation and I ~~submit~~ Dr. Bidie should be deputed to examine the matter in communication with the Commissioner and Messrs. McIvor and Broughton on the spot.

The cost of mossing must be ascertained accurately.

It is much to be regretted that the system of coppicing has not been carried out as fully as was intended by Government. And I would require explanation.

I would direct Dr. Bidie to examine and advise in communication with the Superintendent on the best means of carrying forward the experiment. The plan which suggests itself to one who like myself has examined the over-thick plantation is to cut over each alternate row as is being done by private planters.

In the meantime the report together Dr. Bidie's should be sent to the Commissioner for early and full report.

23/3

The annual reports, I think, give it.

But this ~~to~~ will let in the sun light which Mr Broughton tells us (see ante) is fatal to the formation of alkaloids - and the wind which Dr. Bidie dreads as fatal to the existence of the trees!

J.D.S.

It seems to me that we are enquiring & re-enquiring, ordering and counter-ordering, too much. We have a well paid 'Quinologist', who (after these

getting at all of his business forced to be able
to advise conclusively on this question
of mossing & coppicing: and the man
(supported by Dr. Bidie) positively
condemns the former. If we wait
till the Supt., the Quinologist, & the
Commissioner, all agreed, we shall
never cease writing: and we are bound,
(I think) to take the opinion of the ~~p~~ person who appears
to be the most competent of the three to ~~p~~
decide such a question as this — the
especially when his opinion is confirmed by our own nominee
Quinologist — I w.d then direct Dr. Bidie
the Commiss.r to give instructions to
the Superintendent to take such
measures as may be most prudent
~~further~~ with a view to the speedy suppression
of the mossing, and the adoption of the
Coppicing system —

~~[illegible] that the coppicing system [illegible]~~

Mar 25/73

93

Dr. Bidie's Report —

The opening paras
of this Report give a
most interesting account
of the progress & value of
the various species of
Chinchona grown on
the hills — but the question
which is more immediate-
ly before us is dealt with
fully in Para 13 &c. under
the head of Harvesting the
bark —

It appears that
a barking process of
the living tree and a
dependence on the
renewal of the bark
by a natural process
has long been [illegible] in
Java: great advantages
are claimed for it —
Has this been tried
on the Nilgiris? is it
worth a trial? Certainly
Mr. McIvor's process of
mossing commends itself
to my judgment in
preference to it —

& should be recorded

Is the best time for harvesting the bark by the Coppicing ~~process is~~ a process coincident with that which a skilled Gardener would choose for pruning trees - If not probably the consideration of "crop" would carry the day and the tree left to make the best of the unfavourable conditions under which it had been coppiced - This very consideration may have led to certain trees being coppiced when full of sap & to their detriment in after life -

Paras 26-27-28: all tend to show that great care and skill are required in the treatment of trees under the Coppicing System and as regards skilled labour there is scarcely a pin to choose between the one system and the other - The skill required to avoid injuring the Cambium in the removal of the bark is not of a very high order it is merely

Reply [illegible]

NB:

If Mr. Broughton refers to Mr. Dalzell as the gentleman who has been Chinchona [illegible] on these occasions, he should be brought to book severely - there are other objectionable features in his paper -

light handed manual dexterity - all else seems within the ~~[illegible]~~ reach of the intellect of the ordinary Cooly - The expense of the process should be considered ~~[illegible]~~ of course -

Dr Bidie's report is most interesting and valuable it points to further experiments disposing of rotting

I have also read Mr Broughton's report - It does not appear to ~~me~~ to touch in any way Mr McIvor's plain out-spoken exposition of affairs contained in his report to the Government dated 9th August 1873 - Mr Broughton deals largely in insinuations ~~[illegible]~~ the bona fides of those who are in charge of the Chinchona Experiment on the Hills - The main point of interest in his report is his ~~experiment~~ comment on the deterioration of the old bark on decorticated trees. This is stated by Dr. Bidie in Para 22 of his report & appeared to be a matter of great importance, but when I see that it refers only to a diminution of alkaloids in the thin stem and branch bark above the part of the tree operated on, and not on the strips of bark left on the trunk itself the importance of the matter is reduced in my mind to zero.

It is surely a small matter, if the part harvested under the mossing process produces the excess ~~of~~ in Quinine attributed to it, that the light stuff in the head of the tree should lose some of its alkaloid producing qualities.

I am not convinced by Mr. Broughton's reports that the coppicing process is in any way

This is I see stated in plain terms by Mr. [illegible] in reference to coppiced bark received from Darjeeling

11.7.76

superior to the mossing; indeed I believe that that is calculated to produce a large quantity of bark of the quality which Mr. Broughton objected to send to the English market at all, viz. Branch Bark. We have sufficient trees to enable us to carry on these processes pari passu, and I would most earnestly advocate this course being pursued.

We have carried a grand experiment to a certain stage of success, it would be a bad thing to vitiate it by hasty orders at this ~~stage~~ point. I would place all information at the disposal of the Coonoor and Mr. Kerr [illegible] and direct them partly to enlarge their coppicing operations, maintaining the mossing system also carefully recording results, but I would not send Dr.

Bidie
again. He deserves
our most cordial thanks
for what he has done

26.1.74

Revenue Dept.

Note

Since the file of papers connected with Dr. Bidie's report on the Cinchona plantation was circulated to the Hon'ble Messrs Sim and Robinson, a report has been received from Mr. Broughton verifying, from analyses, the suggestion of Dr. Bidie, that the increase of alkaloids in the bark renewed under moss is "obtained at the expense of the

Bidie

[illegible] — He deems

[illegible]

the original bark" (see para 22 of Dr. Bidie's report) — As this newly ascertained fact has an important bearing on the pressing question, the papers are recirculated, with Mr. Broughton's report, before being sent on to His Excellency the Governor.

Note.

Recirculating papers connected with Dr. Bidie's report on the Cinchona Plantation.

I.D.S.

C-19: March/72 R.27

I do not see what we can do with Dr. Bidie's report beyond sending it to Mr. McIvor for any observations he may desire to make, through the Comm.r & in view to the careful obtaining & recording of all statistics.

The merits of the rival systems of mossing & coppicing can only be determined by Ex

2.

experiments which are in progress – though on a very limited scale. The C. O. 5th Dept. last the Govt. desired that ~~25 p.c.~~ some 6000 trees ~~[illegible]~~ 11 to 10 yrs of age should be reserved for coppicing and the of all others hereafter – The Commr should instruct the Subdr to coppice the reserved trees, if he has not already done so – under every varied condition of time &c likely to give the experiment a thorough trial – carefully recording all the results.

L.O.S.

No. 57

Memorandum

Mr. Smith [illegible] received with the [illegible] to Dr. Bidie [illegible] his [illegible] would [illegible] Board [illegible] 109 [illegible]

The undersigned has the honour to acknowledge with thanks the receipt of the Specimens of Cinchona Barks forwarded for the use of the Government Central Museum.

Govt. C: Museum,
Madras 7th May/74

Bidie MD Surgeon Major
Superintendent Govt. C: Museum

To
The Under Secretary to Government
Revenue Department

Revenue Department.

Note.

The Government directed in Council on the 31st March that Dr. Bidie should be demi-officially desired to proceed to the Hills and, in communication with the Commissioner and Mr. McIvor, to arrange for a good number of Chinchona trees- not beyond that already ordered- to be coppiced as effectually as possible.

2. A draft on the subject is now submitted for approval-

As

3. As it is very desirable that the correspondence should be printed for reference as well as for ultimate transmission to the Secretary of State it is submitted that the order may be headed "Confidential" instead of being communicated in a demi-official form to Dr. Bidie. It would also seem desirable that all concerned should be in possession of the papers (1) because the first two are written with reference to Government orders not confidential and form part of a series of correspondence and (2) because Dr. Bidie's report contains many valuable

I myself see nothing in the inquiry and proposed delegation of Dr. Bidie which shd. lead to ~~a dif~~-~~ferent~~ unusual treatment of the matter - Seriously object to any "Demi Offal" treatment and I see no reason for treating the thing confidentially. The wider & fuller the discussion the better for Govt.

10/4

valuable suggestions which require consideration at the hands of the Government Officials on the Nilgiris. It might yet be considered whether any good object is gained by making the order a confidential one.

4. There are some expressions in Mr. Broughton's letters which would be as well omitted in print and they are indicated so as to be excluded if thought desirable.

5. Dr. Bidie might perhaps be allowed travelling batta while on this duty. Provision for this has been made in the draft.

Note

On coppicing Chinchon
trees

115

No. 434

Pro: of the Madras Government
Under date the 10th April 1874

Read the following papers.

From the Commr. Nilgiris — K.S. 13 Augt. 1873, No. 37.
From the Govt. Quinologist — " 9 September 1873.
From Surg: Major G. Bidie, M.B. — " 15th Novr. 1873, No. 194.
From the Govt. Quinologist — " 4 March 1874

1. The correspondence now before Govt. refers principally to a difference of opinion between the Supt. Govt. Chinchona Plantations and the Govt. Quinologist as to the comparative merits of harvesting the bark by the "mossing" and "coppicing" systems.

2. Both these gentlemen have stated their opinions at length and it is not the present intention of

His Excellency the Governor in Council to examine minutely their statements because it appears to him plain that, owing to circumstances unnecessary to recapitulate, the "coppicing" system has not as yet had ~~a fair~~ the trial ~~The somewhat~~ which the Government intended. ~~acrimonious tone which has been imported into the discussion is to be regretted. The apparent contradictions as to matters of fact may, as has been suggested, be owing to a partial misapprehension of the actual meaning of the terms used. At all events His Excellency does not wish~~

~~wish the discussion on these points carried further.~~ 11)

3. As the subject is one of the greatest importance the Govt. took advantage of the presence of Dr. Bidie at Ootacamund to obtain the views of a competent judge ~~ideas of a third person~~ upon the matter at issue, and they are much indebted to him for the interesting report which he has submitted. ~~The conclusions reached show that while mossing has its merits there are signs that the trees thus treated suffer general deterioration. The suggestion put forward in paragraph 22 that the details~~

Para 16 which notices and extends experim^t of barking without the ex[illegible] sense of [illegible] to be taken

~~alkaloids in the original bark are diminished to an extent proportionate to the increase manifested in the renewed bark has received decided corroboration from the analyses subsequently made by Mr. Broughton and recorded in his letter of the 4th March 1874.~~

4. The Governor in Council quite concurs with Dr. Bidie that there are not yet sufficient materials to admit of a satisfactory comparison between the two systems. Both must be prosecuted till all doubts are removed. The number of trees

already

already mossed will afford ample means for completing the experiment as regards the "mossing" system. As to the "coppicing" it is the wish of His Excellency that ~~Dr. Bidie should himself proceed to the Nilgiri Hills, and in communication with~~ the Commissioner ~~and~~ should arrange with the Supt. Govt. Chinchona Plantations ~~arrange~~ for the experiment indicated in paragraphs 26 – 28 of ~~his~~ the report being carried out in as thorough and effectual a manner as possible. The number of trees to be thus dealt with need not in the first instance exceed the 6000 referred to in G. O. 5th Septr 1873, No. 952. ~~The details of this experiment will~~

Does this mean that no more trees be mossed? If so I dissent. DS

~~[illegible] notice Para 16 &~~
~~[illegible] further experiment~~

It is also desirable to carry out further the experiments mentioned in paragraph 16 of Dr. Bidie's report relating to the renewal of bark without moss. Some hundred trees might thus be treated. It will be interesting to know the value of barks renewed in this way.

I have proposed a different arrangement in a recent Minute –

will be left entirely in Dr. Bidie's hands and he will make the necessary arrangements for recording all points connected with this trial. While engaged on this duty Dr. Bidie will draw a travelling allowance of Rs. 10 per diem.

5. In regard to other matters alluded to by Dr. Bidie His Excellency the Governor in Council desires that Mr. McIvor will attend to the suggestion in para 2 for the transmission of dried specimens of each variety of Chinchona to the Madras

Museum

Museum. The proposals to abandon inferior plots (para: 3 & 8); to thin out the Red Barks (para 4) and Crown Barks (para 8); to investigate the causes of the premature decay of C. Calisaya (para: 9); and to abandon the Grey Bark cultivation (para 10); will also meet with careful attention at the Superintendent's hands

6. It is of great importance also in the conduct of the "mossing" experiment that accurate returns of the nature indicated in para 20 should be recorded, and the Supt's particular attention should be drawn

to this, as well as to the necessity for showing the Expense of the process.

7. The Commissioner will communicate to N. Broughton copy of G.O. 30th January 1873, No. 126, Revenue Dept., as he appears to have omitted to do so before.

3 The Commr. Nilgiris Dts 1st May/74
1 G. Bidie Esq. M.D. — " —
1 The Govt. Quinologist " —
14 The Bd. of Revenue — " —

G. O

On the mossing & stripping systems of Chinchona trees —

Dy Secy

Proof slips sent for Under Secy's approval

60-64

No 194 Government C. Museum
Madras 15th November 1873

Rd

From
Surgeon Major G. Bidie M.B.
Supdt Government C. Museum

To
The Secretary to Government
Revenue Department.

Sir,

With reference to your demi official dated 26th September I have the honour to submit for the information of the Right Honorable the Governor in Council, the following remarks regarding the Government Cinchona Plantations. I have confined my observations exclusively to the subjects prescribed to me, & have endeavoured to render the report as practical as possible.

Before detailing the results of my

inspection I take the liberty of placing on record, that everything which I saw on the estates gave me a very high impression of the ability, care and energy of the two officers, who have been chiefly instrumental in bringing the Cinchona experiment on the Neilgherries to its present promising condition.

2. Number of each species Cultivated.

At the close of the past official year there were 1,170,029[*] Cinchona trees under culture, and they occupied an area of 1,222 acres. The following figures give the number of trees of each variety of bark:-

Crown bark	514,839
Red	579,938
Yellow	33,850
Grey	28,759
Other species	12,643
Total	1,170,029

The above commercial terms are for practical purposes sufficiently distinctive of the several kinds of Cinchona on the estates, but the number of species and varieties which they embrace is very extensive, and apparently increasing, for not only do young plants show a tendency to depart from the typical characteristics of the parent, but hybrids are being constantly produced. In fact the varieties seen here lead to the suspicion, that many of the forms which have been raised to the rank of species are nothing more than varieties. With the view of elucidating this point I would beg to suggest, that good dried specimens in duplicate of each variety be sent to the Herbarium of the Madras Museum, with the view of one set being ultimately conveyed to Europe, for comparison with typical specimens in other collections." &c

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[*] These figures are obtained from Mr McIvor's report.

Comparative growth of the different kinds of Cinchona

3. "Red barks. The red barks (Cinchona Succirubra) are by far the fastest growing and show, in accordance with their natural habit, the most decided tendency to develop into large trees. They do not, however, thrive well in high or exposed situations or in grass land, and there are in No 1 Denison, the Napier, and Hooker estates considerable patches which might with advantage be abandoned. In these portions, owing either to great exposure or bad soil, the plants have assumed a bushy appearance, and give no prospect of ever getting much larger. These plots no doubt give the estates a more compact appearance, but no

62 Copies – for Revenue S. O. No 404 of 10 April

no private planter would spend money on such unpromising trees. I would therefore recommend that these inferior plots be abandoned, and the recorded acreage and number of plants reduced accordingly. The oldest red-bark trees were planted in 1862, and some of these have attained a considerable size. I measured the one which is considered the largest of that year's planting, and recorded the following results:-

Girth 1 ft above the ground – 26 inches
do 6 ft above do – 21 inches
Height (about) – 32 feet

These dimensions are, however, considerably above the general average. Of ten trees taken at random in the 1862 lot the following were the mean measurements:-

Girth 1 ft above ground – 19.3 inches
" 6 ft above " – 15 "
Height (about) – 25 feet

The whole of these trees had been mossed, and there were no unmossed red-bark trees of the same year's planting in the vicinity to compare with them. The next oldest of the Red-bark trees were planted in 1863 and have not been mossed. They cover the western slopes of the ravine in which the 1862 trees are growing. They can thus be readily contrasted with the somewhat older trees, which have undergone several mossings, and certainly appearances are decidedly in favour of the younger unmossed trees, the foliage being darker and more luxuriant and the growing points longer and more vigorous.

In another part of the Neddivuttum plantation I took the dimensions of some Red-barks which had been planted in 1865. Ten mossed and ten unmossed trees were measured,

and

and the following are the means of these measurements:-

Mossed

Girth at 1 ft above ground — 15.4 inches
— " — " — 6 ft above — " — 10.725 — " —
Height (about) — 19.2 feet

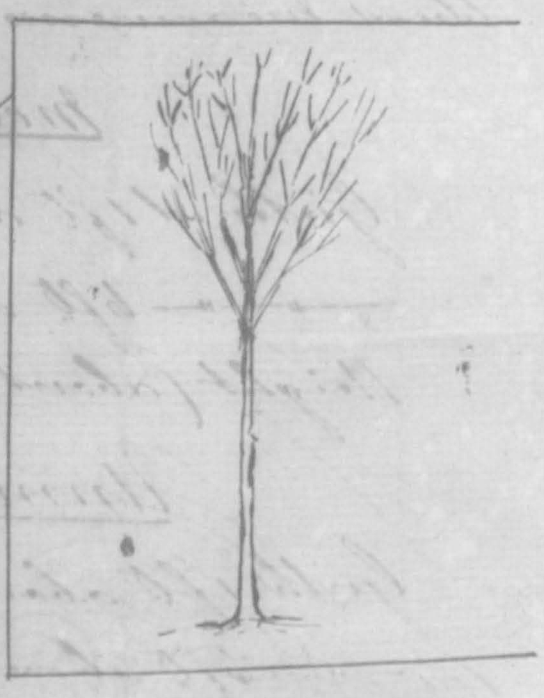
Unmossed

Girth 1 ft above ground — 15.3 inches
— " — 6 ft above — " — 10.45 — " —
Height — 20.5

So far as mere dimensions of stem go there is but little difference between the mossed and unmossed trees, but taking a birds-eye view of the trees the most casual observer cannot fail to notice the superior luxuriance of the un-mossed.

4. In all the older parts of the plantations the Red-bark plants are much too crowded. This is no doubt an advantage as regards mossing, as the dense expanse of foliage overhead excludes the sun

and causes the lower branches to drop off. In other words the trees prune themselves, and the branches, instead of spreading laterally, assume more or less the direction shown in the margin.



At the same time the stems get spindly, and there will not be the same amount of root development as in trees less crowded and more freely exposed. The Cinchona too is chiefly a surface feeder, and there is reason to believe that all those trees which were propagated from cuttings, of which there is a very large number, will be found particularly deficient in descending roots. I should therefore in case of a severe storm feel uneasy regarding the risk to the more crowded portions of the red-bark plantations, as if once

I believe the tree grown from cutting forms a taproot [illegible]

once the wind were to gain admission by prostrating a few trees, the damage might be very serious. The peril too will get greater the larger the trees become. Mr. McIvor will be best able to judge as to whether the plots can be safely thinned out at the present stage of their growth. I should say the risk of thinning now would be infinitely less than that to which the trees will be exposed in case of a storm, if permitted to remain in their present crowded state. Moreover the trees can never attain their natural dimensions of stem while so crowded, and the branches can rarely reach a size which will yield useful bark. It need hardly be added that if it be decided to thin out the plantations now, the trees which are removed will yield a considerable immediate revenue.

5. The total number of Red-barks planted out in the several plantations is 5,79,938 and, taken as a whole, the trees are in a flourishing condition. From a commercial point of view the Red-barks are of course less valuable than some of the other species, for although yielding a comparatively large amount of alkaloids they give but little quinine, the only one of any great value in the English market. Experience in India, however, leads to the conclusion, that the other Cinchona alkaloids are nearly, if not quite, as valuable from a therapeutical point of view as quinine, and as the plantations were established chiefly for the

benevolent

benevolent purpose of supplying a cheap febrifuge to the fever-stricken poor of the Country it seems to me fortunate, that we possess so much of this very productive, rapid growing and easily cultivated species. No better proof of the Red-bark having found a congenial abode in its new quarters could be found than the fact, that vigorous seedlings spring up in thousand under the old trees.

6. Crown barks The crown barks, (Cinchona officinalis and several varieties) are much slower growing than the red, and never attain so large a size. They also naturally grow at a greater elevation than the former species, and will thrive

on grass land, and are not so easily injured by exposure to high winds. Still they grow best in sholaland, where there is generally more or less shelter and good soil. In very exposed situations, where they encounter the full force of the S. W. monsoon, they get stunted, and covered with a dense crop of lichens, while the outer layers of the bark perish, crack and ultimately fall off.

7. The oldest crown barks on the Government estates have been 10 years planted out, and the largest of these is not more than 24 feet high, while the majority are much less, and small in girth. The private planter who has put down this species will therefore have to wait a long time, certainly from 8 to 10 years at least, before getting any regular return from Crown barks, but this will ultimately be compensated for by the superior value of the bark. As a rule the crown barks yield a smaller amount of total alkaloids than the red barks, but then the proportion of crystallisable quinine in the crown barks is generally considerable, whereas in the red barks it is comparatively small. These peculiarities give to the former a high commercial value, whereas it seems highly probable that the red barks, when their deficiency in quinine is known, will become nearly unsaleable in the English market. This as already remarked is, however, a matter of little importance so far as the interests of

Government are concerned, as for general medicinal purposes the one series of alkaloids are about as efficacious as the other. If the amorphous preparation now made on the plantations could only be sold for 8 or 10 annas an ounce, so as to place it within the reach of the very poor of the population, the consumption would be very large and the boon to fever-stricken districts simply inestimable.

8. The crown barks do not cover the ground so rapidly as the red species, and they have not therefore, as a rule, begun to interfere with each other in their lateral development. In some situations, however, they are beginning to get crowded, and if not thinned out are likely to get weedy. In many places the trees have a dwarfed appearance the stems being

short

short, very thick at the base, and tapering rapidly. Such stems are not likely to increase much in size. There are also considerable patches, more especially on the exposed ridges and slopes of the Dodabetta plantations, where the plants have a bushy appearance, and give no prospect of ever becoming trees. I think therefore the Superintendent might with propri consider, whether it is worth while keeping up such unpromising pla The mossed crown barks, owing to the removal of their lower branches and the faded hue of their foliage, present, on taking a birds eye view of an estate, a very inferior appearance compared with trees that have not been barked. I also observed in both the red and crown barks which had been mossed, a tendency to produce an unusual amount of flower and seed, a peculiarity very common in plants which may have had their vitality reduced in any way.

9. Yellow barks. The yellow barks (Cinchona calisaya and varieties) have not been planted in such numbers as the kinds above mentioned, there being only 33,850 yellow barks on the Government estates. Of these, except a few planted in 1863 & 64, the majority are comparatively young, having been put out between 1867 & 1872. The yellow barks have a stronger family likeness to the crown than to the red barks, but they are more compact and bushy in appearance than the crown. A patch of the plants on the lower part of the Kilgraston estate looks very well, but, from some obscure cause, yellow barks are apt to die off after attaining a considerable size. This

is a subject demanding very careful investigation, as the Cinchona Calisaya is one of our most valuable species. I could see nothing special locally to account for the mortality, but would advise that some of the plants be tried in moist sheltered situations at as low an elevation as may be available on the Government estates. The attention of the Superintendent might also with advantage be specially directed to this subject, as, from his well known skill and experience in the culture of Cinchonas, Mr. McIvor is more likely than any one else to discover the cause of and the remedy for the mysterious manner in which the plants sometimes die off.

10. Grey barks (C. nitida, C. micrantha, C. peruviana &c). Of the grey barks 28,759 have been planted out. From a commercial point of view the grey barks are of little value, as they

usually yield little or no quinine and are very poor in the other alkaloids. The grey bark trees on the Government estates are by no means luxuriant, & seeing they are comparatively so worthless they might all, except a few to be kept as botanical specimens, be grubbed up as soon as they have reached — maturity, and more valuable species be planted out instead. The bark could of course be utilised in Mr Broughtons factory.

11. Other species. The chief of these are the Cinchona Angustifolia and Cinchona Pitayensis. The plants of these are still young, and have made little progress but look healthy.

12. General remarks on the appearance of the trees. The plantations as a whole are looking very well, and the culture of the Cinchonas in Southern India may so far, be regarded as a perfect success. The estates are

fast

fast becoming very valuable property and it now only remains to realise more fully the main object for which they were begun, viz. to provide a cheap febrifuge for the poor.

Harvesting the Bark.

13. Mossing process. As the ingenious system of harvesting the bark has now been for some time in operation, its merits and demerits may be fairly discussed. I shall first briefly describe the process as it was exhibited to me, the plants operated on having been seven year old Red barks, on the Kilgraston estate. From these one crop of bark had been removed one year prior to my visit, and the remaining strips, consisting of portions of the original bark which had thus been one year under moss, were removed in my presence. When the mossing process is in operation

the coolies are divided into gangs consisting of 5 men each, viz 2 Barkers, 2 Mossers, and 1 man to split and roll up balls of bast to secure the moss on the denuded stem. The process commences by the barkers attacking a stem with their knives, and removing the bark in strips from 2 to 2½ inches wide, and from a point as high up as they can conveniently reach down to the bottom of the stem. In doing this they first make 2 perpendicular cuts through the bark, so as to define the width of the strip, and then with the back of the knife, used as a lever, they gently separate the bark from the wood all along the tracks of the cuts. When this has been done and the bark removed, the exposed surface of the wood is seen to be covered with

This exclusive of men gathering moss

with a layer of gelatinous like sub:stance, the Cambium, which consists of active young cells from which future additions to the wood and bark are derived. It is of great im:portance that the Cambium layer should not be injured by the knife, or allowed to dry or be exposed to the sun, as if injured in any of these ways the bark will fail to renew. It is plain therefore that the removal of the bark by this method is a process which requires some skill and considerable care, and to conduct it successfully well trained men are necessary, as has been pointed out by Mr McIvor. But to return to the barking. As soon as the strips of bark have been removed by the 2 barkers, the 2 Mossers begin work. One man taking

(mossers)

taking up a small bundle of the soft tree-moss, which has been previously collected, wraps it round the stem, commencing about 6 inches above the upper extremity of the newly denuded surfaces. The second mosser then takes a ball of bast & passing this round and round the moss secures it to the tree. As soon as the first portion is thus tied on another bundle is applied and so on, from above downwards, till the whole of the barked portion of the tree is completely enveloped in a soft moist covering.

14. While the mossing process was being exhibited to me I timed the men, and found that 10 could only, although doing their very utmost, get through 10 small trees in one hour. Of course if the trees were large and the men had to

work

work from ladders the results, as to out-turn of work, would be greatly less. The cost of barking an mossing is therefore considerable. At the rate at which the above experiment was executed the stripping & mossing would in the first instance cost about 1½ anna per tree and, if we allow ½ anna more for repairs, the total cost per tree would be abou 2 annas. On the other hand the green bark of the ten trees which I saw stripped weighed exactly 23½ lbs. Say that this on exsiccation yields 10 lbs of dry bark (which it will hardly do), then on each pound of dry bark there is a charge of 2 annas for stripping & mossing alone. The above calculation has reference only to Neddivuttum where the moss is comparatively abundant, but at Dodabetta where it has to be brought from long distances, the cost must be at least twice as much.

15. The harvesting of the bark in the manner described above viz. by partial removal, is not altogether a new one, as will be seen from the following extract from Howard's "Illustrations of the Nueva Quinologia of Pavon", page 3 of article Cinchona uritusinga. "It may not be out of "place to mention also here a curious "practice by which the inhabitants "of Loja flatter themselves that they "secure economical bark-cutting. "They cut off (Don Riofrio told me) "the whole of the bark of the trunk "of a small tree, leaving only one "broad strip, so as not to destroy the "tree which gradually replaces its "loss; and the second time of cutting "the bark is called Cascarillas - "resecadas, and esteemed as of "superior quality. This practice

"appears to be as old as the time "of Ruiz, as I find it mentioned "in a M. S. of his in the British "Museum." This so far as the simple removal of the bark and leaving a strip is concerned is almost identical with Mr McIvor's process, the chief advantage of which is, that by the immediate application of a soft moist covering of moss to the decorticated stem the young growing cells of the Cambium are protected from light and atmospheric influences, likely to interfere with their development and the elaboration of the alkaloids.

16. That such a covering is not absolutely necessary for the renewal of the bark is, however, shown by the quotation given above, and by the following experiment which has been carried

out on the Dodabetta estate on crown bark trees. In June 1873 some of these were stripped and no moss applied, and I examined 15 of this lot on the 9th October and found as follows:-

On 5 trees bark renewing perfectly
" 4 do do do well
" 5 do do do fairly
" 1 do do do imperfectly

Considering the recent date at which the trees had been barked, the above results would compare very favorably with a similar number of mossed trees. The renewal of the bark in this experiment took place in exactly the same way as would have been the case in a mossed tree, and the only conditions necessary to secure success are, that the cambium layer shall not be injured and that the operation of stripping be carried out in damp

It will be interesting to know [illegible] Quinine [illegible]

weather, so that the delicate cambium cells may not be injured by exposure. But little attention has been paid to bark renewed without the protection of moss. From the few analyses of such made by Mr Broughton, it appears that while there is no appreciable increase of total alkaloids, there is a very decided increase in the amount of Quinine.×

17. Physiological effects of stripping and mossing:- It is hardly necessary to say that the removal of a large portion of the bark of a young and growing tree, cannot fail to affect its growth in various ways. In the economy of the plant the inner bark is the great channel through which the sap, after being elaborated in the leaves passes downwards to supply materials for the formation of new wood, bark, and the numerous products found in vegetable tissues. When a portion of bark therefore is removed from a stem the descending current

× Para 34 of letter in G.O. No. 2453 of 22nd Septr 1868.

current of nutrient sap is interfered with, and if a complete ring of bark be removed there will be an arrest in the development of wood below the ring, and the tree may perish. The partial removal of the bark in the mossing process does not entirely arrest the formation of new wood, as the strips of bark left uninjured enable the tree to carry on a modified circulation. But although the formation of wood is not entirely arrested the new tissue is apt to be deposited in diminished amount at the places where the bark has been stripped off, and thus we get a somewhat diminished and irregularly shaped stem, the deformities of which are of course likely to be increased by successive barkings. And further, if by any chance the Cambium layer is destroyed there will at the part of the stem thus injured be a

complete

complete arrest of wood development, and not only so but the wood on the exposed surface may actually perish. The speciment marked A (sent under a separate cover) is a horizontal section of a stem which was barked in 1871, and illustrates the irregularity in the formation of the annual zones of wood to which I have alluded, and also shows the results of barking when the Cambium layer has been destroyed. It will be observed that the wood in the depressions on the margin of this section, that is in the places which were denuded of bark and Cambium, is more or less decayed, and that the tree has been endeavouring to cover up these dead portions by bridging the gaps with processes of young wood advancing from the sides of the wounds. It need hardly be said that such a stem is not and never can be a sound and healthy one; indeed there is every prospect in a soft wooded tree like the Cinchona succirubra of its becoming quite hollow as it gets older. Stems in such an extremely mutilated condition as this specimen are, however, quite exceptional, and this section has been brought forward merely in illustration of the preceding remarks.

18. At the same time there can be no doubt that under the barking and mossing process, there will always be a certain percentage of more or less complete failures, cases in which entire strips or portions of strips of bark will fail to renew — immediately, and thus leave wounds which will be covered up by the slow cicatrising process illustrated in specimen A. Thus in the case of the 2,000 Cinchona Succirubra trees referred to in para 2 of Government Order No. 549 of 29th May 1873, there can be

be no doubt that a very large precentage of these have failed to renew by the "first intention," which they should do in the mossing process, and are now closing up by slow cicatrisation from the sides of the wound. When inspecting this portion of the estate I stripped 20 trees of their covering of moss in one place and 20 in another, and amongst the 40 trees thus taken at random and examined, there were 33 failures more or less complete, or a percentage of 82.5 in which the bark had not completely grown again after a lapse of 2 years. Indeed every thing I saw while making my observations impressed me with the fact, that — the mossing process to be successful must be carefully performed by skilled labour, rigidly supervised by a European superintendent.

19. I have already alluded to the fact that trees under the mossing

process look much less vigorous and healthy than others which have never been touched. There are several reasons for this, the chief of which are the — removal of all the lower branches, and the check or shock communicated by the removal of the bark. The removal of the branches takes place either — naturally, owing to the trees being too crowded, or is done purposely to facilitate the mossing process. In either case the result is, that the tree is deprived of a large amount of its foliage, and thus becomes less capable of rapid stem development and less likely to strengthen its position by the lateral and downward extension of roots. — Altogether there can be no doubt that a mossed tree, owing to the — various unnatural conditions that it has to endure, is never likely to attain its normal size, or to have a perfectly sound and healthy stem, and it certainly

certainly runs a much greater risk of dying prematurely, than a tree which has not been subjected to mossing.

20. When the process was first introduced on the estates it was believed, that a period of 18 months would be sufficient for the renewal of the bark, but experience has shown that 2 years are barely sufficient. My own opinion is that the oftener the process is repeated on a tree the slower will its bark renew. Of course the protraction of the period of renewal affects, from an economical point of view, the value of the process, and I would recommend, that — accurate returns be obtained shewing the period that has been required for the complete renewal of the bark on all trees that were stripped for the first time say from 18 to 30 months ago, and trees that were barked for the second time during the same period. The return should include both —

crown and red barks. It will also be desirable to ascertain accurately the average yield of bark (a) in trees stripped for the first time, (b) of renewed bark in trees stripped for the second and third time.

21. During recent years of our experience of the mossing process it has been anticipated by some, that although there is a stage in the Cinchona at which the amount of alkaloid in the natural bark is stationary or perhaps diminishing, the renewed bark will continue throughout the life of the tree to possess the remarkable richness, exhibited in the bark of young trees renewed under moss. In arriving at any conclusion on this important point, we must of course be guided entirely by the results of the analyses conducted by the Government Quinologist.* So far these do not show any noteworthy gain in the quantity of alkaloids in the renewed bark of the older Cinchona succirubra trees, and we must therefore conclude, that when this species reaches the age at which the amount of alkaloids in the natural bark is stationary the mossing process ceases to have any marked influence on increasing the alkaloids in renewed bark. With regard to the crown barks the evidence on this point is more favourable, but as the quality of this bark is always variable and as the trees may not as yet have arrived at that age at which the alkaloids in the natural bark will cease to increase, it seems desirable to continue the analyses of the bark of the oldest crown bark trees from time to time.

22 And here another question arises

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*Para 17 & 23 of letter in G. O. No 549 of 29th May 1873.

wise, as various facts appear to me to point to the conclusion, that mossing does not increase the alkaloids by exerting a fostering influence on the process by which they are eliminated from the crude sap, but that the increase is possibly obtained at the expense of the original bark. In other words it seems probable, that the amount of alkaloids in the portions of original bark remaining on a mossed tree will have their alkaloids diminished to an extent proportionate to the increase manifested in the renewed bark. I anticipate this because the active reparative process going on in the bark that is being renewed is likely to attract to it strong currents of formative material, so that not only may the

the greater portion of the new alkaloid elements in the circulation be appropriated by the bark which is being renewed, but it may also receive additions from old deposits in the original bark on the upper parts of the stem &c. This would not probably account for the whole of the increase, but nevertheless the question is an interesting and important one, and should I think be investigated by Mr. Broughton.

23. On the whole the mossing process has as yet been fairly successful. It must be recollected, however, that it has hitherto been applied to young and vigorous trees, and that although they have not suffered very much from the barking process it is hardly to be expected that we

can go on, year after year, for any length of time denuding a tree in this way without diminishing its vigour and shortening its existence. I look upon the mossing process therefore as still only in the experimental stage, but believe that the critical period has begun which will enable us to pronounce absolutely on its value. As its merits have already been sufficiently explained to Government I have deemed it advisable to dwell chiefly on its weak points, with the view of the whole question being thoroughly sifted. The issues at stake, so far as Government are concerned are very great, and private planters naturally look to the Government plantations for information as to the best and most economical method of harvesting their bark.

24. *Coppicing.* So far we may be said to have had no experience whatever of this method of harvesting the bark, as the few experiments which have been made have been on too small a scale and not conducted in a manner likely to throw much light on the subject. The oldest coppiced trees are some red-barks which were cut down in 1866. I was not able to find the whole of these, but those which I saw had not done well. This is hardly to be wondered at. as in the first place some of the trees were immediately over the scarp of a road, a bad situation for coppiced trees, and in the next place too many shoots had been left to grow up from the stumps. The next coppicing experiment was made in 1871 two

hundred and forty C. succirubra trees having been cut down in that year. Of these forty are on the Kilgraston estate and form a single row flanked on each side by tall neighbours, while the 200 are on the Denison estate and constitute a plot which has been completely cleared. As regards the 40 trees on the Kilgraston estate they can hardly be said to have had fair play, as their neighbours have so completely shaded them as to deprive them, to a considerable extent, of the necessary light & air. Too many shoots have also been allowed to spring up from the stools, and these shoots, owing to the dense shade, were observed in many instances to be too feeble to stand erect. No opinion as to coppicing can be deduced from this part of the experiment. The 200

coppiced trees on the Denison esta
have done better, all the stoo
with a very few exceptions, havin
survived, and the shoots have gro
fairly and are looking healthy.

25. Another coppicing experi
was carried out in June of 1873, fif
eight red bark trees having been
down, while a similar number o
contiguous trees, of the same spec
and age, were barked and mosse
with the view of the results of the
systems being rigidly contrasted.
must say at once that
trial is on much too paltry a sc
and that the coppiced trees were
at an unfortunate period of the
as, being then full of sap, they
course bled profusely and thus
a great risk of dying or havin
their vitality more or less perm
impaired. Owing to the short t

that had elapsed since this experiment was instituted it was quite useless for any practical deduction, but I may remark, that all the stools had either thrown up shoots or gave promise of doing so. The same remarks apply to a small coppicing experiment on crown-barks on the Dodabetta estate, these trees having also been cut in June 1873.

26. It will thus be seen, that the coppicing experiments have not been of a character to allow of any definite opinion being given as to this system of harvesting the bark. To permit of this they will require to be on a much more extensive scale, and conducted in a somewhat different manner. Considering the long & trying dry season which the plants have to endure, from December to March, on the Government estates, and that the Cinchonas are surface feeders it will not be judicious to clear away

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the whole of the trees in any plot in a single season. Such a measure would subject the stools to such an amount of sun and drought, that in all probability a large per centage of them would perish, while those left would most likely throw out comparatively feeble shoots.

27. I would therefore recommend that only every second row of trees be cut down in the first instance, and that the standing row be left untouched until the young shoots have attained some size. Experience will determine how long the standing trees should be left intact to nurse the young shoots. In the operation of coppicing great care is required not to injure, in the slightest degree, the bark which remains on the stool, and the stem should be cut a-cross not more than 1 inch above

the surface of the ground. All the stools which I saw at Neddiwuttum were generally a foot or more high, but a low cut stool has advantages which it is needless to specify here. Of course if a shoot, as sometimes happens, is found naturally growing within a foot or so of the base of the stem, & when the tree is coppiced, then the cut may be made higher so as to save the shoot. Another point of great importance is, that when the stools begin to throw out shoots, all these save one or two of the most vigorous should be carefully removed. If two have been left then, as a rule, at the end of a year or so one should be cut away so as finally to leave but one.

28. The question as to the period of the year at which the trees should be coppiced, is one of considerable difficulty, and has
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yet to be determined by actual experiment. The trees hitherto coppiced have bled so profusely as almost to forbid a repetition of any such experiment, but I feel sure the proper season will be found some where between October & March, when the trees are partially at rest. I would therefore recommend that as a coppicing experiment not fewer than three or four thousand trees be cut down, and that every second row be left standing, so as to protect the roots of the stools from drought until the young shoots which they throw out have acquired some size. If this be done and the other conditions which I have pointed out be also attended to, there is every reasonable prospect of the experiment being successful, and affording the necessary data for arriving at a definite opinion as to
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the applicability of the coppicing system for harvesting Cinchona bark. It need hardly be said that an accurate diary should be kept of everything, horticultural and economical, connected with this trial, so that there may be no necessity for any further experiments of the kind. If coppicing be ultimately adopted as the better method of harvesting the bark the plantations should be worked on the plan adopted in oak coppices, which yields an annual supply of bark. One advantage of the coppicing system would be, that it would afford an abundant supply of firewood for the factory at Neddiwuttum, a matter of great importance as jungle wood is now getting scarce.

29. In the instructions received from Government I was directed to give my opinion as to the respective merits of the "mossing"

and

and "Coppicing" systems of treating the trees, but it will be seen that at present there are not sufficient materials to permit of a satisfactory comparison. The mossing system has had a fair trial and so far has answered fairly, but as I have already observed the experiment has not yet passed through the crucial stage, and there are yet various facts regarding it to be worked out and collected, which must be before any one trying to arrive at a final conclusion as to its merits. As to the coppicing system it is to be regretted that experiments of a more extensive character were not instituted at an earlier date, for, as matters now stand, some years must elapse before a final opinion can be pronounced on this method of working the estates.

states. It may be mentioned, here that private planters have not all waited to obtain information from Government experience as regards coppicing. In Bengal this system is exclusively employed in harvesting the bark; and on the Neilgherries one planter has tried it with results which are so far satisfactory. In conclusion I have to record my thanks to Mr. Broughton & Mr. McIvor, for the courtesy with which they received me and the ready manner in which they supplied me with information. I was also much indebted to the Assistant Superintendent at Neddivuttum, for attention and assistance in various ways.

I have the honor to be,
Sir,
Your Most Obedient Servant,
Bidie M.D. Surgeon Major,
Supdt. Government C: Museum

Confidentials -

Rev: 1873 : Dept
No. 3687

Government C: Museum

No. 194

From

Surgeon Major G. Bidie M.B.
Supdt Government C: Museum

To

The Secy. to Government
Revenue Department

Dated 15th
Recd 15 } November 1873

Enc: $\overset{5}{1}$.

Report on the present appearance of the Government Cinchona plantations and on the systems of "mossing" & "coppicing"

S.O. No. 434 - 11 apl/74.

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