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MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No. 3782 ~~Press~~ Mis.

Dated 18 11 1878.

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COMMISSIONER'S OFFICE, X/

Ootacamund, 4th November 1878

No. 155

FROM R. H. Maclean Esqr.

COMMISSIONER, NILGIRIS.

To

The Secretary to Government

Revenue Department

Ootacamund

Madras.

SIR,

With reference to G.O. No. 2452 of 8th ultimo, I have the honor to forward herewith 142 copies of Report of the Chinchona committee appointed under G.O. No. 930 of 1st June 1878 R. D; one copy having already been forwarded with my letter No. 130 of 28th September 1878.

The remaining 6 copies, the Agl Superintendent

* this Incls Stamps Rs

intendent of the Government Press,

Fort St. George, states were sent by

him to the Registrar of the Revenue

Secretariat ___

I have the honor to be

Sir

your most obedt. servt.

W. W. Bailey

Commissioner

CINCHONA COMMITTEE'S REPORT.

Ootacamund, 31*st August* 1878.

From

THE PRESIDENT AND MEMBERS OF THE
CINCHONA COMMITTEE,

To

THE SECRETARY TO GOVERNMENT,
Revenue Department,
Ootacamund.

SIR,—We have the honor, in obedience to G.O., No. 830, of 1st June 1878, to report that the subjects referred to us in paragraphs 4, 5, 6, 7 and 8 have been duly considered in Committee.

2. The first meeting of the Committee was held on 24th June, and subsequently the business of the Committee has been discussed in ten meetings. A Sub-Committee inspected the several Government plantations, and also visited the principal private estates on the Nilgiris accompanied by Dr. King.

3. It seemed so important to obtain the evidence of Dr. G. King, Superintendent of the Cinchona cultivation in Darjeeling, in regard to his experience of cultivation and alkaloid manufacture, that at our first meeting we resolved to request that Dr. King might be permitted to attend to give evidence on the subjects necessary to our deliberations. Dr. King arrived at Ootacamund on the 1st August, and his evidence will be found in Appendix A. The Committee desire to acknowledge their obligation to the Bengal Government in placing Dr. King's services temporarily at their disposal, and are much indebted to that gentleman for the valuable information he has communicated to them.

4. As stated by the Government of India, the main object which the Government had in view in the establishment of cinchona plantations in India was to afford the people of the country a cheap febrifuge.

To produce a cheap manufactured article the raw material must, first, be obtainable at a low price; secondly, the process of manufacture must be inexpensive and exhaustive; lastly, the product must be efficient and economical in use.

These elementary facts were clearly seen by Mr. Broughton, but his factory had to be discontinued, for though its amorphous quinine was thoroughly efficient, the bark supplied to it was costly and the method of manufacture did not prove exhaustive in practice.

5. We have now to consider by the light of further experience here and elsewhere whether any of the elementary conditions have so altered as to give a reasonable hope that the philanthropic intentions of Government are likely to meet with their best fulfilment by the resumption of local manufacture.

6. The course of inquiry necessitates our reviewing the condition and prospects of the Government plantations in this Presidency and in that of Bengal, where local manufacture has for some time been practised.

7. In regard to the Nilgiri plantations Captain C. Walker's recent report furnishes for the first time clear statistical details, and we have supplemented these by personal inquiries and inspections.

The materials we have collected are placed as appendices to this report for convenience of reference and the correction of our conclusions.

8. The points in regard to which the Committee is specially desired to offer opinions are—

(*a*) The possibility of locally manufacturing a drug that shall be commercially and chemically an economical production, while of such medicinal value as to justify its cost.

(*b*) The investigation of other modes of utilising the bark for the use of the population at a reasonable cost.

(*c*) The reappointment of a local Quinologist.

(*d*) The consideration of Captain Campbell Walker's report on the present condition of the Government cinchona estates on the Nilgiris, and other papers relating to cinchona.

9. It will be convenient to consider the subjects in the order above stated.

(*a*) "*The possibility of locally manufacturing a drug that shall be commercially and chemically an economical production, while of such medicinal value as to justify its cost.*"

10. At the outset of our inquiry we were met by the statement that the problem put to us had already been solved in Bengal, where "an efficient and very cheap febrifuge" has been prepared and "is sold to the public at Rupees 20 per pound, or about one-fourth of the cost of quinine at the present time."

11. We were therefore forced, as a preliminary step, to investigate the conditions under which this result had been effected, and ascertain whether they afford grounds on which to recommend that the produce of the Government plantations in this Presidency should be converted into a similar febrifuge, either locally or in Bengal.

12. It will be within the recollection of Government that this question, as regards Madras, was somewhat exhaustively dealt with by a Committee appointed under G.O., No. 759, of the 22nd June 1874.

This Committee had the advantage of conferring with Messrs. Broughton and McIvor on the subject of their report, and of examining them in regard to the accuracy of the calculations on which they based their conclusions. The facts brought out in the report of that Committee have never been challenged, nor, so far as we are aware, have they ever been noticed by the Secretary of State in connection with the revival of the question of local manufacture.

It was shown by the Committee that the 445½ lb. of mixed alkaloid produced under Mr. Broughton's superintendence (in 1871-72 and 1872-73) had in the net value of bark and expenses of manufacture (not including any portion of Mr. Broughton's salary) cost the Government £3,083-12-0, while the same weight of crystallised sulphate of quinine might have been landed in the Medical Store Department of Madras, all charges included, for £2,895-10-0, so that Government was actually paying more for an inferior article than for the most expensive of all the preparations of cinchona bark (*paragraphs* 18 *to* 25). It was further demonstrated that the commercial value of the 445½ lb. of mixed alkaloids, as produced by Mr. Broughton, was not more than £1,483, while the actual cost of production was not less than £3,080 (*paragraph* 30). It was shown, moreover, that for the actual expenditure in the local production of 445½ lb. of mixed alkaloid, the Government might have purchased in Europe at current prices in the open market, inclusive of all charges of transport, duty, &c., either 1,233 lb. of sulphate of cinchonidine, or 2,055 lb. of sulphate of cinchonine, by which means, for the same money expended in local manufacture, three or four times the bulk of febrifuges of equal value might have been bought and their use extended in this proportion to the poorer population (*paragraph* 27).

13. The original estimate of the late Mr. McIvor was that red cinchona bark could be produced on the Nilgiri estates at a cost of 6*d.* (4 Annas) per pound of dry bark; but when examined before the Committee of 1874, Mr. McIvor had to admit (*paragraphs* 61 *to* 63) that he was unable to state the cost to Government of the raw material he delivered over to the alkaloid factory, and that his estimate of 6*d.* per pound referred only to expenses of cultivation and collection.

14. With the subject of local manufacture again re-opened, it seemed to us a point of vital importance to endeavor to ascertain as clearly as possible at what cost the Government has been able to produce bark. Fortunately since the conclusion of the labors of the Committee of 1874, some experience in regard to this matter has been obtained both in the Nilgiri and Darjeeling experimental culture. In both these experiments it must be noted that a Government works with a saving of expense in comparison with ordinary planters, who, in addition to their unremunerative outlay for many years, would have, in the first instance, to pay a price for the land cultivated, the cost of survey and demarcation; and in the case of Nilgiri cultivators, an annual assessment on the entire area after five years' tenure.

15. The method of working the Government estates on the Nilgiris does not permit us to show the cost of production of bark for each variety cultivated, or for bark from trees of different ages. Our only data available are—(1) the yearly expenditure on cultivation and harvesting and (2) the interest on capital account; while on the other side we have the actual weight of bark yielded by the estates.

16. *Cost of Bark on the Nilgiris.*—The capital account of the Nilgiri estates according to a statement furnished to us by the Accountant-General, given in Appendix E, was closed at the end of the official year 1875-76, showing a balance of charges of Rupees 11,22,116-15-6 or an outlay of about Rupees 1,323 per acre of the cultivated area* of the estates. This capital account includes all expenditure on unremunerative experiments, such as the cultivation at Mailkonda, with balance of interest on yearly outlay calculated at 4½ per cent. The following figures show the past cost of bark production:—

Year.	Yearly Charges.	Interest.	Total.	Amount of Bark collected (lb).	Cost per Pound.
					RS. A. P.
1875-76	44,657	49,018	93,675	65,170	1 7 0
1876-77	70,875	50,495	1,21,370	1,03,341	1 2 9
1877-78	68,031	53,645	1,21,676	1,38,807	0 14 0

The estates are probably now in full bearing, and considering the present age of the trees, it seems to us more than doubtful whether the estimated yield, as calculated by Captain C. Walker, of about 400,000 lb. per annum will ever be realized. This certainly will not be the case without more attention to renewals of trees that have failed, and thicker planting of some portions of the estates than has lately been practised. We do not think it probable that the estates will in their present state yield more than 200,000 lb. of bark yearly (unless some radical changes are made in the management of the plantations).

17. If the balance of receipts be applied to the reduction of the capital account, the annual charges for interest will be lessened, and also the proportionate cost of production. If, then, we take the average of the working charges and the interest on Rupees 6,00,000 capital, instead of on the present capital account, and assume that after 1878-79 the yield of the plantations will not be less than 200,000 lb. of bark annually, the cost to Government of producing bark on the Nilgiri estates will in the future be about 7 Annas per lb. These charges will diminish year by year if the principle of setting the profits of each year to the diminution of the capital account be accepted, so that five or six years hence it may be hoped that the capital account will be extinguished, and the yearly charges of cultivation and harvesting would then represent the cost of production. In process of time, therefore, when the capital account † is extinguished, Government Nilgiri bark may be produced and harvested for something like 4 Annas a pound.

* The area under Cinchona according to Captain Campbell Walker's report is 848·4 acres.

† The Accountant-General in his statement (Appendix E) shows net charges against the estates of only Rupees 8,06,683 up to 1876-77. In the following year 1877-78 the proceeds of crop sales was £33,231. Against this will have to be shown the yearly charges for 1877-78, and the balance, upwards of two lakhs, goes as shown above to diminution of capital.

18. We have seen that so far as the Nilgiri estates are concerned, the cost of the dry bark on the spot, excluding all charges for packing and carriage to ports of shipment, has in past years been not less than Rupee 1-2-7 per lb., very different figures from the estimate of Mr. McIvor of 4 Annas per lb., on which the Madras Government hoped to be able to extract the mixed alkaloids at a cost of 1 Rupee per ounce.

19. We wish to note here that cultivation of cinchonas on the Nilgiris being entirely experimental in the first instance, was necessarily more costly than it would have been if there had been any experience to guide the operations. Private individuals have largely availed themselves of the experience acquired by means of the Government experimental culture, and no doubt will be able to produce bark at a lower expenditure of capital in the cultivation. But notwithstanding the costly character of the cultivation, the yield of barks from the Nilgiri estates will, if sent to England for sale, very soon have repaid every rupee expended on the experiment; and the financial results have been such as to lead to a very considerable development of private enterprise in cinchona culture both in Southern India and Ceylon. Costly as the cultivation has been, the realised value of the produce of the estates for the last two years, after deducting all charges and interest on capital outstanding in 1875-76, has been sufficient to return an average annual dividend of twenty-four and half per cent.

20. It seems to be clear from Captain Campbell Walker's report, and from the personal observation of the Committee, that more attention should be given to renewals and replanting on the Government estates, if the annual yield of bark is to be increased. Unless great attention is given to this matter, the amount of febrifuge material available for Government uses will not greatly increase. Trees are constantly dying out, and to keep the estates in fair order they should be promptly replaced, and every vacant spot of ground planted.

21. *Cost of Production of Bark in Sikkim.*—The Sikkim estates up to 1875, according to Dr. King, consisted of 1,762 acres under cultivation. Since then new estates have been planted, making the total area now under cultivation 2,124 acres. The planting operations on a large scale were commenced only in 1867. The capital accounts of the new estates are kept distinct. Up to 1875 the total expenditure, including interest at 4 per cent., had been Rupees 7,62,487, which, spread over 1,762 acres, amounted to Rupees 427 per acre. As, however, in the Madras capital account interest on outlay has been calculated at $4\frac{1}{2}$ per cent., we have thought it right, for purposes of comparison, to make the necessary alterations in Dr. King's figures. In this way we make the total outlay up to 1874-75 Rupees 7,82,217 or 443 per acre.

22. Some portion of the expenditure in Darjeeling, like that of the Nilgiris, was of an experimental nature, and included outlay on abandoned sites; and the Accountant-General of Bengal fixed the capital account of the present estates at the end of the official year 1874-75 at Rupees 3,50,000, but this amount was obviously inaccurate in regard to the actual cost of the experimental culture to Government, and any calculations in regard to the cost of production would be fallacious that did not include total charges and accruing interest. The following statement shows the actual cost of production of bark at Darjeeling :—

Year.	Charges.	Interest of Capital at $4\frac{1}{2}$ per cent.	Total.	Bark Crop.	Cost per Pound.
	RS.	RS.	RS.	LB.	RS. A. P.
1875-76 ...	42,937	35,199	78,136	211,931	0 5 10
1876-77 ...	49,539	37,223	86,762	207,781	0 6 8
1877-78 ...	57,900	39,647	97,547	345,000	0 4 6

23. It will be seen that the cost of production of bark in Darjeeling has been very much less than on the Nilgiris. Nearly the whole of the cultivation in

Darjeeling is of the red bark (*succirubra*), which grows very freely there, but contains so small a quantity of quinine that manufacturers do not care to use it. The crown barks (*C. officinalis*) which thrive so well on the Nilgiris, and which yield bark fetching the highest prices, have completely failed there. The only quinine-yielding plants are two or three kinds of *C. calisaya*, which, according to Dr. King, are propagated with difficulty, and a robust hybrid, which promises to be a good quinine yielder.

24. The cultivation of red bark on a large scale at Darjeeling was commenced long after that on the Nilgiris, so that the experience of the earlier experiment no doubt led to more economy in cultivation. Labor, moreover, is abundant and cheap at Darjeeling, whereas on the Nilgiris it is dear and in parts bad. The habit of the red bark is one of rapid growth, while the crown barks, which constitute the more valuable portions of the Nilgiri estates, are slower in arriving at maturity.

25. The greater yield of bark from the Darjeeling estates is due partly to the difference in the methods of cropping and partly to closer planting. At Darjeeling the trees of eight years of age and upwards are entirely uprooted, and the land so cleared planted anew. Coppicing also is resorted to experimentally, and Dr. King in his evidence is inclined to regard this method of cropping as the one that may hereafter yield the best results. There is no experience yet to show how land that has had the trees uprooted will bear a second or third crop. Dr. King states :—

"Replanting the same land with red barks the same year as red barks have been uprooted, *results in many death vacancies.* I am now trying in Sikkim the results of replanting one, two, and three years after uprootal, but as yet I have no reliable experience to offer." (*Q.* 14).

It is evident from this statement that the calculated yield of the yearly bark crop of 366,000 lb. may, after a few years, if the uprooting is practised for the major part of the crop, fail to be realised, except from the continued opening of new estates.

26. On the Nilgiri estates the plan of cropping has hitherto almost exclusively been that of stripping layers of bark from the living trees, and the renewal of the bark under damp moss—a system enthusiastically advocated by the late Mr. McIvor, and practised by him on private estates in which he was interested as well as on the Government plantations. The coppicing system of harvesting the bark has not yet had a fair trial on the Nilgiri estates. Some remarks on these systems of harvesting will be found in Appendix C. Captain Campbell Walker reports that the stripping and mossing system has up to the present time had no injurious effect on the growth and vitality of the trees, but from personal observation we are not prepared to endorse that statement.

27. In regard to local extraction of the bark alkaloids, Mr. Broughton's work on the Nilgiris ceased from the end of 1874, as the Madras Government came to the conclusion that it could not be profitably conducted; but since that date the Bengal plantations have yielded considerable experience which it is necessary to review.

28. Under the direction of Mr. Wood, the Quinologist to the Bengal Government, a temporary manufacturing establishment was organised on the Sikkim plantations in 1875, and from that time to the present nearly the whole of the produce of the estates has been worked up into amorphous alkaloid, which has been issued for hospital use and sold to the public under the name of "Government cinchona febrifuge." The process adopted by Mr. Wood was not the same as that of Mr. Broughton. Mr. Broughton *boiled* the *fresh* bark in dilute acid, while Mr. Wood adopted a process of *cold* extraction from the *dried* bark. The nature of the product in both cases was essentially the same. In Mr. Broughton's process he failed to recover, on a manufacturing scale, more than 64 per cent. of the total alkaloids. Mr. Wood in his first two years of manufacture did not recover 50 per cent. of the alkaloids present in the bark operated on, but in the third year a return of somewhat above 50 per cent. was obtained. We now learn from Dr. King that in view of these unsatisfactory results proposals were made in 1875 to the Bengal Government to establish a regular factory in Calcutta with steam-power, improved apparatus, and skilled superintendence, as experiments had shown that with proper appliances seven-eighths of the alkaloids present could be obtained on a manufactur-

ing scale. Up to the present time, however, by the process of cold extraction and without a regular plant and skilled labor, these results have not been obtained, and about one-half of the precious constituents of the bark operated on have been lost to the world.

29. The following results have been obtained by Mr. Wood in manufacture from bark calculated to contain 4 per cent. of alkaloid :—

Year.	Bark used.	Outturn of Alkaloid.	Percentage of Alkaloid.
	lb.	lb.	lb.
1875-76	107,130	1,987	1·85
1876-77	190,798	3,750	1·91
1877-78	239,680	5,395½	2·3
Total ...	537,608	11,132½	2·0

The actual cost of the febrifuge, according to our calculations of the cost of production of bark, has been as follows :—

Year.	Value of Bark.	Manufacturing Charges.	Total.	Price per Pound of Febrifuge.
	RS. A. P.	RS.	RS. A. P.	RS. A. P.
1875-76 ...	89,057 13 0	6,920	45,977 13 0	23 2 3
1876-77 ...	79,409 2 8	15,234	94,733 2 8	25 4 2
1877-78 ...	67,410 0 0	19,008	86,418 0 0	16 0 3
Mean cost of manufacturing alkaloid ...				20 6 5

30. A few observations are necessary in regard to these figures. The Bengal experience has entirely confirmed the opinion of the Committee in 1874 as to the unprofitable character of alkaloid manufacture by crude processes and appliances. Mr. Broughton's process was especially designed for doing away with expensive apparatus and skilled labor, and he recovered only 64 per cent. of the total alkaloids. The remaining 36 per cent. was lost in manufacture. Mr. Wood's process, with simpler appliances, has in the three years ending 1877-78 caused a total loss of alkaloid of 50 per cent., or 11,132 lb., which, at Rupees 20 a pound, may be valued at Rupees 2,22,640. On a commercial scale of manufacture probably not more than 85 or 90 per cent. of alkaloid present in bark is recoverable. Taking the lower estimate, the bark used in local manufacture at Sikkim ought to have yielded 18,924 lb. of alkaloid, or 7,792 lb. more than the quantity obtained. The value of this at Rupees 20 per pound would be Rupees 1,55,840. This loss, therefore, has resulted to the Bengal Government from a perseverance in imperfect manufacturing processes.

31. Mr. Wood has come to the conclusion that a full commercial outturn of alkaloid is impracticable without a regular factory establishment. We are entirely of the same opinion. But factory establishments, steam-power, and skilled supervision in India are very costly, and we are very dubious as to the ability of any Government establishment in this respect competing with manufacturers who have made cinchona alkaloid extraction the study and special labor of their lives. It is only fair to Mr. Wood to note that he estimates when the Calcutta factory is in full working order that the cost of production of febrifuge will not be more than Rupees 11-9-0 per pound, but we have to add that in this calculation it is assumed that the bark will not cost more than 3½ Annas per pound to grow and harvest, a rate which further experience in culture may show to be hypothetical in the future as it has been in the past.

32. The product which has been temporarily described as "Government cinchona febrifuge," according to Mr. Wood, is stated to have a tolerably uniform composition of—

Quinine (crystallisable)	15·5
Cinchonine	33·5
Cinchonidine	29·0
Amorphous alkaloid (uncrystallisable)	17·0
Coloring matter, &c.	5·0
	100·0

It is issued in the form of an almost white powder, very light and flocculent, with a somewhat unpleasant aromatic odor and bitter taste. The alkaloids dissolve freely in weak acids, lime-juice, &c., but a small portion of the mixture, consisting of resin or coloring matter, is insoluble in dilute acid, and no doubt the controversy as to the solubility of the drug has arisen from the fact that no amount of acid will make an absolutely clear solution. The Chemical Examiner of Madras, who has, at the request of the Committee, examined a specimen in regard to its solubility, states that—

"Dilute sulphuric acid, prepared according to the instructions on the label, dissolved 98·24 per cent. of the febrifuge, the insoluble matter appearing to be coloring substances."

33. This preparation is packed in 1 lb. tins, and is advertised for public sale at Rupees 20 per lb. We learn from Dr. King's report, No. 84-C, of 15th September 1877, that besides the quantity supplied to the Medical Store Department, 834 lb. were bought by the public from 1st April to the 31st August 1877, and the demand was said to be increasing. In Bengal and Northern India arrangements have been made by the Surgeon-General, Calcutta, to substitute 75 per cent. of the sulphate of quinine formerly supplied to the Native Army and Civil Hospitals by an equivalent amount of the "febrifuge," and suggestions have been made for a similar substitution of the cheaper preparation in the Presidencies of Madras and Bombay.

34. A collection of papers showing the recent results of the trial of Mr. Wood's febrifuge, and of a similar preparation made by an English manufacturer, Mr. Whiffin, and called by him "Quinetum," have recently been printed by the Government of India, and copies have been supplied to us. We have had before us also the elaborate and carefully conducted experiments made in India in 1866-67 in regard to the therapeutic value of the separated alkaloids of cinchona bark, quinine, cinchonine, cinchonidine, and quinidine. It was then proved beyond all question that all these alkaloids in their purified state, and in the form of soluble sulphates, were possessed of febrifuge power; that sulphate of quinidine was quite equal to quinine in therapeutic value, and sulphate of cinchonidine very nearly so; and that sulphate of cinchonine, while possessing valuable febrifuge properties, was in large doses apt to cause nausea, vomiting and derangements of the bowels, and was not quite so speedy in its action in arresting periodic fevers as the other alkaloids.

35. If the separated alkaloids of cinchona have by severe tests been proved to possess the power of curing malarious fevers, and if the cinchona bark itself possesses the same property, it is a natural inference that the associated alkaloids, as they exist in the bark, must have a similar effect. The careful trials given to Mr. Broughton's preparation in this Presidency from 1869 to 1874, left no room for doubt that the mixed alkaloids were useful and efficacious in the treatment of fevers, and as the Bengal preparation is almost identical in composition, the Committee consider that the therapeutical value of Mr. Wood's febrifuge may be assumed as proved, not only by the testimony of numerous reporters of high professional standing, but by the fact that the chemical constituents of the febrifuge are identical with alkaloids which, in their separated condition, have been proved to be good febrifuges.

36. It is a fact not generally known that up to a recent date the medical profession throughout the world had been using not a pure sulphate of quinine, but a sulphate of the several alkaloids, including cinchonine and cinchonidine, as they existed naturally in the various barks used by quinine manufacturers. It was only on the publication of the British Pharmacopœia that the test of the solubility of

quinine in ether was given as the distinctive mark of a pure quinine. As nobody questioned the efficacy of the mixed sulphates of cinchona alkaloids from 1820 to 1865, it is reasonable to conclude that they were practically of equal value with the pure sulphate of quinine enforced on manufacturers by the "purity test" of the Pharmacopœia.

37. But while admitting the medicinal value of amorphous cinchona alkaloids as prepared by Messrs. Broughton and Wood, it is quite certain that there are practical inconveniences in popularising the use of a febrifuge in this form. These are—

(1) The insolubility of the preparation, except in acids which the people in India are not likely to have at hand.

(2) The somewhat nauseous taste of the crude alkaloids and frequency with which it causes nausea, or vomiting and purging.

(3) The appearance of the drug, so different from the commercial quinine to which the Indian public have long been accustomed.

38. The febrifuge powder would be to a certain extent soluble in lime-juice or tamarind, the only acids likely to be found in native bazaars, but owing to the physical properties of the powder it is not easy to mix with fluids, unless there be appliances for rubbing it into a paste, and then gradually diluting with the necessary liquid. Sulphuric acid or hydrochloric acid are not articles commonly at hand in India.

39. The taste and nauseating effects of the remedy probably depend upon the uncrystallisable alkaloid present, which is apparently more irritant and disagreeable than the alkaloids which are convertible into crystalline salts.

40. The Committee appointed by the Bengal Government to consider certain matters connected with the Government cinchona febrifuge, say:—

"We are unanimously of opinion that although the cinchona febrifuge issued by the Government Quinologist is, in its present form, a preparation of great efficacy in the cure of malarious fever, yet it does in certain cases cause some amount of nausea and vomiting. We believe that to a great extent these unpleasant symptoms have arisen from errors in administration. But after allowing for such errors, we believe that the drug contains a nauseating principle from which it ought to be if possible freed." (*Report dated 27th July* 1877.)

41. This Committee apparently agreed in the main with the Nilgiri Committee of 1874, who reported:—

"In our opinion, if local manufacture is to be carried on at all, an attempt should be made to obtain crystalline salts of cinchona alkaloids. * * We are certain that medical officers would prefer to use mixed sulphates to the present amorphous powder. * * It would be a work of time to popularise a preparation of cinchona alkaloids which stops short of the crystalline form." (*Paragraphs* 57 *and* 58).

42. We note here that Dr. King and Mr. Wood are members of the Calcutta Committee still deliberating on this question, and that the Committee has recommended a trial, by competent observers, of the following mixture of crystalline salts of the alkaloids before determining the ultimate form which local manufacture in Bengal is to assume:—

Sulphate of quinine	...	4 parts,
Do. of cinchonidine	...	8 „
Do. of cinchonine	...	9 „

and we understand that experiments are now in progress with the above mixture. We believe from all antecedent facts in reference to these several preparations that there can be no reasonable doubt as to the efficacy of the mixture, and its entire suitableness either for the medical institutions of the country or for general use by the native public. In appearance and taste such a mixture would be undistinguishable from ordinary quinine as sold in the shops, and as the combination pretty nearly represents the actual proportion of alkaloids in natural red barks, divested of all nauseating principles (unless cinchonine is considered a nauseating component), it should be not only effective, but popular with all classes.

43. We have now to see what the commercial value of such a mixture would be. Prices of quinine have been ranging very high in 1877 owing to the increased

demand caused by the Russo-Turkish war, but these high prices are now falling. The latest prices charged in the Home invoices (1877) to the Madras Government, with 20 per cent. added for freight and "charges," have been taken in the following calculation:—

			RS.	A.		RS.	A.
4 lb. of sulphate of quinine (bleached)	..	@	79	4	=	317	0
8 lb. of do. of cinchonidine	...	„	21	0	=	168	0
9 lb. of do. of cinchonine	...	„	6	0	=	54	0
21 lb. mixed sulphates	...	„	25	10	=	539	0

The mixed sulphates thus prepared would last year have cost Rupees 25-10-0 per lb., but as quinine has now fallen considerably in value, and as 20 per cent. is too high a proportion for actual "charges," it is probable that any wholesale manufacturer of alkaloids would undertake to mix and deliver the above preparation at the Indian Presidency towns at a cost of from 20 to 22 Rupees a pound, varying with the market value of quinine. The actual price of such a mixture might be accurately ascertained by calling for tenders for, say, 100 lbs. for experimental use.

44. The cost of mixed sulphates and amorphous alkaloid of European manufacture, in the proportion of the composition of the Bengal Government febrifuge, would be as follows:—

			RS.	A.	P.
15·5 parts of a lb.	quinine sulphate	...	12	4	0
33·5 do.	cinchonine sulphate	...	2	0	1
29·0 do.	cinchonidine sulphate	...	6	1	6
17·0 do.	amorphous	...	0	10	10
	Total	...	21	0	5

45. From the prices above indicated it is evident that various proportions of the several commercial sulphates can be mixed so as to bring the cost of the mixture to even less than the amorphous febrifuge now manufactured at Sikkim, and we imagine that there can be no two opinions in the medical profession as to the preferential use of crystalline salts of alkaloids for general purposes.

46. In regard to the resumption of local manufacture of a febrifuge similar to Mr. Wood's we see no economy, or advantage, while a stable and efficient preparation like the sulphate of cinchonidine can be obtained from the European manufacturers for less than Rupees 20 a pound.

In nine-tenths of the fever cases of India cinchonidine is just as efficient as quinine, while it is barely one-fourth of the cost; and, as a matter of economy, we believe it will be cheaper to sell our Nilgiri barks as heretofore in the open market, and to buy in the same way all the cinchona alkaloids required for the use of the public service and the poor, to whom it may be necessary to issue febrifuges gratuitously.

47. It has been objected that with a steady demand for cinchonidine and cinchonine prices are likely to rise. We do not attach much force to the objection, because, in our opinion, with a steady demand for these alkaloids, manufacturers will utilise barks that produce them, and we have no doubt that the supply will keep pace with the demand. This appears to be the opinion of Mr. Howard also, who, as a practical manufacturer of alkaloids, is entitled to a hearing on this question.

48. The Surgeon-General, Indian Medical Department, Madras, has intimated to us that he is prepared to substitute the sulphates of the cheaper alkaloids, or a mixture of them, to the extent of 75 per cent. of his average issues of quinine, but that he is not prepared to accept the amorphous febrifuge of Bengal to that extent, while the objections to it as shown by experience of its nauseating effects continue.

49. We observe also that the Surgeon-General of British Troops in Bengal is unwilling to press the use of locally prepared alkaloids and cinchonidine on the officers of his department, "until their efficacy has received more complete affirmation." The report on their use in British hospitals was said to be of an "unfavorable character."

50. In regard to the resumption of local manufacture, we have taken into account the fact that while Mr. Broughton was absent on leave in 1874, a considerable quantity of alkaloid was spoilt by unskilful extraction, and that the process is one that cannot apparently be safely left to untrained superintendence. Even in the Sikkim experiment, under Mr. Wood's direction, but with rude apparatus, we have seen that an enormous waste of alkaloid occurs, and the amount of red bark likely to be yielded by the Government plantations would not, in our opinion, justify a considerable expenditure on machinery and skilled supervision.

51. Suggestions are made in letter No. 82 from the Secretary to the Government of India, Department of Revenue, Agriculture and Commerce "whether it would not be feasible to have the Nilgiri *succirubra* bark converted into cinchona febrifuge in Bengal under the supervision of Mr. Wood, whose process, it is understood, is more economical than that followed by Mr. Broughton; * * and also, whether it would not be advisable for Mr. Wood to manufacture quinine itself from the Nilgiri crown bark (*officinalis*), which is understood to be very rich in that alkaloid."

52. In regard to the first suggestion, we are of opinion that Mr. Wood's tentative manufacture at Sikkim is proved not only to be less economical, but more wasteful of alkaloid than Mr. Broughton's; and that as Nilgiri red barks, which are obtained by mossing and renewal, fetch an exceedingly good price in the market, greater economy would result by selling the barks at their market value and buying the necessary alkaloids required by the Madras Government by public tender. The cost of packing, land carriage, and freight of bark to Calcutta would be very nearly equal to the cost of transport to the London market.

53. In regard to the second suggestion that Mr. Wood should prepare quinine from the Nilgiri crown barks, we may remark that until Mr. Wood has had some experience of the production of crystalline salts of cinchona barks in the factory at Calcutta, it is not at all probable that he would be able to utilise economically and profitably the crown barks of the Nilgiri plantations. The preparation of a pure and definite alkaloid, Mr. Wood states, "would be a highly technical and somewhat complicated process, requiring the regular personal supervision of a skilled chemist, having some experience in such operations. A heavy expenditure for apparatus, &c., would be necessary at the outset, and the permanent success of the undertaking would much depend on the power of securing a continuity in the system of supervision and control. * * It may result, therefore, that it would be more practicable to obtain a pure alkaloid of *succirubra* origin, by selling our best bark and utilising the branch bark that would not pay for exportation in the production of the present febrifuge."

54. But our present objection to the manipulation of our crown barks in Bengal is that there is no factory, plant or appliances, available for the production of pure alkaloidal salts, and that working with crude apparatus, as in Sikkim, results in enormous waste of material. It has yet, moreover, to be demonstrated that manufacturing operations, with skilled labor and appliances, can be economically conducted in India. Mr. Wood seems by no means sanguine on this point. Inasmuch as some three-eighths of the constituents of bark have been lost to the world, it has still to be shown that it is possible for Government to work up in India the raw material in an exhaustive manner, and at a proportionately small increase of cost.

55. We are of opinion, therefore, that neither of the suggestions of the Government of India can be at present adopted as regards Nilgiri barks without sacrifice of valuable produce and incommensurate results in outturn, and that the manufacturing operations for the production of crystalline salts can be conducted cheaper and more satisfactorily in England than in India. The Bengal Government are able to produce a considerable harvest of bark of inferior commercial value which it would not be remunerative to send to Eurpean markets. The Nilgiri barks, on the other hand, are of high value and remunerative to exporters, and their realised value in the home market would permit Government to purchase largely and economically the febrifuge alkaloids of European manufacture required for use in India.

56. A good deal has been said in regard to the action of Government in disposing of the barks grown on the Nilgiri experimental plantations on ordinary commercial principles. We are disposed to consider this plan of procedure not only free of objection in itself, but as having contributed more than any other circumstance to the embarkation of private enterprise and capital in the cultivation of cinchona in India and Ceylon. The barks produced from the Government estates have been obtained after careful experiment of the advantages of the mossing or renewal process. The reputation of these barks is so well established that they are keenly competed for by the European manufacturers of alkaloids; they have steadily held the first place in the London market; and the Government experience has demonstrated to planters that cultivated bark will fetch a higher price than natural South American bark. The result of the Government sending its best barks into the open market has been to encourage private enterprise on a scale so vast, that in a few years cinchona production will be one of the chief industries of the hilly country of South India and Ceylon.

57. And in connection with this matter we are bound to notice that the Government culture of cinchona in Bengal has had no such beneficial action in developing private enterprise. We regret to learn from Dr. King that private cultivation of cinchonas is, for the time being, practically in abeyance; that the few persons engaged in it availed themselves of the temporary rise in prices in 1876 and 1877 to root up the trees and dispose of their bark; and that no renewal of cultivation on a considerable scale is likely to take place.

In Bengal the whole of the cinchona cultivation bids fair to become a Government monopoly, while in Southern India and Ceylon the extent of cultivation by private enterprise much exceeds the area of the Government estates. It seems to us that in its dealings with the produce of the cinchona estates the Madras Government has followed the established principles of political economy. We do not believe in the ability of any Government to cheapen artificially the production of a commodity of public utility. But in demonstrating that cinchona can be profitably cultivated, the Madras Government has exercised an enormous influence in stimulating production, which in due course will have a decided effect in regulating the supply of bark and reducing the price of alkaloids, not for India only, but for the whole world. We give in Appendix D a statement of bales of bark, South American and Indian, sold by Messrs. Jenkin and Phillips in London during the years 1876 and 1877. This statement shows most conclusively how Indian and Ceylon bark produce is increasing, irrespective of the few hundred bales sent home annually from Government estates at Ootacamund.

58. There is a further objection to the conversion of the produce of the Nilgiri barks into a crude febrifuge for general distribution and sale below its market value, which may be briefly noticed. All the Nilgiri barks are richer in quinine than the Sikkim barks, and during the late demand for quinine, if such a preparation had been made on the Nilgiris from our renewed red barks or from crown barks, it would have paid speculators to buy up the febrifuge and send it home to manufacturers for the extraction of the quinine in it. A procedure of this nature would be of no benefit to the natives of India, for whom a cheap febrifuge is so much desiderated; but it would surely happen if the Government attempted to sell such an article locally at a price below the value of the crystallisable quinine in the mixture of alkaloid. If no such use of the locally prepared alkaloid was made last year in Bengal, it was probably due to the fact that the small quantity of quinine in a pound of the febrifuge was not worth more than Rupees 20 in the market. Dr. King informs us that precautions are taken to prevent such speculative dealings, but in our opinion, if a profit could be made, it would be impracticable to prevent native dealers entering into combinations to collect and export the crude alkaloids.

(*b*) "*Other modes of utilising the bark for the use of the population at a reasonable cost.*"

59. In regard to this branch of our labors, we are unanimously of opinion that no simple preparation of cinchona bark will ever be attractive to the native population in Southern India who are familiar with the appearance of sulphate of quinine,

nor can such preparations in India be economically substituted for the cheaper cinchona alkaloids of European manufacture. The causes of the unsuitableness of the bark preparations for general use are not far to seek. If the preparations are of a simple character, the bulk of the medicine, as in powder, is objectionable, and infusions and decoctions quickly spoil. If spirituous tinctures or extracts are used, the bulk of spirit is often an objection in a medical point of view. On this subject we append a memorandum (Appendix B) drawn up by our colleague, Surgeon-Major Bidie, in whose conclusions we generally concur.

60. A preparation of bark has recently been advocated by Mr. Money, a cinchona planter on the Nilgiris, which he terms a "decoction," but which is really a "tincture," and a trial has been accorded to it by the Medical Department. The report of Surgeon-General G. Smith, M.D., on this trial is given in Appendix F. The results are not favorable to the use of such a preparation for public purposes. It is well known to chemists that alcohol does not extract the whole of the alkaloids from bark unless the quino-tannates of the bark have been previously decomposed by a strong alkali. Mr. Money's preparation is a simple tincture, and the spirituous solution does not contain the whole of the alkaloids of the bark. The great bulk of the preparation, and cost of carriage, would make its use very expensive. In regard to the economical use of such a preparation Dr. Bidie has made some observations in Appendix B.

(*c*) "*Re-appointment of a Quinologist.*"

61. As we have given our views adversely to the resumption of local manufacture, we are of opinion that if the superintendence of the cultivation be in future confided to the care of some one of practical and scientific attainments in botany and gardening, there is no necessity for a chemist to reside on the plantations. The superintendent should have full power to communicate with an European chemist of repute in regard to analyses of specimens of bark of various species, or cropped in various ways, and it would be convenient to the superintendent that some gentleman of established reputation, such as Dr. Paul, President of the Pharmaceutical Society, should be appointed by the Home Government as chemical referee in all questions connected with the cinchona culture in India.

(*d*) "*Report of Captain Campbell Walker and other papers.*"

62. The report prepared by Captain Campbell Walker shows for the first time the actual outcome of the area planted in surviving trees, and these are much fewer than the numbers hitherto estimated as existing. It is quite evident that in the last few years the replanting of vacant ground has not been carried out so actively as it should have been, and to maintain the efficiency of the plantations we are of opinion that a responsible superintendent, thoroughly trained in the theory and practice of scientific gardening, should be at once placed in charge of the whole. We are strongly of opinion that the time has not yet arrived for Government to retire from this great and important experiment, and that there are many things yet to be done, which only a Government anxious to increase the productive resources of its country can undertake. On the Nilgiri plantations two species of cinchona have been successfully introduced, the red and crown barks; but the culture of the yellow barks (*calisayas*) has practically failed on the Government estates, and for this and other species, the proper locality, soil, and climate have yet to be found by actual experiment. Some notes on *C. calisaya* culture will be found in Appendix C.

63. Experience has also shown that certain varieties of the red and crown barks are better growers and freer alkaloid producers than others, and natural hybridisation has produced forms of plants which in habit of growth surpass any of the distinct species, while some of these have proved to be remarkably prolific in alkaloids.

The Committee of 1874, in alluding to this subject, remark:—

"We would advise that the whole question of artificial hybridisation of promising species should be carefully worked out by the superintendent and quinologist in intimate communication."

And in their conclusions, the Committee sum up the question as follows:—

"The hybridisation of species of cinchona is a phenomenon that brings us to the threshold of a new department of enquiry and research, which might be profitably entered upon by the scientific officers entrusted by Government with the progress of the experimental culture of the cinchonas."

64. The late Mr. McIvor in his last communication, No. 91, of 2nd August 1875, made to Government, makes the following statement in regard to the subject of hybridisation:—

"Selection and hybridization has secured for our domestic plants those wonderful improvements which now make it difficult to recognise in our large and prolific grain, in our fine fruits and splendid flowers, their worthless progenitors. Cinchona belongs to a tribe of plants highly susceptible of improvement by these means. * * So soon as our plants flowered, or early in the spring of 1865, I made a vigorous attempt to attain this object. The result was that in 1866 a number of hybrid seedlings were produced. Among these six distinct varieties, possessing remarkable vigor of growth, were selected, and the weakly growing plants destroyed. The selected varieties were planted here and there in every way, soil, exposure, and elevation available. Under all these conditions our new seedlings maintained that remarkable vigor of growth which at first distinguished them. * * Circumstances soon arose which clearly indicated that under certain conditions these seedlings produced a bark of great value. * * Evidence was also clear that in these vigorous growing hybrids we had secured in a marked degree the good qualities of both parents."

65. But it is important to note here that whatever Mr. McIvor did in the way of experiment in hybridisation, not a single line has been recorded to show the results obtained, and we are still left in the dark as to whether the valuable hybrid named "*pubescens*" is the result of artificial crossing or an accident in hybridisation. The omission to keep a record of such important experiments is much to be deplored, and for the future we think Government should insist on all experiments in hybridisation being accurately noted at the time and the results reviewed in the annual report.

66. We are under the conviction that great results may be expected from a steady perseverance in scientific experiment and culture, and that Government alone can afford to work out the problems still unsolved, and with their secured success they can afford to do so without drawing on the public purse. It is on these grounds we advocate the employment of a person of recognized scientific repute in gardening, whose time may chiefly be devoted to the question of improving the various species by cross fertilization and their public distribution, so that we may not rest content until we have varieties that will grow quickly in our different climates and elevations, and at the same time produce such an abundance of alkaloid as to remunerate the cultivators. A memorandum on cultivation and distribution of plants to private individuals will be found in Appendix C.

67. We have in conclusion to suggest that the experimental culture should be systematic, methodical, and prolonged for many years, and that the results obtained, whether successes or failures, should be made public from year to year for the benefit of private cultivators. It is in this direction that we conceive the State may yet accomplish great things in establishing hardy and productive varieties of plants, and thus give a continued impetus to production, so that the desiderata of all interested in the subject may be best attained, a plentiful and moderately cheap febrifuge for India and the world at large.

We have the honor to be,

Sir,

Your most obedient servants,

(Signed) R. W. BARLOW, *President*.
(,,) W. R. CORNISH, F.R.C.S.,
(,,) G. BIDIE, M.B., } *Members*.
(,,) L. A. CAMPBELL,

APPENDICES.

APPENDICES.

APPENDIX A.

Questions relating to Cinchona Cultivation put to Dr. King *by the Cinchona Committee, and his Replies thereto.*

FINANCIAL.

Question.

1. What is the approximate area of the cinchona estates in Bengal belonging to Government?

2. It is observed that you had 2,691,600 plants permanently planted out on the 31st March 1877. Has the number of trees been arrived at by actual census, or from annual record of plants taken from the nurseries for the permanent plantations?

Answer.

1. The Sikkim plantation was surveyed in 1875 by a Party of the Revenue Survey, and a map of it, on the scale of 16 inches to the mile, was prepared and printed. Of this map a copy shall be sent to the Secretary of the Commission.

	Acres.
In 1875 the absolute area was found (base measurement) to be ..	1,762
During 1876-77 there were planted	110
Do. 1877-78 do. do.	252
Total acreage at 31st March 1878 ..	2,124

A survey of these latter two areas has been applied for by me, but I believe them to be pretty correctly stated as above.

2. The number of trees returned at 31st March 1877 as 2,691,600 was not arrived at by actual census. To make such a census annually would cost more than the information elicited would be worth, as the yield of the plantation is estimated by the acre and not by the tree. And for practical purposes the really interesting information is not how many trees stand on an acre, but how much bark can be taken from these trees. With the view of forming a regular working plan for the plantation, I have tried to find out this by uprooting about 120 acres, and by clean coppicing about 20 acres of trees of various ages. But although we work by the acre and not by the tree, every effort is made to secure approximate accuracy in stating the number of trees on the permanent plantations. In first planting out, the land is roughly measured, and the area is checked by counting the number of plants used in planting it, which, since 1872, has invariably been at the rate of 2,722 per acre.

I have claimed above only approximate accuracy, for in dealing with soil so irregular as that of Sikkim and a plant so capricious in growth as cinchona, it would be foolish to pretend to perfect accuracy. The calculations as to number of plants and the rough measurement of the land in planting out are of course by surface measurements. But when surveyed, the acreage is given by base measurement, which in Sikkim averages 15 per cent. less than surface. There is thus always a margin of 15 per cent. against our original calculation and in favor of accuracy.

Question.

3. In Madras experience shows that 50 per cent. of the plants transferred to the permanent plantations fail to reach maturity. Your experience on this point as regards the Bengal plantations will be very valuable to the Committee.

4. In your report for 1875-76 you give the capital account of the Bengal plantations on the 1st April 1875 at Rupees 3,50,000 as settled by the Accountant-General. The Committee will feel obliged by your showing in detail the yearly expenditure from the commencement of the experiment until 1st April 1875, in order that they may be able to understand the system on which the capital account has been made up.

5. The important point in regard to the capital account is to ascertain whether in framing it, the balance of interest on outlying capital has been charged from year to year, as has been done in the case of the Neilgherry plantations. If this has been done, could you, as asked in the preceding question, No. 4, favor the Committee with the rate of yearly expenditure to enable a financial statement to be prepared, as has been done for the Neilgherry plantations, with accumulating interest calculated at 4½ per cent.?

Answer.

3. In Sikkim a percentage (varying with soil, exposure, and season of planting) of newly planted out cinchonas dies. The mortality is heaviest during the first year, and, as a rule, diminishes in proportion as the plants get older. Our practice in Sikkim is to keep filling up death vacancies where they occur in young planting, until it is clear that in such spots cinchona will not grow. As is pointed out in paragraph 2 of my Annual Report for 1874-75, there is every year a large provision of nursery stock for this purpose, and plants so used are not entered in the annual returns as having been planted out during the year. An examination of my last four annual reports shows the quantity of nursery stock available for this purpose during each year. I put the figures in the form of a table:—

Nursery Stock of Succirubra, Sikkim Plantation.

Year.	At the beginning of the Year.	Put into permanent Plantation during the Year.	Available for filling vacancies.
1873-74 ..	417,000	247,000	170,000
1874-75 ..	475,000	310,000	165,000
1875-76 ..	235,000	None.	235,000
1876-77 ..	650,000	406,600	243,400

4 and 5. These questions are so closely related that they may be conveniently answered together.

In my report for 1875-76 the capital of the plantation then being worked for crop was put down at Rupees 3,50,000, that being the sum fixed by the Accountant-General for Bengal, after an examination of the accounts, as the proportion of total cinchona expenditure fairly chargeable against that part of the plantation if it was desired to state its crop accounts in profit and loss fashion. At the request of the Commission, I herewith submit a statement of the total expenditure on the Bengal plantations from their commencement to 31st March 1875, in which annual interest on capital is calculated at the rate of 4 per cent. (that being the rate fixed by the Government of Bengal). This statement includes, I believe, every possible charge against cinchona in Bengal, viz., expenditure on abandoned nurseries and propagating-houses, bungalows and roads at Sinchul, Lebong and Rungyroon in Sikkim and at Nunklow in the Khasia Hills, and of course the total expenditure on the existing plantations of Rungbee, Rishap, Mungpoo, and (as far as it was in existence during 1875) also of the Sittong plantation. The latter includes cost of bridges, roads, bungalows, godowns and the like, and also the total expenditure on quinology and factory. The receipts for sale of plants, &c., during the period (amounting to about Rs. 8,000) are not taken credit for in the statement.

Question.

6. The object of this enquiry is to ascertain the economy or otherwise of the local manufacture of alkaloids; and, to arrive at any definite conclusion, the actual cost of raw material both in Bengal and Madras must be ascertained as nearly as possible. You will see therefore that there must be uniformity in the mode of preparation of the capital accounts, and in the rates of interest on balance of charges, otherwise the data for the calculation of the cost of production of bark in the two Government experiments are unreliable. A statement prepared by the Accountant-General showing the mode of preparation of the capital accounts of the Neilgherry estates will be placed at your disposal.

Answer.

Annual Expenditure on Government Cinchona Plantations, Bengal, from the beginning to 31st March 1875. All Charges are included and annual Interest added at 4 per cent. per annum.

Year.	Rs.	Rs.
1861-62	4,318	
1862-63	10,274	
Previous	4,318	14,764
Interest	172	
1863-64	12,243	
Previous	14,764	27,597
Interest	590	
1864-65	31,957	
Previous	27,597	60,658
Interest	1,104	
1865-66	54,131	
Previous	60,658	1,17,215
Interest	2,426	
1866-67	50,862	
Previous	1,17,215	1,72,765
Interest	4,688	
1867-68	58,615	
Previous	1,72,765	2,38,290
Interest	6,910	
1868-69	71,052	
Previous	2,38,290	3,18,873
Interest	9,531	
1869-70	50,522	
Previous	3,18,873	3,82,149
Interest	12,754	
1870-71	53,002	
Previous	3,82,149	4,50,436
Interest	15,285	
1871-72	51,826	
Previous	4,50,435	5,20,278
Interest	18,017	
1872-73	50,362	
Previous	5,20,278	5,91,451
Interest	20,811	
1873-74	60,471	
Previous	5,91,451	6,75,580
Interest	23,658	
1874-75	60,280	
Previous	6,75,580	7,62,487
Interest	26,627	

The total expenditure, with interest up to 31st March 1875, was thus in round numbers 7⅓ lakhs; the area by survey was 1,762 acres, and the cost per acre was therefore, as near as may be, Rs. 433.

6. According to an estimate submitted by Mr. Wood in June 1875, the annual yield of the plantation would thenceforth be 366,000 lb. of dry bark, which, allowing for accumulated interest at 4 per cent. on a capital of 7½ lakhs, and adding annual working expenses, it would cost 3½ Annas per pound to produce. Mr. Wood's estimate of the annual yield of the plantation was arrived at by calculating by the tree; my calculation by the acre came to much the same. The estimated outturn was considered sufficiently large to be worked to advantage, and our proposal was thenceforth to work the plantation annually up to its full producing power, both by taking the full estimated crop and by converting the whole of that crop into cinchona febrifuge by a manufacturing process by which, out of bark containing on an average 4 per cent. of total alkaloids, 3½ per cent. of

Question.

Answer.

febrifuge should be extracted. Mr. Wood estimated that, worked in this way, the annual outturn of febrifuge would be 12,810 lb. and the net cost (including bark at 3½ Annas per lb., quinologist's pay, and all manufacturing charges) would be Rupees 11 As. 9 per lb. We further proposed to divide the total cinchona expenditure into two parts, viz., (*a*) into charges against capital, which should include the cost of new extensions, additions to permanent buildings, &c., and (*b*) into working expenses, under which should be included all expenditure on the plantation not debitable to capital, and all expenditure on quinology and factory. It was proposed to add the annual capital charges to the capital account, and to debit the charges under (*b*) against the annual outturn of the plantation; in other words, to charge them against crop. For reasons which need not be entered on here, the scheme of working up to full power in both ways has not yet been fully carried out, but the mode of dealing with the annual expenditure has been adopted as proposed, and from the year 1875-76 onward the annual expenditure has been divided into capital expenditure and working expenses: the subsequent financial history of the plantation must therefore be viewed in the light of this fact.

The medical profession in Bengal not having made up their minds in 1875 as to whether they were to accept the cinchona febrifuge in lieu of quinine, Government did not feel warranted in committing themselves to the expenditure necessary for the erection of an efficient factory in Calcutta as had been recommended by Mr. Wood and myself. It was therefore decided not to bring into immediate operation the scheme for working the plantation to its full power, but it was decided to continue in its stead and in the meantime, a rough manufacturing process which had been begun on the plantation as a tentative measure, and which could be carried out at a minimum of cost, but by which only about half the alkaloid could be extracted from the bark. Although the demand for febrifuge has steadily increased, this state of things has gone on until now, and we are now working on a large scale a process which was originally suggested as a mere make-shift. It was further decided to regulate the crop of bark to be taken annually, not by the natural capabilities of the plantation, but by the amount which the quinologist might require to use up in order to meet the current demand for febrifuge. During last year the Surgeon-General for Bengal decided on the substitution of cinchona febrifuge to the extent of 75 per cent. on all indents for quinine, and Government are now accordingly taking active steps for the erection of a factory in Calcutta, in which the whole annual crop of the plantation can be worked up by a process by which at least seven-eighths of the contained alkaloid shall be extracted as febrifuge. As soon as this factory is complete, we shall be ready to work the plantation to its full rate of production, which,

Question.

7. The statement in paragraph 7 of your report for 1875-76, that the cost of the bark produced in Bengal, including interest at 4 per cent. on the capital account, was only seven pence and one-eighth sterling per pound, will require consideration in reference to the mode of calculation of your capital account, and the Committee will be glad to receive any detailed information from you in regard to this important point.

Answer.

owing to extension of acreage, has in the meantime increased from 366,000 lb. of dry bark per annum to a considerably larger amount.

7. In my Annual Report for 1875-76 the cost per pound of the bark crop for the year (195,291 lb.) is put down at 3 Annas 6·21 Pies exclusive of interest on capital, and with interest on the Accountant-General's proposed capital of Rupees 3,50,000, at 4 Annas 9 Pies per pound. If however accumulated interest on the whole cinchona expenditure from the beginning be added, the cost of the bark is raised to Annas 6 per pound and the febrifuge to Rupees 23 Annas 11. It must not, however, be forgotten that had the plantation been worked to the full of its producing power, the price of the bark would (including interest) have been only 3½ Annas. As it is evidently the object of this question to elicit the exact cost of raw material on the Sikkim plantation, I shall continue the financial history of the plantation from 1875 to the end of the financial year 1877-78, so as to show the cost per pound of the bark crop of that year.

	Rs.	Rs.
Year 1875-76, capital expended	9,777	
Previous	7,62,487	8,02,764
Interest	30,500	
Do. 1876-77	16,648	
Previous	8,02,764	8,51,523
Interest	32,111	
Do. 1877-78	10,212	
Previous	8,51,523	8,95,796
Interest	34,061	
The working expenses of the Year 1877-78 were ..	57,900	
The interest	34,061	
Rupees ..	91,961	

The crop was 345,000 lb.

345,000 lb. : 92,000 Rs. :: 1 lb. : x = As. 4 P. 3 per pound.

The net cost, including interest, of last year's crop of bark, was therefore a little over 6*d.* a pound. If worked by the imperfect process at the plantation, this would give, at 2·25 per cent. (the amount actually obtained last year), 7,762 lb. of febrifuge at a net cost of Rupees 17-4-0 per pound.

Bark	92,000
Working expenses of manufacture	41,845
	1,33,845

7,762 lb.: 1,33,845 Rs.:: 1 lb.: x = Rs. 17-4.

If worked in the factory in Calcutta, the result would be (at 3½ per cent. of outturn) 12,075 lb. of febrifuge, at a net cost of Rs. 12-12 per pound.

Bark	92,000
Carriage to Calcutta and manufacturing expenses.	64,100
	1,56,100

12,075 lb.: 1,56,000 Rs.:: 1 lb.: x = Rs. 12-12.

Question.

8. In your Annual Report for 1876-77, paragraph 4, there is no reference to charges for interest on capital in the expenses for the year, nor is any allowance made in paragraph 6 for those charges. The Committee will feel obliged by an explanation on this point.

Answer.

8. In estimating the cost of the year's crop in my Annual Report for 1876-77, no charge is made for interest, and the Accountant-General's proposed capital is not referred to for this reason, that, in their Resolution on my report for the previous year, in which I did calculate interest on capital, Government expressly direct that interest shall not in the meantime be debited against the annual crop, but shall be charged to capital account. Accepting the accuracy of the estimate that, when the plantation is brought into full working, the cost per pound of the bark (*including interest from the beginning*) will not exceed 3½ Annas per pound, and unwilling to delay the issue of a febrifuge for the people at the price originally laid down by the Government of India, the Bengal Government decided that until the working plan already alluded to shall be brought into force, the price charged to the quinologist for bark made over to the factory shall not include interest, which shall instead be debited to capital account.

9. The Committee infer that the accounts of your cinchona estates do not include charges on account of price of land, annual rent or assessment, local survey, but will be glad to have specific information on these points.

9. The plantation has not been debited with the price of land, which, under Lord Canning's Waste Land Rules in force at the time it was taken up, was Rupees 2-8 per acre in *fee simple*.

There is no annual assessment on fee simple land.

The only tax levied in Sikkim is the road-cess, which the plantation pays in cash.

Demarcation and survey charges are, I believe, not included in the statement of expenditure above given. The survey charges would amount to 1 Rupee an acre.

If the Commission desire to include charges under land rent, they ought to allow on the other hand an annual sum for the management of the forest and native cultivation in the cinchona valley.

The cinchona establishment conserves the forest (allowing the Forest Department to remove what timber they want free of charge), and collects and pays into the local treasury the Government land revenue levied on ryots cultivating in the valley. A considerable length of *public* roads is also kept up at the expense of the plantation, and this would require to be allowed for.

10. Would you be good enough to furnish a statement showing the prices realized by Bengal Red barks each year that any portion of the crop has been sent home; and also a statement showing the amount that would have been realized by the bark supplied to the quinologist, if sent to England and sold there year by year?

10. I am sorry I cannot answer this question, as I have not the figures here showing the prices got for some small consignments of our bark which were sent home some years ago. I may however mention that, as far as I remember, the prices ran from 1*s.* to 2*s.* per pound. *No bark has been sent to London since* 1872. Rather than go on under-cropping the plantation, I last year suggested to Government that we should send 50,000 lb. home for sale; but as we soon after extended our temporary febrifuge factory at the plantation, I myself asked Government to cancel my proposal, which they accordingly did. It is in accordance with the reiterated orders of the Secretary of State and Government of India that the object which we have all along kept in view is the issue

Question.

11. You are aware of the average proportion of alkaloids in your bark. Have you ever calculated what amount of such alkaloids (preserving the proportion) you could buy in Europe for the money—

(*a*) that has, at your own valuation, been spent on producing the febrifuge manufactured in any one year?

(*b*) for the money the bark used in the local manufacture would have fetched in Europe?

Answer.

of a cheap and efficient febrifuge and not the realization of commercial gain by the sale of raw produce.

The price of each of the cinchona alkaloids varies not only according to the bark market, but also with the demand for each. Until recent years cinchonidine to some extent, and cinchonine to a still greater extent, have had a low value, because they were mere by-products from the manufacture of quinine, and there was little or no market for them except for the purpose of sophisticating quinine. The experience of the Medical Officers of the three Indian Presidencies having established the febrifugal efficacy of the alkaloids other than quinine, these have obtained an increased value.

Cinchonidine and cinchonine are not more abundant in nature, nor are they more easily extracted from bark than quinine; there is therefore no reason why, in the face of an increased demand for them, they should not increase in market-value. It is recorded in the proceedings of the last Madras Cinchona Commission that, after having been induced to use these alkaloids, the Madras Government had to abandon them in favor of quinine, as they were found actually to be invoiced at a higher price than quinine.

I do not see that, under the circumstances, any satisfactory answer can be given to the question contained in *clause* (*a*), seeing that it is founded on the assumption that the value of cinchonidine and cinchonine would remain the same in spite of a largely increased demand for these alkaloids. In my opinion, a safer basis for calculation would be afforded by comparing the prices of Sikkim febrifuge and Whiffen's quinetum. Quinetum is a preparation of the same composition as Sikkim febrifuge; it is made from the same kind of bark, and is, in fact, an avowed (see advertisements in newspapers) imitation of the Sikkim product.

During 1867-77 we produced 3,750 lb. (= 60,000 oz.) of febrifuge at a total cost, including interest, of Rupees 92,445. Quinetum would, at the average of market-prices for the year, have cost Rupees 2-8-0 per ounce landed in Calcutta. It would thus have cost Rupees 1,50,000 to land 60,000 oz. of quinetum, and the saving by making febrifuge was therefore Rupees 57,555.

Clause (*b*). With reference to this clause, I calculate as follows:—

To produce 3,750 lb. of febrifuge, 190,798 lb. of bark were used. It costs 6*d.* to 8*d.* sterling to land bark in London. A fair average selling price to allow for the Sikkim bark, consisting so largely as it does of quill and root bark, would be 2*s.* a pound. Allowing on the one hand for expenses of landing in London, and on the other for the gain by exchange, I think it would be fair to put down As. 12 per pound as the net average that might have been obtained by

Question.

Answer.

selling our bark in London. That would give a sum total *net* of Rupees 1,43,099.

(The accuracy of this calculation may be tested by considering what the maker of quinetum could have afforded to pay for our bark. At the above rate 100 lb. of it would have cost him £10 ; and, as its average yield of alkaloid is 4 per cent., he could have extracted from this at most 4 lb. (64 oz.) of quinetum, which (charging nothing against manufacturing expenses) would, at 4*s.* an ounce, have brought him £12-16-0.)

We should therefore have netted Rupees 1,43,099 for our bark, and could not have bought an equivalent in quinetum under Rupees 1,50,000.

But it must not be forgotten that in the foregoing calculation I have pitted a presumably perfect method of extraction of quinetum against an avowedly imperfect method of extraction of Sikkim cinchona febrifuge, and that, with our factory in operation, we should have obtained (at 3½ per cent. of yield) 6,624 lb. of febrifuge instead of only 3,750 lb. Had the factory been in operation, the comparison would therefore have been between the cost of production of 6,624 lb. of febrifuge and the net sum obtainable in the London market for 190,798 lb. of mixed Red bark.

GENERAL.

Question.

Answer.

1. What species of cinchona are cultivated on the Bengal Government estates, and what number is there of each species ?

1. At 31st March 1877 the plants on the Sikkim plantation were estimated as follows. Only plants permanently planted out are given; nursery stock is excluded.

Cin. succirubra ..	3,286,000	These are the only species actually cultivated.
,, *calisaya* ..	* 354,500	
,, an unnamed hybrid ..	21,000	
,, *officinalis* ..	25,000	These are mere relics of past cultivation : none of these three species is being propagated now.
,, *micrantha* ..	20,000	
,, *pahudiana* ..	5,092	

2. Have you any experience of hybrids, and if so, what is your opinion as to their productive qualities in respect to alkaloids ?

2. There is in our plantation both amongst *officinalis* and *calisaya*, and to a less degree amongst *succirubra*, a great variety of forms ; to what extent these are the result of sporting, and to what extent the result of hybridization, I am not prepared to say. I do not myself know of a single form of cinchona of which the exact parentage is really known. Many forms are set down as crosses between such and such variations or species ; but the absolute origin of any such has not, as far as I know, ever been demonstrated.

As *officinalis* (*condaminea*) has been a failure with us, I need say nothing about the value of the barks of any of the varieties. The variations of *succirubra* are found to be associated

* Since 31st March a number of the varieties of *calisaya*, which analysis showed to yield poor bark, have been uprooted. These will be deducted in next annual return.

Question.

Answer.

more with differences in growth than with differences in value of bark.

Of various forms of *calisaya* we have had considerable experience in Sikkim.

Our *calisayas* were originally raised from a portion of Ledger's seed collected in Bolivia, and from seeds obtained from Java. Our *calisayas* were all planted in a patch by themselves, and amongst them are recognisable about fourteen distinct forms. Some of these vary quite as much in appearance from each other as does *condaminea* from *succirubra*. The bark of each form has been analysed, with the result of showing that only three kinds have good bark : one of these three is the celebrated variety known as *Ledgeriana* by the Dutch.

The only form of cinchona in the plantation which we recognise as a hybrid and which we have found on analysis worthy of attention, is one which sprung up at a place where *officinalis* and *succirubra* are planted near each other. This partakes of the appearance of both these species, and is presumed to be a cross between them. On analysis its bark was found to be rich both in total alkaloid and in quinine. It is, moreover, a free grower, and affects higher altitudes than *succirubra*. We are therefore propagating it as fast as we can. It appears in most of our returns as an unnamed hybrid, and in some returns as cinchona *sp. ignota*.

3. Are you of opinion that valuable varieties may be produced by careful hybridization ?

3. In selecting forms for cultivation we guide ourselves by analysis of bark and by habit of growth. We have never practised hybridization. The recent observations of a German botanist (Herr Kuntze), who visited lately both the Java and the Sikkim plantations, lead me however to believe that carefully conducted experiments in hybridization might lead to valuable results. Such experiments would necessarily extend over many years, and would require to be conducted by a person of scientific training thoroughly conversant with the practice of the higher kinds of gardening, and to whom almost no other duty should be entrusted.

4. Have any analyses been carried out with the view of ascertaining the influence of

(*a*) Elevation, (*b*) Exposure, (*c*) Light, (*d*) Temperature,

on the production of alkaloids in the bark of the cinchona under your charge ? If so, will you kindly favor the Committee with the available information ?

4—6. I have no information on these points beyond what may be contained in Mr. Wood's published reports, which are no doubt in possession of the Commission. From 4 to 8 years, age has very little influence on the alkaloidal constituents of bark either as regards total contents or composition.

5. Can you furnish the Committee with the results of any analysis showing the changes which take place in the amount and relative proportions of the alkaloids in the cinchona barks according to the ages of the trees ?

6. Have you any facts to show that, after a certain age, a certain waste or degradation of the alkaloids takes place, as pointed out by Mr. Broughton, and if so, at what period of the life of the tree does this process commence ?

Question.

7. What is the average percentage of alkaloids in the Bengal Red and Crown barks respectively, viz.,

(*a*) Red stem bark	(*b*) Crown stem bark.
„ root „	„ root „
„ branch „	„ branch „

8. What are the relative proportions of the several alkaloids in the Red and Crown root barks under your charge?

9. Does your experience lead you to presume that manuring and careful cultivation generally will have any influence in increasing the amount or altering the kinds of alkaloids produced by a cinchona bark? For instance, do you deem it possible to increase the amount of alkaloids generally or of quinine specially in Red barks by such expedients?

10. What are the respective ages at which you have found it most economical to harvest the bark of your trees?

(*a*) Red bark.	(*c*) Crown bark.
(*b*) Yellow „	(*d*) Grey „

11. What is the average yield of bark per tree of

Red, Yellow, Crown, Grey — (*a*) by coppicing? (*b*) by uprooting?

Also what is the average yield per tree of stem, root, and branch bark by the uprooting system?

12. Of the two systems of harvesting bark in Bengal, viz., coppicing and uprooting, which do you consider the most economical?

13. With reference to coppicing, what experience have you—

(*a*) Of the frequency of a crop under this system?

(*b*) Of the quantity of bark that can be thus obtained as compared with that from land planted with seedlings?

Answer.

7. I have no figures for Crown bark, which has been a failure with us.

For *succirubra* the question is answered in the tables given as a foot-note on page 48 of my Cinchona Manual.

8. Beyond the fact that Red root bark is rather richer in total alkaloids than stem bark, and that it contains rather a larger percentage of the alkaloids other than quinine, I have no figures to enable me to answer this question.

9. Manuring does not appear from our experience to increase the amount of alkaloids in Red bark, but it improves the health and increases the growth of the trees. And analysis proves that the bark of quickly growing healthy trees is always richer in alkaloid than that of stunted or sickly trees. The effect of manure is therefore to increase the alkaloid yielded by by an acre of trees. The good effects of high cultivation other than manuring are undoubted.

10. I can answer the question only for Red barks. After various cropping experiments, and after considering the information afforded by analysis, I have come to the conclusion that Red bark should be treated as an eight or nine years' crop, and on that principle the Sikkim plantation is now being worked. Analysis shows that up to eight years Red bark does not deteriorate; it also goes to show that after that it does not improve, and not improbably does deteriorate. By their eighth year, Red bark trees in Sikkim appear to have reached their full growth. After that their growth on the whole begins to flag, and not unfrequently they die. On the whole, therefore, I conclude that eight, or in some situations nine, years is, *for Sikkim*, the safest age to take as the basis of a working plan.

11. I regret that I cannot answer this question, as we do not work by the tree but by the acre. In the appendix on page 6 of my Annual Report for 1876-77 will be found the yields per acre of root, stem, and twig bark on both coppicing and uprooting systems. And on page 8 of the report for 1875-76 will be found similar figures for that year.

12. My experience is not yet sufficient to enable me to offer an absolute opinion as to the relative merits of the two systems of coppicing and uprooting. I am, however, rather inclined to believe that complete coppicing will ultimately prove the more advantageous.

13. With reference to coppicing, I am not yet prepared to say (*a*) how often a tree may be coppiced: I know of no experience as to how the coppice of Red barks itself bears coppicing. (*b*) There is no actual experience as to the yield of coppice stools of any given age as compared with the yield of uncoppiced trees of a like age. But we know by experience that a coppiced stool bears shoots varying in number from two to ten, and that each of these shoots is when one, two,

Question.

14. What experience have you of replanting land on which a crop has been taken by uprooting the trees?

15. In your "Manual of Cinchona Cultivation," it is stated that the average yield of the Red barks at Darjeeling is of root bark from 7 to 8 per cent., stem bark from 5 to 6 per cent., and branch bark 2 to 4 per. cent of alkaloids. It is observed that your cropping is principally the result of entire uprootal, by which you get a normal proportion of root, stem, and branch bark, the average yield of which, by your own calculation, should not be less than from 4 to 5 per cent. of total alkaloids. The Committee will feel obliged by your explaining how it is that in practical manufacture your quinologist appears to recover only something less than 2 per cent. of febrifuge, a portion of which being insoluble in acids can scarcely be reckoned as alkaloids?

16. The Committee appointed by the Madras Government in 1874 to report on alkaloid manufacture, showed that Mr. Broughton recovered on a manufacturing scale about two-thirds of the total alkaloids present in the bark. The details of his process were known to Mr. Wood, who has apparently adopted a process which Mr. Broughton definitely rejected after experiment as causing great waste of alkaloid. The Committee will be glad to learn from you how it is that a process which practi-

Answer.

or three years old, as large as or often larger than a seedling tree of equal age. My own belief is that the yield obtainable by working an acre of stools by coppice over eight years will far exceed the yield of an acre of trees remaining non-coppiced and finally uprooted at the end of their eighth year. The reasonableness of this is at once apparent when it is recollected that a coppiced stool is provided with the root system of a tree, and that the shoots have a correspondingly large supply of nourishment brought to them. A seedling, on the other hand, has to make its root system for itself *pari passu* with its general growth.

No kind of partial coppice is, in my experience, *of any use*. Coppicing must be complete, or at most only a few standard trees per acre may be left. The shoots must be treated as seedlings, and the land must be kept as clean as for new planting. All vacancies can be made up with every condition of success. The bark of coppice shoots is quite as rich as, and often richer than, that of young trees of the same age as the coppice.

14. Replanting the same land with Red barks the same year as Red barks have been uprooted, results at first in many death vacancies. I am now trying in Sikkim the results of replanting one, two, and three years after uprootal, but as yet I have no reliable experience to offer.

15. It is quite true that the proportions of alkaloids in root, stem and twig bark have been found on analysis as stated. But it must not be forgotten that in laboratory analyses perfectly clean, and above all, quite dry samples are used. In collecting bark on a large scale perfect purity is impossible; root bark, for example, carries some soil on it; twig bark has often to be sliced off (as it cannot be peeled), and therefore carries some wood with it. Pieces of dead and diseased bark are moreover included by the bark collectors and dead bark contains no alkaloid, while diseased bark contains very little. Moreover, bark is very hygrometric, and, in a moist climate like that of Sikkim, always contains, even when nominally "dry," a considerable percentage of moisture. The average yield of the mixed bark, as it is issued to the factory, is therefore believed to be correctly stated at about 4 per cent. Actual analysis has indeed given that result. During the first years of the factory, the actual outturn of febrifuge was a little under 2 per cent.; during 1877-78 it was 2·24 per cent.

16. The reason for the smallness of the outturn is, as has been already explained, that the plantation factory is worked on a process avowedly imperfect, from which no better result was ever expected, and which, originally proposed as a make-shift, has come to be worked on an unexpectedly large scale. The process is not considered satisfactory as worked at the plantation. The present product (cinchona febrifuge) is by no means considered a final one. Mr. Wood's first object was to pro-

Question.

cally loses from 50 to 60 per cent. of the alkaloid present in the bark, can be considered satisfactory; and also how, in your opinion, the great waste in manufacture during 1875-76 and 1876-77 could have been obviated?

17. If the money which the bark used in the manufacture of the Bengal febrifuge would have fetched by sale in Europe, would have purchased a larger amount of alkaloids there than the returns by Mr. Wood's process, are you prepared to admit that the latter is not an economical process?

18. It is proposed to substitute Mr. Wood's febrifuge for quinine to the extent of 75 per cent. in the hospitals in Bengal. Can you give any information as to the extent to which the cinchona alkaloids other than quinine have of late years been used in these hospitals?

19. Have you any recent analysis to show the average chemical composition of Mr. Wood's febrifuge?

Answer.

duce an efficient febrifuge as cheaply as possible, utilising all the small unmarketable bark, and adopting no refinements of manufacture. But it is intended to improve the febrifuge, and possibly to turn out another product. The waste that has hitherto occurred would have been obviated had the full working scheme proposed in 1875 been adopted then. Part of that scheme was that a steam manufacturing process, on the same principle as that carried on at the plantation, should be conducted in Calcutta, by which it had been actually demonstrated that 3½ per cent. of febrifuge could be extracted from bark containing 4 per cent. of alkaloid. As regards the principle of the manufacture, I can only say that Mr. Wood's experiments showed it to be better than Mr. Broughton's, as involving less machinery and giving an outturn about equally good. Mr. Wood's is the process of DeVrij with modifications, and is not claimed as original by Mr. Wood.

17. As the premises cannot be proved, I can hardly answer the question that follows from them. I have always understood that the main object of Government in carrying on the Sikkim plantation is to supply its own hospitals and the people at large with a cheap and efficient febrifuge, which shall always be obtainable free from adulteration and at an unvarying price. I have not understood that their object is, by the sale of bark in England, to raise money with which to buy quinine or other medicines. If raising money were the object, it would be more readily attained by growing cocoa or areca nuts, or some other product for which there is a steady local demand.

18. In Appendix B of my Cinchona Manual will be found details of the quantity of cinchona alkaloids supplied to the Government Medical Departments for the Presidencies of Madras, Bombay, and Bengal from 1867 to 1875, together with, in some cases, the prices paid for them. Sikkim cinchona febrifuge at Rupees 16-8-0 per pound has been supplied to the Bengal Medical Department as follows:—

	lb.	oz.
During 1875-76	1,607	14
1876-77	1,942	14
1877-78	3,011	0
From 1st April to 22nd July 1878	2,180	0
	8,741	12

To Bombay during the same period 600 or 800 lb. have been sent.

19. I have no recent analysis of Mr. Wood's febrifuge. It is believed not to vary to any great extent in chemical composition, and its therapeutic effects are always the same.

Further Questions submitted to Dr. King.

Question.

1. Will you kindly favor the Committee with such information as you possess in regard to—
   (1) The extent of private cinchona culture in Sikkim?
   (2) The present condition of private enterprise?
   (3) Your opinion in regard to the future extension of private cultivation?

2. Will you kindly give us the data on which Mr. Wood estimates the cost of manufactured alkaloid in Calcutta at Rupees 11-9-0 per pound?

Answer.

1. There was never more than one private plantation in Sikkim entirely devoted to the growth of cinchona, and that was and is still owned by the Darjeeling Cinchona Association. But in several tea gardens in the district, patches of cinchona (chiefly *succirubra*) were put out some years ago. And in these and other gardens avenues of *succirubra* trees were planted along roads. The Cinchona Association's plantation was brought up to 1,000 acres, but the patches in private gardens nowhere extended to more than 30 acres, and that area was probably reached only on the Tukvar Company's estate. In the other gardens I should estimate the average number of plants at probably 20,000 each. Some two years ago, the Cinchona Association decided to abandon the cultivation in favor of tea, and with that object about 200 acres of red barks were uprooted and tea was planted instead. The bark from these 200 acres having reached the market at a favorable time, brought a good price,* and this apparently induced the majority of the managers of tea gardens on which there were any cinchona trees to uproot their trees and send the bark home. To such an extent was this done, that in only two or three out of about ten or twelve gardens that carried any cinchona trees, do any trees now remain. (2) I do not know of a single garden in Sikkim (except the Government plantation) on which cinchona has been planted for several years. The feeling in the district is all in favor of tea and against any other kind of cultivation, and I do not believe (3) that cinchona is at all likely to be planted anew on any private garden in the district. In my own opinion the price of red bark —the only species easy of cultivation in Sikkim —is certain to fall when the large number of red bark trees planted in Ceylon and elsewhere come into bearing, and it is too late in the day now for private planters to plant red barks with the hope of good financial results. The case is different with crown and yellow barks, which have nowhere been largely planted and which are in steady demand as sources of quinine, whereas red barks are for the most part used for the manufacture of pharmaceutical preparations and not as sources of quinine. I think the Sikkim planters are probably right in their determination not to extend the cultivation of red bark.

2. The data of Mr. Wood's calculation are as follows:—

He estimates the annual bark crop at 366,000 lb. of dry bark, which shall cost, and shall be made over to the factory, at 3½ Annas per pound.

* We note that Darjeeling barks of fair quality fetched in the London market in 1877 from 2*s.* 3*d.* to 4*s.* per pound.

Question.

3. In the event of the Madras Government resuming manufacture with its red barks and selling alkaloid at cost price to the public, would there not be a possibility of the mixed alkaloids being bought and sold for the extraction of quinine?

4. Will you kindly give us your views as to the possible economical use of our red barks in the local production of alkaloid, bearing in mind the value of such barks in the market, and the amount of bark likely to be harvested annually from about 350 acres?

Answer.

The total cost of the bark is thus put down at 80,000 Rupees. To convey this to Calcutta and there to manufacture it into cinchona febrifuge he estimates will cost Rupees 68,000. This latter item includes carriage to Calcutta, the cost of chemicals, fuel, rent, quinologist's pay, labor (including European foreman), repairs, and cost of machinery.

The bark is estimated (and the estimate is founded on analyses) to contain 4 per cent. of alkaloids, of which seven-eighths ($3\frac{1}{2}$ per cent.) can be extracted in the factory. The outturn is therefore 12,810 lb. of febrifuge at a net cost of Rupees 11-9-0 per pound.

3. If the Madras Government resumed the local manufacture of a febrifuge, the presumption is that it would first supply its own hospitals, dispensaries and officers, and that only such febrifuge as remained would be available to the general public by purchase. This is the plan followed in Bengal, but in that Presidency, while public institutions buy the febrifuge at Rupees 16-8-0 per pound, the general public pay Rupees 20 per pound for any quantity under 20 lb. Both Rupees 16-8-0 and Rupees 20 are prices a good deal above the estimated actual cost when the factory shall be in operation.

For Bengal the whole of the febrifuge is disposed of by a single officer, viz., myself, and, acting on the principle that the febrifuge is intended by Government for use only in India, I would decline to sell it for export. And at present it is only by exporting it that febrifuge could be profitably used as a source of the manufacture of quinine. It would, under present arrangements, be practically impossible for any one to purchase febrifuge in sufficient quantity to make it worth while to export it to Europe for such a purpose. And I do not see any difficulty in thus preventing exportation, even were the manufacture and sale of febrifuge to assume much larger proportions than at present. An arrangement of a like sort could readily, I presume, be made in Madras.

4. Red bark grown on the Nilgiris—and especially bark of the first renewal under moss—differs considerably in the proportion of contained alkaloids from Sikkim-grown bark, and as our calculations for the utilization of our Sikkim produce are founded entirely on the composition of our own barks, I am not prepared at present to answer this question as far as red barks are concerned. The matter would require some consideration. As for the Nilgiri crown barks, it would be easy to extract from them the quinine they contain in a form as pure, and as efficient therapeutically, as Howard's well known sulphate. This could be done in this country at a cost *less than that at which cinchona febrifuge is extracted from red bark in Sikkim.* If the Committee like to send a hundred pounds of Nilgiri *condaminea* (crown) bark to me, it can be manufactured by Mr. Wood, and the quinine obtained can be sent to the

Question.

5. The Committee will be glad to receive your opinion in regard to the general condition of the Government estates as to—

(1) The system of cultivation followed;
(2) The present condition and future prospects of the estates;
(3) The system of harvesting bark;

and any other points of importance noticed by you in your recent visit to the estates, which the Committee may have to notice in their report to Government.

Answer.

Committee. By this means the feasibility and advantage of the local manufacture of quinine can be put to a practical test. I should not think there would be any difficulty in working the Nilgiri crown barks for quinine, and (should the Committee so desire) in working the red barks for cinchona febrifuge in Madras, where I understand there are two Government laboratories and two Professors of Chemistry.

It is impossible for me estimate with any degree of accuracy the probable yield of the 350 acres under red bark in the Government plantations on the Nilgiris. Such an estimate, to be of any value, would require to be founded on a detailed acquaintance with every part of the area under these barks, and such an acquaintance I do not possess.

5. (1) The present system of cultivation seems to me to be very good. The estates are on the whole quite as free from weeds as it is necessary for cinchona plantations to be, and the weeds present are for the most part annuals that are easily uprooted. Some parts of the Dodabetta estate are in my opinion too clean, as on such steep slopes the continual removal of weeds cannot fail to encourage loss of surface soil by wash. In a few spots on all the plantations there is a deep-rooting perennial grass as a weed: this should be dug out, as it visibly affects the health of the trees.

(2) The present condition and future prospects of the plantation are very far from uniform. Some pieces both of red and crown planting appear to me to look very well indeed; the trees are in good leaf, are comparatively free from flower and seed, have stems that girth fairly well, and stand regularly and close together. I have seen nothing in any private cinchona plantation better than a large patch of *succirubra* in the Napier estate or than the fine piece of the same species near the Neddiwattum jail. Some patches of crown bark on Dodabetta are also very good indeed, and the only bit I have seen to beat them is a corner of crown bark planting near the writer's house on the Welbeck estate.

On the other hand, there are some very poor pieces both of red and crown planting on all the Government estates, and here and there, even in the good patches, there are scattered a good many weak, sickly, and stunted plants.

Patches both of crown and red barks stand on land which should never have been planted. It had originally been grass-land, and, although not by any means devoid of humus, the surface soil is infertile stuff. Moreover many of the bad patches are much exposed to wind. In all cases when exposure to wind and poor soil are associated, the trees—both red and crown—are in my opinion in a hopeless condition, and the best thing to be done with them would, I think, be to root them out so as to secure, without further loss of time and money, what bark they now carry; and having done this, I would let the land for native cultivation (if any body will take it) or allow it to revert to waste.

Question.

Answer.

There are several such patches on Dodabetta and on the upper parts of the Neddiwattum and Hooker estates. It is perfectly clear that red bark trees cannot, even when planted in good soil, stand wind, and this should be borne in mind in all future planting. Crown barks, though much more tolerant of wind, should not, in my opinion, be planted in windy spots. Crown barks get on fairly well on grass-land if it be sheltered, but red barks do badly on grass-land in any situation.

Besides these hopeless patches, there are a good many bits in the Neddiwattum, Hooker, and Pykarah estates planted with red barks, where the trees are doing badly simply because the elevation is too great for this species. On such spots the red bark should, I think, be uprooted, and crown barks should be planted in their place.

There are, as I have said, besides these patches, scattered trees all over the plantation which are clearly in bad health, and, bearing in mind that in proportion to the vigor of a tree is the alkaloidal richness of its bark and that the bark of a dead tree contains absolutely no alkaloid, I would, without further delay, uproot all such trees. I would, moreover, suggest that it be made a standing rule on the plantations that as soon as trees show any signs of dying they should be uprooted forthwith.

So much for the bad bits of the plantations and for the unhealthy trees in the good bits. But if the good bits be looked at carefully—and especially from a little distance with a glass—there will be perceived in many parts of them an evident deficiency in health, as indicated by the enormous amount of flower and seed carried by the trees, by the scantiness of their foliage and by its pale green and often almost yellowish tint. The heads of a number of trees, moreover, are seen to carry many dead twigs, while the tops of some are entirely dead. These appearances for the most part coincide with the areas of the plantation where the trees have been barked, and they are most marked where barking has been done oftenest. There are on the Neddiwattum plantation a good many trees which have not been barked: these stand for the most part separate from the barked trees, and the appearance of barked and unbarked trees cannot be compared so well as on the neighbouring private estate of Balmadies where there is a fine bit of red bark planting, on which three-fourths of the trees were coppiced from three to five years ago, while the remaining fourth were once partially barked and mossed. On Balmadies it is easy to distinguish at a distance, and by a single glance, the old and barked trees,—the heads of the coppiced shoots being densely covered with leaves of a good healthy green, and carrying no dead twigs and but little flower and seed.

These appearances, together with general physiological considerations, led me to the conclusion that, although the barking process

Question.

Answer.

advocated by the late Mr. McIvor may be practised to the extent of removing the entire bark of a tree once, or one and a half times, or in some cases even twice, yet that it does in the end begin to tell on the general health and vigor of the tree, and, if pursued long enough, will most undoubtedly kill it. In order to test the general truth of this conclusion, Dr. Bidie and I had three crown bark trees uprooted on Dodabetta. The first was a tree that had been once barked, and that was evidently much affected in health; the second was a tree that had been barked once, but which appeared as healthy and vigorous as any of its fellows that had received exactly similar treatment as regards barking, and which might in every respect be taken as an average healthy mossed tree; the third was a tree that had been coppiced at Mr. Broughton's instance five years ago.

The roots of the first two trees were as regards extent and healthiness much the same, the wood and bark of the root in both cases appeared to be healthy; but the extent of the roots and especially of the root fibrils was small. The root of the coppiced tree was almost twice as large, and the root fibrils were greatly more abundant, and there is no doubt that in general health and vigor the root of the coppiced tree was far superior to that of the two mossed trees. Barking thus appears to affect the entire tree. Judging from the appearance of the roots of these two barked trees, there was nothing to prevent good coppice shoots to be thrown from their stools had they been cut down, and *pari passu* with the growth of such shoots, the roots would probably have increased in size and vigor.

With reference to the future working of the plantation, I think it of the greatest importance to put to a practical test on a sufficiently large scale, the behaviour under coppicing treatment of trees that have been frequently barked, and which (presumably from that cause) have become clearly deficient in health and vigor. Coppicing has never had a fair trial on any part of the Nilgiri plantations. It has hitherto been done in a rude unworkmanlike manner, and on by far too small a scale. In Sikkim I find that only clean coppicing is of any use, partial coppice being, on account of drip and shade from the standing trees, an utter failure. I am not prepared to say (without experience) that a similar plan will answer quite as well in the Nilgiris which have a drier and by far more windy climate than Sikkim. But I am quite sure that the large proportion of failures in the few coppiced trees to be seen on the Nilgiris is due to the stools and young shoots having been exposed to dense shade and much drip, as well as to the trees having been cut at a bad season and too high from the ground. In future experiments coppicing should be done at the season when the trees are most at rest, the surface of the stool should not be much above the level of the soil,

Question. *Answer.*

and at least 5 acres should be done in one place. After coppicing, all vacancies should be filled up with seedlings and the ground should be cultivated as highly as if it were planted entirely with seedlings. When the coppice shoots have begun to appear they should, if too numerous, be thinned out, and, as they grow, a little earth should be gently heaped round the collar of the stool, so that the young shoots may root into it and be supported against the wind. There is enough coppice at Neddiwattum and on the Balmedies estate to show that red bark trees, if cut while yet healthy, will coppice freely on the Nilgiris, and on Dodabetta the few crown bark trees that were coppiced prior to barking have done well. I think it may therefore be assumed that healthy red and crown barks can be coppiced successfully. I am also of opinion that trees of both species may also be coppiced successfully, although they have had the whole of the original bark previously taken by McIvor's process, or even though they have also had some of their renewed bark so taken, provided they are not visibly in bad health from that or any other cause. The only doubt is in the case of trees where, as above described, the general health appears to have been weakened by barking and mossing. And this doubt should be set at rest by experiment without further delay. If it turns out that such weakly trees do not coppice well, I would uproot them and thus secure all the bark they now bear, for I feel pretty sure they have already begun to die, and after they get into hopelessly bad condition their bark will be useless.

(3) As to harvesting the bark, the mossing process does not appear to affect the health of the trees, for a time at least, and as renewed bark brings a very high price, I do not see why the two plans of mossing and coppicing should not be combined, trees being barked, say, to the extent of their original bark and clean coppiced when the latest taken half has been completely renewed. At present the plantation is worked purely on the mossing system, which appears to me to have the disadvantage of affecting the health and (as I fear) of ultimately killing the trees, besides which bark of the second and third renewal is thinner and less rich in alkaloid than that of the first renewal and than original bark: moreover, cases of failure to renew are by no means unfrequent. The system also appears to me to have the very serious objection that by it one works in the dark. To be cropped regularly and at the same time to be maintained in efficiency, every plantation must be worked with some kind of idea, however rough, of the real amount of its mean annual yield. Of the actual mean annual capacity of yield of the Nilgiri plantations, under the present system, absolutely nothing is known. The Superintendent estimates the Dodabetta crop this year at 35,000 lb. of dry bark, but he does not know how or why he has arrived at these figures. The real yield may be 45,000 lb., and if so, he

Question. *Answer.*

is omitting to draw a dividend which has fallen due, or the real yield may be only 25,000 lb., in which case he is really encroaching on his capital under the belief that he is drawing a fairly earned dividend. Part of this uncertainty is no doubt due to the plan of calculating by the tree. I think a larger unit would give a more manageable basis, and I would suggest an acre of trees as the unit instead of one tree.

If it be decided to introduce coppicing as the complement to the barking and mossing system, the first step will be to convert the area that has been longest under the latterinto coppice. This will require to be done judiciously, the most sickly pieces being taken in hand first. The uprootal of the thoroughly bad patches treated of in the early part of this memorandum might, if there be scarcity of labor, be deferred until the most sickly patches of barked trees have been coppiced. The conversion into coppice of the barked areas will be a work of time, and during the time the change in the working of the plantation is being carried through, the annual yield of bark will vary in amount; but this is unavoidable. After the conversion has been effected, the plantation should be worked on a regular plan, and for this purpose it should be divided into blocks. I would suggest that the operations of each year should be marked in color on a map—it would be a good thing to have duplicate maps for the Commissioner's Office and Secretariat;—each year's map should be kept in the office, so that a glance at these maps will at once show the exact history of each block. At present the past history of many most interesting and important points connected with these plantations is unknown from the absence of records.

(Signed) GEORGE KING.

NOTE BY Dr. KING.

In compliance with the invitation of the Committee, I append a few notes on points not asked in the preceding question.

1. It should be borne in mind that *C. succirubra* is to all appearance a short-lived tree, and the trees that remain unbarked on the Napier estate and elsewhere should not be looked on as good for many years. Coppicing or mossing, or a combination of both, should not therefore, I think, be too long deferred for these trees.

2. In all future planting a closer planting distance should be adopted. I find 4×4 feet (giving 2,722 trees per acre) the best distance for Sikkim. Closely planted cinchonas grow much faster during the first three or four years than widely planted trees, mainly from the mutual shade and protection which they afford each other. As soon as the plants appear to be too crowded alternate lines can *be rooted out* (coppicing so close is useless), and at a later date alternate trees in the same line can be taken, leaving the plantation 8×8 feet.

3. In order to secure good unhybridised seed, patches of selected trees should be planted at a distance from the plantation—on the west side of the hills for example—and from each other. These should be well cultivated and cared for, and should be kept as seed trees.

4. It is well known that cinchonas are prolific in varieties which vary greatly in appearance and in quality of bark. The plantation should be carefully gone over, and botanical specimens and

samples of bark should be collected from each variety. Each tree thus collected from should bear an indelible number fixed to it. A list of such numbered trees should be made, and their positions should be indicated on a map. The botanical specimens from each of these trees should bear the same number as the tree itself and so should the sample of the bark. The latter should be carefully analysed. Varieties that prove to have bad bark should be ruthlessly uprooted, and the cultivation of varieties that prove on analysis to have really good barks should be most energetically carried on. All future replanting and extension of the plantations should be made to as large an extent as possible with such varieties only.

5. I think *calisaya* is worthy of more attention than it has hitherto received on these plantations. The little field of *calisayas* at Neddiwattum contains 14 varieties. Some of these I know to have poor bark. Analyses should, I think, be made of bark of all 14 species. The bad should be uprooted, the good propagated; and a well sheltered piece of shola land should be selected a good deal lower than Neddiwattum and *calisaya* should be tried there. It is a species which affects warmer spots than *succirubra*, and which requires a climate not only warm but moist all the year round.

G.K.

APPENDIX B.

Memorandum on the various modes of utilising Cinchona Bark and its Preparations as Febrifuges, with a Statement of their Comparative Cost.

CINCHONA bark has been known and used as a febrifuge in English medical practice for upwards of 200 years. For a long period after its introduction it was sold under the name of "Jesuit's Powder" or "Peruvian Bark," and it continued to be known under one or other of these names until a comparatively recently period in England. Prior to the discovery of quinine in 1820, by Pelletier and Caventou, bark was administered as a medicine in the form of powder, infusion, or decoction, and there can be no doubt that periodical fevers were and can be successfully treated by these simple preparations of the drug. At the same time the experience of over 50 years in the use of alkaloid constituents of bark shows, that there are certain advantages—therapeutical and economical—attending their use, which have led to their almost exclusive employment in preference to the cruder preparations. It now remains for me, therefore, to notice briefly the comparative merits of the several preparations of cinchona bark.

Powder of Bark.—This preparation of course contains all the active principles of the drug, but as these are not in a very soluble state, only a small proportion of them is extracted by the gastric juice. A full dose of, say, sulphate of quinine ranges from 10 to 12 grains, and to obtain the same therapeutical effect with bark-powder it would be necessary to give a dose of from $\frac{3}{4}$ to 1 oz. Such a quantity of the powder would be objectionable not only on account of its bulk, but also because of the quantity of indigestible woody tissue administered, which would induce irritation of the stomach and bowels. Crude bark also contains astringent principles, which from a medical point of view are sometimes of advantage, and sometimes the opposite. As a rule, bark-powder cannot be administered in doses exceeding 60 grains without causing nausea, vomiting, or diarrhœa, and its disagreeable taste proves a further objection. On the other hand, as 60 grains would represent less than 2 grains of the sulphate of one of the cinchona alkaloids, it will be seen how impotent we would be to deal with severe forms of fever if restricted to this preparation of bark. At the same time, it must be allowed that in simple forms of malarial fever bark-powder is often very useful, more especially when it is necessary to husband the stock of quinine. I will now glance briefly at the economical aspect of the question. Say a case of fever is being treated with 60-grain doses of bark, of which four are given daily, and that the value of the bark is Rupees 2 per lb.* On an average it takes three days to check even a mild attack of fever with bark-powder, so that the total value of bark necessary to effect a cure would be Annas 3-3†.

Decoction of Bark.—In preparing the decoction, bruised bark is boiled in water, and the resulting liquor strained and kept. While hot the decoction is clear, but gets turbid as it cools, partly owing to the deposit of tannate of starch, and partly to that of cinchona-red, which is more soluble in hot than in cold water. The decoction contains rather more of the alkaloid principles of the bark than the infusion, and also more of the astringent properties and coloring matter. Its efficacy would be considerably increased by using acidulated instead of simple water, as the acid would assist in the decomposition of the combination in which the alkaloids exist in the bark, and promote their solution in the liquor. Both the decoction and infusion are apt to undergo decomposition, more especially in a hot climate, and must be administered fresh. According to Soubeiran bark loses two-thirds of its weight by decoction and about one-third by infusion. The decoction is a more active preparation than either the infusion or powder, but like these has a nauseating taste, and is objectionable on account of the bulk of the dose. At times when given in full doses it produces vomiting and purging, and in some cases it induces constipation. The strength of the officinal decoction is 1 in 16. Say four doses of 2 oz. each are given daily in a case of fever, thus the patient will consume per diem about $\frac{1}{2}$ oz. of bark of the value of 1 Anna. As in the case of the powder, it will usually take three days to check the fever, and therefore the total value of the drug, including cost of preparation, will be about 3 Annas 3 Pies. As regards the therapeutical aspect of the question, it may be remarked that 8 oz. of decoction of bark per diem would represent somewhat less than 6 grains of the sulphate of quinine.

Infusion of Bark.—In preparing the infusion the bark is reduced to coarse powder, boiling water poured over it, and the mixture allowed to macerate and then strained. The result is a coloured fluid containing a very weak solution of the alkaloids, the greater portion of which is left in the marc. The infusion of cinchona therefore possesses little or no febrifuge properties, but is a very good tonic.

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* The price of the bark at present in stock in the Medical Store Depôt is Rupees 2-3-10 per lb.
† In every case fractions have been omitted in these calculations.

Extract of Cinchona Bark.—This, like the decoction and powder, is an old preparation. The London form of extract was a watery, and the Edinburgh a spirituous one and therefore more active. Brande states that pale bark yields 30 per cent. of watery extract. The extract of the British Pharmacopœia is a fluid watery one, spirit being added, in due proportion, to prevent decomposition; it is a good preparation, and one part of it is equal, in medicinal value, to four of bark. During the past year a quantity of extract of Nilgiri red bark was prepared by the Medical Department according to the Edinburgh formula, and distributed for trial as a febrifuge in the form of pills. By the Edinburgh process more than 30 per cent. of extract is got from bark, and as it contains a considerable amount of the alkaloids, it must possess active febrifuge powers. The results of this practical trial of it are not yet available, but it is probable that they will show that it is more effectual than powder or decoction. The best mode of administering the spirituous extract is in the shape of pills, but these unfortunately are rather difficult to make, and when made liable to become hard. A pound of bark will yield 2,100 grains of extract at a cost of Rupees 7-4-0, and there will be 140 doses in that quantity. Supposing, then, that four doses are given per diem to a patient suffering from fever and that it takes two days to check the attack, the cost of treatment by this remedy will be Annas 6-7.

Tincture of Bark.—This preparation, of which Mr. Money's so-called "decoction" is an imitation, has long been known to the profession, but it is rarely used except as a tonic in conjunction with other remedies, as the large amount of spirit which it contains renders its employment as a febrifuge objectionable. The tincture is prepared by percolating proof spirit through bark-powder. The spirit extracts a considerable portion of the bitter and astringent principles of the bark, and the tincture is theoretically supposed to contain from 3 to 4 grains of the cinchona alkaloids per ounce. Some further remarks regarding this form of preparation will be offered when speaking of Mr. Money's "decoction."

Money's "Decoction of Bark."—This article, which is referred to in the orders of Government marginally noted as a "decoction," is a tincture, and is said to be prepared by boiling 5 oz. of bark in a quart bottle full, say 24 oz., of spirit. It is therefore slightly stronger than the officinal tincture, which contains one part of bark in five of spirit. Say that the Nilgiri cinchona barks yield on an average 5 per cent. of alkaloids, then 1 oz. of Mr. Money's tincture would theoretically represent from 4 to 5 grains of the alkaloid principles of the bark. To give a patient a full febrifuge dose therefore, it would be necessary to administer from 2 to 4 oz. of the "decoction"—a quantity which, on account of the amount of alcohol, would generally be highly objectionable. The results of the practical trial of this preparation by the Medical Department are not favorable, and do not require further notice here as they have been specially alluded to in the body of the report. It may be mentioned, however, that the bulk of the "decoction" rendering it difficult of transport, as well as the liability to loss from breakage of bottles in transit would, apart from all other considerations, prove serious objections to its general use as a febrifuge. Mr. Money offers to supply the decoction at 1 Rupee per quart bottle, provided the Government make over their gardens on the Nilgiris to him to apply their bark to this purpose. At the present time the intrinsic value of Government bark is about 1 Rupee per pound, so that the total cost of a quart bottle of the "decoction" under such an arrangement would be about Rupees 1-5-0. Say that in a case of fever 6 oz. of the "decoction" are given daily in three doses of 2 oz. each, and that the fever is checked in two days, thus the total cost of treatment will be Annas 10-6. It will thus be seen that Mr. Money's proposal would, if accepted, prove a rather expensive one to Government.

G.O., No. 2,129, of 27th June 1877, and G.O., No. 2,641, of 4th September 1877.

Cinchona Alkaloids.—The preparations of these most commonly used in medical practice are as follows:—

Sulphate of quinine
Do. of quinidine.
Do. of cinchonidine.
Do. of cinchonine.

Since the discovery of quinine in 1820, that principle has gradually taken the place of the cruder preparations, but there can be no doubt that up to a comparatively recent date commercial sulphate of quinine contained more or less of the other alkaloids, as the old officinal tests for sulphate of quinine were not such as to preclude their presence. By the tests prescribed in the British Pharmacopœia such admixture is rendered impossible, and as the other alkaloids are not included in the category of officinal drugs, these valuable preparations are thereby practically excluded from English practice. When the culture of cinchonas was introduced in India, it became of great importance to ascertain the therapeutical value of substances which formed so large a portion of the alkaloid constituents of Indian grown barks. Accordingly in 1866, under the order of Her Majesty's Secretary of State for India, extensive trials in the treatment of fevers were made with chemically pure sulphates of the several alkaloids in some of the more malarious districts of the Madras Presidency. The total number of fever cases treated was 2,472, the number of cures 2,445, and the number of failures 27. The ratio of failures per 1,000 cases treated was, in the case of each alkaloid, as follows:—

Sulphate of quinidine	6·024
Do. of quinine	7·062
Do. of cinchonidine	9·925
Do. of cinchonine	23·255

These results are of great interest and importance to India, inasmuch as the red bark, the kind most easily grown and most productive, is rich in the other alkaloids, although ordinarily containing but little quinine. The prices of the supplies of the several alkaloids at present in stock in the Medical Store Depôt, Madras, are, in round numbers as follows, including 20 per cent. for freight, insurance and all other charges:—

	Rs.	A.	P.	
Sulphate of quinine	79	0	0	per lb.
Do. of cinchonine	6	0	0	,,
Do. of cinchonidine	21	0	0	,,
Do. of quinidine	36	0	0	,,

According to the figures just given, the efficiency of these alkaloids in curing fever is very nearly equal, except in the case of cinchonine, which is somewhat less energetic than the others. Say that it takes five doses, viz., four per diem of 5 grains each, of either quinine, cinchonidine or quinidine to check an attack of fever, then the cost of the drug in each instance will be as follows, and the time occupied in effecting a cure a little over one day:—

	A.	P.
Sulphate of quinine, five doses of 5 grains each	4	6
Do. of cinchonidine do. do.	1	2
Do. of quinidine do. do.	2	0

In the case of sulphate of cinchonine, if eight doses of 5 grains each at the rate of four doses per diem are required, then the cost of the drug will be a little over 6 Pies, and the time occupied in checking the fever two days.

Broughton's Amorphous Quinine.—This preparation received careful trials in Madras hospitals, and it was found that it effected a cure in nearly the same time as that required when using the European made alkaloids, but with a somewhat larger expenditure of the drug. The selling price of the article was latterly Rupees 1-8-0 per ounce. Say that in a case of fever it took six doses of 10 grains each to check the attack, then the total cost of the drug would be Annas 3-3.

Mr. Wood's Febrifuge.—The selling price of this article is Rupees 20 per lb., and the Bengal authorities now state that the proper dose is from 3 to 5 grains. Say, then, as in the case of Mr. Broughton's preparation, that six doses and two days are required to cure an attack of fever. The cost of six doses of 5 grains each will be Annas 1-4. From our experience of Mr. Broughton's kindred preparation, however, I am inclined to think that six doses of 5 grains each (= 30 grains) of the Sikkim drug would not by any means have the same efficacy as 60 grains of the former.

Comparative Cost of Treatment.—The comparative cost of treating cases of fever with the several preparations of cinchona bark will therefore be as follows:—

	A.	P.
Sulphate of cinchonine	0	6
Do. of cinchonidine	1	2
Bengal febrifuge	1	4
Sulphate of quinidine	2	0
Powder of bark	3	3
Decoction of bark	3	3
Broughton's amorphous quinine	4	6
Sulphate of quinine	6	7
Extract of cinchona	10	6
Money's decoction		

In the foregoing remarks I have tried to express in hypothetical cases the relative therapeutical value, and the cost of the ten preparations mentioned. As regards the cruder substances, viz., the powder, decoction and extract, I believe that the periods required to effect a cure under their use are rather under-estimated than otherwise. There is, therefore, no pecuniary gain by using such articles so far as the cost of the drug is concerned, while, on the other hand, the patient must be detained for a longer period under treatment than if the alkaloids had been administered. Such detention of course means a loss of pay to the bread-winner if the person belongs to the laboring classes, and increased cost of dieting and other charges to the hospital if he or she is an in-patient.

(Signed) G. BIDIE, M.B.

APPENDIX C.

During the progress of the investigations of the Committee, they expressed a wish that Dr. King and myself should visit the several Government cinchona estates, and while thus engaged we embraced the opportunity of seeing the chief private plantations on the Nilgiris. The following notes were made during these visits, and all the important parts of them were read to Dr. King, who agreed generally in my conclusions. I have omitted such points as are specially noticed in the general report. While at Neddiwattum we were in constant communication with Mr. Rowson, the Assistant Superintendent, and were very favorably impressed with the knowledge which he possesses of everything connected with his charge, and the interest which he displays in his work. The Head Overseer at Dodabetta is also a careful and intelligent subordinate. The subjects noticed in these notes are as follows:—

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NEDDIWATTUM.

The trees on this property consist practically of red and crown barks, the grey and yellow barks having for the most part died out. Of the red barks there are several varieties, the most notable and common of which are the ordinary form and another with somewhat more pubescent and less corrugated leaves. The latter seems to be a very vigorous growing and hardy variety, and we noticed that it has been extensively cultivated on the Devashola estate. The red barks planted in 1862 are on the whole healthy. Most of them are flowering and seeding very profusely, and as even their leading shoots are bearing fruit, I think it probable that they are not likely to grow taller. Some of them have been barked six times, which shows how tolerant this species is of the operation; but from the present appearance of the trees I deem it certain that this system of cropping can scarcely be continued longer with safety as regards most of the trees.* The red barks of 1863, 64, 65, and 66 planting are mostly all good, and those on the lower parts of the property, especially near the jail, very luxuriant. I again examined the 2,000 trees near the jail, amongst which Mr. Broughton and myself reported a good many failures in the renewal of the bark. They have been barked four times, and are in beautiful luxuriance as to foliage; but even now old failures in renewing may be detected. Some of the later plantings of red bark, such as those in the ravines of the Napier estate, are very flourishing, and as yet do not show that tendency to run to seed and the decline in the foliage which is observable in the older trees after repeated barking. On the No. 2 Dennison, the more westerly part of the property, the red barks are much exposed and have not done well, the trees being small in size and showing a great many blanks. Even the crown barks on the upper portion are dwarfed, weather-beaten, covered with lichens, and have a thick outer coating of dry cracked bark. The red barks on this site might be uprooted and crown barks substituted. On the grass-land on the Napier estate too the red bark trees have proved a failure, and my recommendation is that they be rooted up and crown barks planted closely, say, at the distance of 4 × 3½ or 4 × 4 feet. Speaking generally the crown barks on all the higher and more sheltered parts of the Neddiwattum property have done well, but from inacquaintance with their habit of growth when first introduced, they have been planted too far apart. In most cases we might have had nearly double the number of trees on the ground. I will allude to the yellow and grey barks, and also specially to the mossing and coppicing systems and their effects on the trees further on.

* As my views regarding the appearance of the trees differ somewhat from those of Captain Campbell Walker, this may be due to the fact that we inspected them at a different period of the year, and that I have seen them oftener and probably watched their appearance more critically than he has done. I may also mention that the views of Dr. King as to the appearance of the older mossed red barks are identical with my own.

PYKARAH ESTATES.

WOOD ESTATE.

The trees along the "avenue," which leads from the upper part of the property to the lower sections, are mostly red and crown barks. Those at the upper end of the avenue evidently suffer greatly from the wind, especially the red barks. They are also densely covered with lichens, which generally happens when the trees are much exposed to the south-west monsoon, and are not thriving. The trees along the middle and lower parts of the "avenue" are larger and more vigorous, from being in a less exposed situation. Many of them, however, have failed to renew their bark properly under the mossing system. This may possibly be due in part to improper manipulation, as the estate is so distant from the Assistant Superintendent who lives at Neddiwattum, rendering it quite impossible for him to exercise the necessary personal supervision. At the bottom of the "avenue" we saw red bark trees being re-barked, and noticed that the renewed bark, although three years old, is remarkably thin. The specimens we saw could not be more than one-twelfth of an inch in thickness. It will therefore when dried be very light, and the crop will likely come short of estimate. In some instances the denuded surfaces left by the previous barking had failed to renew. Trees in this condition, when deprived of the remaining strips of bark, must inevitably perish. They should therefore either be left intact till covered with a complete coating of bark, or coppiced. We saw some grey barks at the lower part of the avenue, but they did not seem very flourishing. There are also a few yellow barks planted along the edge of the avenue road. They have all assumed a bushy habit and are dying back at the end of the young shoots. Time did not permit of our taking more than a bird's-eye view of the lower portion of the Wood estate, which is planted with red barks, but it appeared very *patchy*. Some portions contained trees of fair size, but large numbers are shrubby and miserable, and there are numerous blanks. It is possible that better drainage or more shelter is required in this situation, and if the latter, it might be afforded by planting some of the species of the eucalyptus. The store for the dried bark on this estate is in dangerous proximity to the drying-house.

HOOKER ESTATE.

The land in this property is all somewhat high and exposed, and as a rule the red barks have not done well. In some ravines they are vigorous and well grown, but there are large blocks in which they are either stunted or have assumed a bushy habit. Here, in some cases, as at Neddiwattum, the trees show a great tendency to run to seed. Large numbers of the stunted and bushy red barks might be uprooted and crown barks, thickly planted, substituted with advantage. The crown barks thrive here better than the red, but, as in the other plantations, have been planted too far apart. This could only be remedied now by coppicing and planting between the rows, as young trees planted under the shade and drip of the older ones never thrive. I consider the site of this plantation too high and exposed for red barks. The grey barks in shady ravines have grown better and look more healthy than on any of the other estates, so far as I have seen.

DODABETTA.

As this property was inspected by the Committee in their official capacity, my remarks will be brief. The trees on this estate may be said to be all crown barks, as the other species are few in number. On some of the higher and more exposed parts the cinchonas have assumed a bushy habit, and are not likely to increase in value. To save further expense in culture the plants in these patches should be uprooted and the ground allowed to revert to grass. Some of the older trees which have been repeatedly barked, as well as others with a southerly exposure, are beginning to flag and exhibit a somewhat sickly appearance. The remedy for these would be to coppice, and when this is done to plant young crown barks between the rows of stools, as the ground could carry twice as many trees as now exist. From the appended notes* regarding a series of trees carefully examined by Dr. King and myself, it will be seen that one of these semi-sickly trees, No. 1, A., had a perfectly healthy root, and would probably have yielded good coppice shoots. We also re-coppiced 3 of the 50 trees coppiced in 1878 with the view of ascertaining the yield of bark, and the tolerance of the stools as regards a repetition of the operation. Detailed information regarding our observations will be found in the annexed notes under No. 1, No. 2 and No. 3, and the stools should be marked with permanent labels bearing these numbers and their future progress carefully watched. It is perhaps scarcely fair to draw rigid conclusions from the results of this experiment, as the trees were originally badly coppiced and cut down at a wrong season; but so far as I am able to judge, crown bark coppice shoots on Dodabetta will require from 7 to 8 years to reach the stage at which they can be economically re-coppiced. The average yield of green bark per stool in this case was 5⅓ lb.† In appended notes, under No. 4, there will be found remarks regarding a tree coppiced in 1873, which we uprooted with the

* See page 45.

† The whole of the figures in this paragraph refer, of course, to green bark.

object of ascertaining the influence of coppicing on root development. The results of our examination were so far satisfactory, as they show that when coppicing is successful it induces a remarkable increase in the size and number of the roots of the plant. The root development in the case of this stool was much in excess of that observed in No. 1A, a semi-sickly tree, and even of that of No. 5, a healthy tree of the same age growing in close proximity to the coppice stool. The yield of bark from this tree was coppice shoots 6 lb., roots 5 lb., total 11 lb. The uncoppiced tree referred to as No. 5 in appendix, was uprooted partly with the aim of ascertaining the yield of bark from a healthy well grown tree as contrasted with the return from the semi-sickly tree No. 1A, and partly with the view of being able to compare its root-system with that of the coppiced tree of the same age, growing under precisely the same conditions. As already stated its roots were inferior in size and number to those of the coppiced tree. Both this tree and that referred to as No. 1A were planted in 1863, and each had been barked once. Their yield of bark was as follow when uprooted :—

	No. 1A, a semi-sickly tree.	No. 5, a healthy well grown tree.
	lb.	lb.
Boot bark	4	4
Stem	7	10
Branch	4	9
Total lb. ..	15	23

It will be observed that in both instances the weight of the root-bark was the same, but that the healthy tree gave eight pounds more of stem and branch bark than the sickly one. The yield of stem and branch bark of each tree examined was per annum of its age as follows :—

		lb.
Coppice shoots (of Nos. 1, 2, 3, and 4)	5 *years old* (average) ..	1·100
Semi-sickly tree, No. 1A,	15 *do.*	·733
Healthy tree, No. 5,	15 *do.*	1·266

The following figures give the yield of root-bark in each case per annum of age of the tree, viz., 15 years in each case :—

	lb.
Coppiced root	·333
Semi-sickly tree, No. 1A	·266
Healthy tree, No. 5	·266

For further particulars, see notes on page 18.

Yellow Barks *(Cinchona calisaya)*.—The number of trees of this species now growing on the estates is stated in Captain Campbell Walker's report to be 552, but I am inclined to think that he has under-estimated the number. *C. calisaya* embraces a great many varieties, and it is possible that he has classed some of these as hybrids allied to other species. In one corner of the Napier estate, on a sheltered dry slope, Dr. King and myself found no less than 14 varieties of the yellow bark, some of which are very different in appearance from the typical forms of the species. In the absence of flower and fruit, therefore, it is not at all surprising that Captain Campbell Walker should have regarded some of these as varieties or hybrids belonging to other species. There can be no doubt, however, that the mortality amongst the yellow barks has been very great, and that most of those remaining are in a more or less sickly state. On a private property in the neighborhood of Coonoor I saw one or two trees of this species in a much more vigorous condition than any on the Government estates, and another planter in that quarter is about to give the yellow barks a trial on a limited scale. It appears to me, therefore, that further experiments should be made in the culture of this very valuable species, under conditions different from those to which they have hitherto been subjected on the Government property. For instance, a small plot might be planted in some part of "Sim's Park" at Coonoor, where they could be carefully watched by Mr. Jamieson. I would also suggest a small experiment in forest-land, in a sheltered ravine at an elevation of from 3,500 to 4,000 feet, in the neighborhood of Neddiwattum. These trials, together with our past experience, would settle the question as to whether or not *C. calisaya* can be successfully cultivated in this part of India. It is reported that one or more plants of this species are thriving in or near the Devala district of Wynaad, but time did not permit of our inspecting them.

Grey Barks *(Cinchona micrantha, C. nitida, &c.)*.—The grey barks grow fairly up to a certain age, and then gradually die down. Mr. Rowson stated that, according to his experience, they are intolerant of barking and mossing, but we saw some on a private estate on the eastern side of the hills which had borne the operation fairly. This bark is not much valued as a commercial product, as it contains chiefly cinchonine. The principal consumption of grey bark is on the continent of Europe. It does not seem necessary, therefore, to continue the culture of species yielding grey bark.

Supply of Seeds and Plants to Planters.—The demands for these, both in India and Ceylon, are very large and rapidly increasing. At Dodabetta and Neddiwattum seeds are collected and the propagation of young plants carried on to meet those demands. The price of seeds is at present As. 4 per ounce, and of plants Rs. 10 per thousand, these rates being considered sufficient to cover the expense of collecting and packing the seeds, and of raising and packing the seedlings. I question, however, if Rs. 10 per thousand covers the expense of propagating plants raised under glass from cuttings, and it seems desirable therefore that the charge for these should be revised. Considering the activity with which cinchona culture is now being carried on by private individuals in India and Ceylon, and that they chiefly depend on the Government plantations for supplies of seeds and plants, it seems necessary that more special arrangements should be made to meet such demands, as the encouragement of cinchona culture will indirectly promote the object which the Government had in view in starting their plantations, viz., the provision of a cheap febrifuge for the people of India. Every additional acre of land brought under cinchona culture will increase the supply of bark, and thereby reduce its price and that of its products. As matters now stand seeds and plants are reared and distributed under the restriction, that this task is not to interfere with more important work.* This order, it appears to me, should be modified, and a special establishment provided for the supply of plants and seeds; the charge for issues being sufficient to cover actual cost to Government. With regard to the culture of seeds there are some suggestions which I have to offer, with the view of maintaining the vigor and purity of species. As is well known, cinchonas have a great tendency to cross-breeding, and from past experience it may be regarded as an established fact, that purity of stock cannot be secured when different species are cultivated in the same neighbourhood. At present too the supplies of seeds are chiefly collected from trees which have been subjected for a series of years to barking and mossing, by which their natural vigor has been more or loss impaired. To secure supplies of absolutely true and healthy seed it would be desirable to have small preserves of standard trees left intact as seed-producers, and grown in isolated spots so as to be beyond the risk of hybridisation. Regarding cinchonas under culture, Weddell, the great French authority on the botany of the family, says that, admitting their tendency to produce cross-breeds, "if we attach any importance to the preservation of purity of race, it is principally to slips that we must have recourse for the purpose of propagation." There can be no doubt, however, that plants raised from seeds in the manner suggested, would be quite true to species and preferable in every respect, while their propagation would involve less trouble and expense.

G.O., Revenue Department, No. 274, of 20th February 1878. See para. 4.

Coppicing and Mossing.—The bark crop has hitherto been, I may say, exclusively harvested by Mr. McIvor's mossing process. Some of the older crown bark trees have been barked and mossed four times, and some of the older red barks six times. Both species have shown a wonderful tolerance of the operation, but there are now obvious symptoms of the process having affected the vigor of the older trees. At the present time some of the trees which have been frequently barked evince various signs of declining vitality, such as less luxuriant foliage, great tendency to flower and seed even on the top and upper side shoots, tardy renewal of bark, and renewed bark comparatively thin. The original estimate of the average time required for the renewal of bark on mossed trees was 22 months, but at present renewed bark on the older trees is rarely fit for lifting under three years, and even then it is often as thin or thinner than natural bark. This slow rate of renewal and the thin condition of the bark of course affect considerably the yield from trees cropped under this system. One marked characteristic of the older mossed trees is the comparatively small amount of branches and leaves which they bear—a deprivation which must of necessity diminish the vigor and arrest the development of the plant. Repeated observation also demonstrates that the mossing process necessitates constant and intelligent supervision of the labourers, and the results of careless manipulation are evident in some of the less accessible estates on which it was impossible for the superior officers to give the barking the necessary attention. I am now of opinion, however, that the mossing system is a good and economical one up to a certain stage of the life of the tree. I would therefore in the case of both red and crown barks propose to bark and moss four times, which would secure one crop of natural bark, one of mossed natural bark, and two of renewed bark. On the completion of the fourth stripping moss should again be applied, and kept on till complete renewal takes place. At this stage, that is before the trees begin to flag, I would propose to coppice. This would bring in a third and large crop of renewed stem bark, as well as some natural stem and branch bark. As yet we have had little or no experience of the ability of a mossed tree to throw up coppice shoots, but, provided the mossing system is not pursued too long, there can be no doubt that the stool of the cut tree will retain its vitality and produce vigorous shoots. In the case of the red barks too it is highly probable that it will be found practicable to subject their larger coppice shoots to the mossing process, and thus again secure further harvests of mossed and renewed barks. It seems to me that this combination of the two systems of harvesting deserves serious attention, and that a coppicing experiment on a block of the older mossed trees should be carried out next dry season, when the trees are at rest and not likely to bleed.*

* This portion of my notes was read to Dr. King and he quite agreed with me in my views as to the present state of the older mossed trees, and the propriety of combining the mossing and coppicing systems.

As has been repeatedly pointed out by others as well as myself, the trees hitherto coppiced have been felled at a wrong season, and the operation improperly done. The only approach to a fair trial of the coppicing system was in the experiment carried out on the Dennison estate in 1871. Two hundred trees were operated on, and notwithstanding various defects, all the stools with one exception survived. The shoots on these are now vigorous and strong, and one of the largest, measured by Dr. King and myself, was about 20 feet high, and girthed 15½ inches at the height of 4½ feet above the level of the ground. Nearly every stool in this plot carries two or more shoots, and in most instances they are so well developed at their lower ends, that nearly every trace of the old stumps has disappeared. These shoots are, as a rule, much larger than trees of the same age raised from seedlings would have been. I am of opinion that the time has now arrived when these stools ought to be recoppiced, and, as the experiment will be one of much interest and importance, it should be conducted with the greatest care. It is further desirable that a sample of the coppice bark should be sent home for analysis. The opportunity might also be taken to spare some of the larger shoots and subject them to the mossing system. From an examination of the root of a coppiced tree, referred to in the notes on the Dodabetta estate, it is evident that root development is increased by the operation of coppicing. While at Neddiwattum we had the privilege of seeing Mr. Rhode's experiment in coppicing red barks, on his estate at the upper end of the Ouchterlony Valley. Shoots have sprung very freely from the stools in this case, and nothing could be more satisfactory than their size and vigor at the present time. Intermixed with the coppiced trees there are numbers which have been barked and mossed, and looking from the opposite side of the valley the coppice shoots can at once be recognised by the richer green and greater luxuriance of their foliage.

Hybridisation.—As this subject is specially referred to in the general report of the Committee, my remarks will be brief. The tendency to cross breeding in cinchonas, as elsewhere remarked, is so strong, that no contrivance can prevent it if different species are grown near each other. In the various reports of the late Superintendent repeated allusion is made to hybrids possessing valuable qualities, but as he left no special record of his experiments and observations, it is now very difficult to ascertain the plants referred to, and the results of much valuable experience have been lost. At the present day there are numbers of hybrids on the estates, but as a rule their origin and qualities are unknown. One of these, a very hardy, smooth-leaved, quick-growing tree, belonging to the red bark family, is said to be worthless as an alkaloid producer, but it is desirable that further specimens of its bark should be subjected to analysis. Again there is a hybrid called *C. pubescens* of vigorous growth and hardy constitution, from the bark of which Dr. DeVrij obtained 10·67 per cent. of total alkaloids, of which 4·72 per cent. was crystallised sulphate of quinine. Mr. Howard also analysed a specimen of the same bark at a later date, and got a total of 12·20 per cent. of the sulphates of the alkaloids, of which 6·00 per cent. was sulphate of quinine and 5·00 sulphate of cinchonidine. Mr. Howard speaks of this as a variety of *officinalis*, but the specimens submitted to Dr. King and myself from the same tree show, that it is a hybrid with a strong strain of the *officinalis* family, and apparently a cross between *C. officinalis* and *C. succirubra*. The specific name of *pubescens* which has been applied to it is unfortunate, as it has already been given to a distinct species, viz., *C. pubescens*, Vahl. There seems to be some further confusion regarding this Nilgiri hybrid known as *pubescens*, as on a private estate I found the owner diligently propagating a kind quite different from the tree pointed out by Mr. Rowson as the true *pubescens* of Messrs. McIvor and Howard, which yielded such remarkable results on analysis. The plants referred to on the private property seem more allied to the red than the crown barks, but this may be due to their having been raised from seed and thus partly reverted to the type of one of the parents. This confusion and uncertainty indicates how much has yet to be done in the matter of hybridisation, and how necessary it is that all such experiments should be conducted with the utmost care, and the results recorded with mathematical precision. It also seems desirable that a typical tree of each hybrid and variety should be labelled, so as to prevent confusion and to admit of ready reference. Accurate records of their history and qualities should also be kept up, and be accessible to individuals engaged in or interested in cinchona culture.

Valuable species or varieties of Cinchona.—On certain estates belonging to private owners there is a variety, locally termed *C. lanosa*, being largely propagated, but as nearly all the plants are still young, it was only after a prolonged search on several of these estates that satisfactory specimens in flower and from a well grown tree were secured. These specimens are now before me, and indicate that *C. lanosa* is nearly allied to the "strong growing" crown bark of the Government estates. Its obvious good qualities are its vigorous growth and hardy constitution, which permit of its being successfully cultivated under widely different conditions as to elevation, temperature and moisture. No very definite information could be obtained as to its alkaloid yielding qualities, but as the late Mr. McIvor was interested in the estates on which it is being planted, it is probable that he selected it partly on account of the value of its bark. It is said to come true from seed—a circumstance which, if correct, supports the view that it is a variety and

not a hybrid. None of the officials on the Government estates could afford any reliable information as to its origin and history, and so far as could be ascertained there is not a tree in the Government plantations which agrees exactly with this *C. lanosa*. The specific name *lanosa* which has been given to it is inappropriate, as the leaves of the typical trsees seen in two different localities are smooth and not *woolly*. In vigor of growth and size of stem it is more like a red than a crown bark tree, and promises to be a very valuable acquisition to the owners.

On the Dodabetta plantations there is a variety of crown bark called "strong growing" by the late Superintendent which is deserving of notice. It is at once distinguishable amongst other crown barks by its more robust habit and larger leaves. It is said to be very quick-growing, especially hardy, and to yield a rich bark. I was also informed by the Overseer Narrainsawmy, who is very observant and has a very retentive memory for facts connected with his charge, that it renews its bark quickly and that the renewed bark is thick and good. Owing to the superior size of its stem too it will yield a larger amount of bark than the ordinary varieties of crown bark trees. It is very desirable therefore that this "strong growing" variety should be largely propagated.

There are at Neddiwattum two very distinct varieties of red bark, viz., one with the ordinary leaves, smooth above and slightly pubescent below, and the other with leaves slightly pubescent on the upper and very pubescent on the lower surface. The latter is more robust and hardier than the smooth-leafed variety, and is said to yield superior bark. We found the pubescent kind much more common on private estates than on the Government plantations. I would recommend that special analyses be obtained of the bark of the pubescent and ordinary variety of red bark, from trees of the same age and growing under precisely the same conditions. This would settle the question as to the comparative merits of their bark; but even if they should be found equal in alkaloid-yielding properties, it would be desirable to encourage the culture of the hardier and more robust pubescent variety.

Decline in the amount of Alkaloids in Nilagiri Barks.—The most recent analyses of Madras barks by Dr. Paul and Mr. Howard show a very marked decline in their total yield of alkaloids. Eleven samples of crown barks from Neddiwattum, Dodabetta and Pykarah were submitted to Dr. Paul, and the results of his investigations show a great deterioration in the quality of mossed, unmossed and renewed bark. For the actual figures see G.O., Revenue Department, No. 715, of 8th May 1878. In the report by Mr. Howard he does not give the percentage of alkaloids found by him, but states generally that "the *officinalis* of each plantation shews a deficiency in alkaloid of each of the three sorts, the renewed and unmossed shewing it the most: the quinine is deficient on the average 10 per cent. compared with last year." He further states "I have found a similar deficiency in the *officinalis* from another private plantation, the crops of which I could compare in a similar way." "The renewed *succirubra* bark shews an even more marked inferiority, the average of this year's crop is about 25 per cent. deficient in quinine, and though the total alkaloids is less, the deficiency is in the quinine, the cinchonidine being more than last year." Unfortunately the ages of the trees from which the barks submitted for analyses were taken are not given. It is therefore impossible to say exactly whether this deterioration may not have been partly due to the age of the bark, Mr. Broughton having pointed out that certain changes take place in the alkaloid constituents of cinchona bark according to age. On the whole, however, as the inferiority is so general and not confined to one species, I am rather inclined to believe that the decline both in the quantity and quality of the alkaloids was due to climatic influences, the two past seasons having been particularly trying to all kinds of cultivated plants. The occurrence of such deterioration in bark shows how essential it is, that there should be a scientific officer in charge of the estates able to watch and investigate such changes, and, with the aid of the chemist, to seek out their causes.

G. BIDIE, M.B.

Ootacamund,
31*st August* 1878.

APPENDIX TO NOTES ON DODABETTA ESTATE.

(*See Page* 41).

Memorandum as to Cinchona officinalis trees on the Dodabetta Plantation, examined and barked by Drs. King and Bidie on the 14*th August* 1878.

No. 1A.

A specimen of *C. officinalis*, planted in 1863, growing in splendid black soil on the slope of the ravine within a quarter mile of the entrance to the estate, proceeding from the garden. This

tree was not in a very healthy state, and was a fair sample of many such on the plantations. It was barked once in 1877, and being then in a semi-sickly state, the bark did not rise freely. The bark also renewed slowly and imperfectly. It was uprooted in our presence and yielded as follows:—

	lb.
Root-bark	4 very thin.
Stem-bark	7
Branch-bark	4
Total	15 lb. of green bark.

The stem was cut across at the crown of the root, as if for coppicing, and showed fine healthy tissues. The roots were also healthy, and it is fair to presume that if this tree had been carefully coppiced at the proper season, it would have given off healthy shoots. The stem was not in a healthy condition, and would probably have died in course of time.

No. 1.

One of the fifty trees of *C. officinalis* planted in 1863 and coppiced in 1873. I saw these trees in September 1873, and they were then bleeding most profusely. The coppicing had also been done in such a manner that it is simply wonderful that they survived the operation. The stem had been coppiced in 1873 about one foot above the surface of the ground, and bore nine sturdy shoots. These were carefully removed with a saw and the cut surfaces dressed. The nine shoots yielded of green bark somewhat thin in character, as follows:—

Bark	8 lb.

We left on this stool some twelve small side-shoots, all small, coming off below the coppiced surface and not true coppice-shoots.

No. 2.

Also one of the fifty *C. officinalis* trees planted in 1863 and coppiced in 1873. This stool bore six coppice shoots, which were removed together with about three inches of the old stool, which left a fine surface of living wood and healthy bark. The surface of the stool having been dressed, the bark of the coppice shoots was removed. It was thin, as in No. 1, and weighed 5 lb. in the green state.

No. 3.

Another of the fifty *C. officinalis* trees planted in 1863 and coppiced in 1873. This stool bore three large and three small shoots, which were removed along with about two inches of the stool so as to get rid of the dead and reach the living wood. Cut surface having been dressed, the bark was removed from the shoots and found to weigh 3 lb.

The total yield of green bark from the three coppiced trees was therefore as follows:—

	lb.
No. 1 Stool Coppice Bark	8
,, 2 do. do. do.	5
,, 3 do. do. do.	3
Total	16

Average yield of bark per tree 5⅓ lb. As the coppice shoots are five years old, the produce of green bark has been at the rate of about 1 lb. per annum. I requested the Overseer to mark the stools Nos. 1, 2 and 3 with permanent wooden labels, so that their future progress may be carefully watched.

No. 4.

This was also one of the trees of *C. officinalis* planted in 1863 and coppiced in 1873. It being of great importance to ascertain the state of the roots in coppiced trees, this stool was uprooted and a vertical section made down the centre of the stool. Both in number and in size the roots greatly exceeded those of tree No. 1A, also uprooted, and with few exceptions were healthy. Judging from this specimen, coppicing, when shoots come off freely, seems to have the effect of increasing the root development. Owing to the number and tangled nature of the roots the removal of their bark was attended with some difficulty and not very perfectly performed, but it was considered preferable to sacrifice a little bark rather than to cut up the roots and so destroy the distinctive characteristics of the specimen. The green bark weighed as follows:—

	lb.
Bark of coppice shoots	6
Do. of roots	5
Total	11

The sections of this stool, marked No. 4, are herewith forwarded. It will be observed that the wood is generally sound, except small portions on the upper coppiced surface and on one side. Considering that this tree was coppiced at a wrong season and carelessly handled, the results show how tolerant this species is of the operation of coppicing.

No. 5.

This tree, an uncoppiced one, was selected as a contrast to No. 1A, it being in a healthy state. It was growing immediately below the patch of fifty trees coppiced in 1873. It was planted in 1863 and had been barked once in 1877. It was of good size and looked, as already stated, quite healthy. It was uprooted, and on examination the roots were found very much on a par as to size and number with those of No. 1A. The roots, marked No. 5, are forwarded for examination and comparison with those of No. 4 belonging to a coppiced tree. It will be observed that they are much less developed than those of the latter. The stem bark did not rise very freely and the renewed portions, one year old, are rather thin. As in No. 4, it was found impossible to remove the root-bark quite perfectly without injuring the roots and so damaging the specimen. The yield of bark was as follows:—

	lb.
Root-bark	4
Stem-bark	10
Branch-bark	9
Total	23

It will be observed that the above yield from a healthy tree contrasts very favorably with the return from the semi-sickly tree No. 1A, the total harvest in that case having amounted to only 15 lb. The whole of the bark referred to in these notes has been handed over to Mr. Lorne A. Campbell, to be reweighed when dry.

G. BIDIE, M.B.

OOTACAMUND,
15*th August* 1878.

APPENDIX D.

London Bark Sales—Jenkin and Phillips.

Date.	South American Barks.						East Indian Barks.					All other Barks.
	Calisayas.	Carthagena.	Columbian.	New Granadian.	Other American Varieties.	Total American Barks.	Madras and Nilgiri.	Darjeeling.	Ceylon.	Unspecified.	Total East Indian Barks.	
1876.												
February 10th and 15th	391	143	...	...	121	655	...	...	...	14	14	98
April 6th and 11th ...	659	...	515	...	99	1,273	...	...	...	170	170	251
April 25th	313	...	1,495	56	331	2,195	...	...	...	9	9	69
May 4th and 9th	231	...	54	34	...	319	636	...	29	25	690	164
June 16th and 20th ...	342	...	448	93	66	949	...	...	...	31	31	38
July 13th and 18th ...	220	7	925	58	47	1,257	...	...	...	15	15	54
July 27th and 1st August ...	184	...	690	39	156	1,069	...	...	47	6	53	97
August 10th and 15th ...	182	...	557	335	7	1,081	...	...	99	...	99	97
August 24th and 29th ...	406	186	850	163	107	1,712	...	...	...	14	14	167
September 21st and 26th ...	261	200	760	...	118	1,339	...	...	...	49	49	200
October 5th and 10th ...	349	...	141	93	550	1,133	...	...	...	25	25	90
Total ...	3,538	536	6,435	871	1,602	12,982	636	...	175	358	1,169	1,428
1877.												
January 11th and 16th ...	297	20	388	71	155	931	...	...	36	87	123	152
January 25th and 30th ...	217	45	66	18	259	605	...	...	2	49	51	14
February 12th and 13th ...	561	25	264	67	209	1,126	...	...	10	17	27	86
February 22nd and 27th ...	522	12	...	...	357	891	...	...	24	12	36	172
March 8th and 18th ...	601	44	352	114	111	1,222	12	55	...	132	199	499
March 22nd and 27th ...	334	226	263	175	52	1,050	...	83	...	42	125	226
April 5th and 10th ...	307	103	203	107	346	1,066	159	100	...	81	340	9
May 5th and 8th ...	571	4	307	64	120	1,066	20	260	...	39	319	182
May 17th and 24th ...	576	207	404	...	559	1,746	...	32	...	75	107	181
June 14th and 19th ...	216	140	679	15	118	1,168	...	108	76	108	292	72
June 28th and July 3rd ...	710	12	...	74	83	879	...	85	1	78	164	15
July 12th and 17th ...	246	...	1,128	...	57	1,431	...	...	3	27	30	19
July 26th and 31st ...	277	110	1,370	...	125	682	134	115	...	49	298	99
August 9th and 14th ...	291	38	1,195	...	54	1,578	...	93	43	...	136	2
August 23rd and 28th ...	361	300	1,230	86	140	2,117	26	204	45	72	347	104
September 6th and 11th ...	286	172	1,460	...	81	1,999	104	...	7	13	124	95
October 4th and 9th ...	215	60	285	...	112	772	34	...	4	47	85	94
November 15th and 20th ...	212	172	1,157	340	96	1,977	...	...	8	7	15	273
November 29th and Dec. 4th ...	254	21	936	163	185	1,559	29	74	590	...	693	161
December 13th and 18th ...	311	104	944	130	58	1,547	85	...	16	...	101	240
Total ...	7,365	1,815	12,631	1,424	3,277	26,512	603	1,209	865	935	3,612	2,595

The figures refer to "bales," "packages," or "serons."

APPENDIX E.

Account of Receipts and Expenditure on account of the Cinchona Plantations from the commencement up to the close of 1875-76 taken from the Accountant-General's Books, Returns of Sale from India Office, and other sources.

Years.	Receipts. Value of Bark supplied to the Quinologist.	Value of Bark sent to England.	Value of Bark supplied to other Governments and Cash Receipts.	Total.	Charges. Establishment including Superintendent's Salary.	Buildings and Plant.	Other Charges.	Value of Convict Labor.	Interest on Balance of Charges.	Total.
	1	2	3	4	5	6	7	8	9	10	11
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1860-61	...	...	...	...	...	...	4,821 5 0	...	...	4,821 5 0
1861-62	...	...	...	...	...	...	22,914 15 4	...	216 15 4	23,131 14 8
1862-63	...	...	...	...	...	...	48,390 0 0	...	1,257 14 4	49,647 14 4
1863-64	...	...	...	...	...	...	53,173 9 2	...	3,492 0 10	69,392 8 7
1864-65	...	...	...	...	...	...	59,666 12 0	...	6,614 11 5	90,726 0 4
1865-66	...	...	...	...	...	...	58,887 5 0	...	10,697 6 2	98,734 9 2
1866-67	...	...	...	...	...	3,700 0 0	52,632 0 0	48,666 10 8	15,140 7 1	1,43,267 11 7
1867-68	...	...	...	...	...	3,025 0 0	43,295 14 4	48,666 10 8	19,687 7 6	1,40,337 3 7
1868-69	...	...	...	...	...	2,600 0 0	30,636 1 0	48,666 10 8	27,779 7 8	1,34,783 11 2
1869-70	...	...	...	...	...	1,650 0 0	19,163 0 0	...	33,769 2 3	80,365 7 7
1870-71	...	...	...	...	...	300 0 0	6,143 0 0	...	37,317 8 6	67,490 13 10
1871-72	...	...	...	...	...	850 0 0	13,160 4 9	...	40,143 10 0	71,811 4 1
1872-73	...	...	...	...	...	550 0 0	16,441 0 0	...	42,766 10 3	72,481 10 3
1873-74	...	...	...	...	...	558 0 0	15,091 14 0	...	45,064 5 1	73,288 3 1
1874-75	...	...	...	...	...	1,700 0 0	17,417 0 0	...	45,758 13 5	81,282 5 5
1875-76	...	...	...	...	...	1,550 0 0	27,423 0 0	...	49,018 5 3	95,225 5 3
	0 5	2,63,793 2 3	...	...	...	18,513 0 0	4,89,257 0 7	1,46,000 0 0	3,78,724 13 1	12,96,287 15 11
	14 10	12,467 7 2	...	...	...	...	58,408 14 10	...	50,495 4 3	1,21,371 10 3
	15 3	2,76,260 9 5	...	...	...	18,513 0 0	5,47,665 15 5	1,46,000 0 0	4,29,220 1 4	14,17,659 10 2
		61,939 8 4	1,04,976 11 9	1,74,171 0 5						
1876-77		...	4,33,746 9 4	4,36,804 14 10						
		61,939 8 4	5,38,723 5 1	6,10,975 15 3						

	Rs. A. P.
Net Results.	
Total charges up to 1875-76	12,96,287 15 11
Total receipts do.	1,74,171 0 5
Net charges	11,22,116 15 6
Add charges of 1876-77	1,21,371 10 3
	12,43,488 9 9
Deduct receipts of 1876-77	4,36,804 14 10
Net charges up to 1876-77	8,06,683 10 11

APPENDIX F.

GOVERNMENT OF MADRAS.

REVENUE DEPARTMENT.

27th June 1877, No. 2,129.

Read the following paper :—

From J. W. B. MONEY, Esq., to the Hon. D. F. CARMICHAEL, Chief Secretary to Government' Fort St. George, dated Ootacamund, 4th June 1877.

I HAVE the honor to acknowledge the receipt of your letter of the 22nd ultimo, informing me, by order of His Grace in Council, that the whole of my correspondence relating to the Government Cinchona Gardens on the Nilgiris is under the consideration of His Grace.

2. I am aware of the difficulty felt by Government in the matter. They have, of course, no wish to injure me by the continued infringement of their promises, but at the same time they see no practicable mode of making their bark available for the troops and the people of India without a large expense, and the establishment of a Quinine Manufactoty with doubtful success as to the results.

3. It was with a view to meet this difficulty that, in my letter to the Secretary of State of June 1875, I proposed, as an alternative, to buy the Government Gardens. But, as I told you in my interview in Madras on the 21st ultimo, my real object is to avoid the loss in Europe caused me by the competition of the Government bark in the European markets. It occurs to me that another solution is open which might, perhaps, meet the views of Government.

4. It was only in about 1825 that the febrifuge alkaloids and the mode of extracting them from the bark were discovered. For the previous two centuries mankind had been contented and derived inestimable benefits from mere decoctions, so well known to our ancestors as Jesuit's Bark.

5. For the troops and the people of India it will surely be sufficient to give them what sufficed our ancestors for two centuries without resorting to the more complex and delicate machinery required to extract the alkaloids from the bark, and to exhibit each alkaloid separately.

6. Should Government agree with me in this, I would offer to convert the bark of their gardens into a most efficacious decoction at no cost to Government, but that of buying the decoction ready made at the moderate rate of one rupee (Rupee 1) per quart bottle.

7. We have now for some years been making a similar decoction for the use of our own people with eminent success. The late Mr. Samuel Wauchope, a Bengal Civilian, my partner, took several bottles of this decoction with him to Hoogly in Bengal and administered it gratuitously, as far as it went, to the fever-stricken population of that district. It acquired so instantaneous a reputation that he was besieged by crowds who had walked over 50 or 60 miles to get a drink of it.

8. If the Government would make over their gardens on the Nilgiris to me to apply their bark to this purpose, I would undertake to supply them with any quantity of this decoction, which they please to take, up to the full bark produce of the gardens, at one rupee (Rupee 1) quart bottle delivered at the garden, each bottle of which should contain a ¼ lb. of dry bark pounded and the remainder pure alcohol. This rupee per bottle would give a small profit, from which at the same time I would cultivate and carry on the gardens at my own expense.

9. This solution would enable the Madras Government to apply their gardens to the noble purpose for which they were first established, to supply a cheap febrifuge to the people of India and would at the same time achieve my object in relieving me from the competition of the Government bark in the European market.

10. Should His Grace in Council be willing to entertain this proposal, I would afford full information as to the preparation of this decoction, and supply samples of it for the testing and report of the Government medical authorities.

11. This decoction has none of the objectionable qualities which have made Mr. Broughton's preparations and those of the Bengal Government of so little practical use. It is nothing but pounded bark and alcohol, the original Jesuit's Bark of our ancestors.

ORDER THEREON, 27th June 1877, No. 2,129.

RECORDED, with an intimation that if Mr. Money will send specimen of his decoction to the Surgeon-General, Indian Medical Department, inquiry will be made into its efficacy as a febrifuge.

(True Extracts)

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

22nd August 1878, No. 1,351.

Read the following paper :—

From Surgeon-General G. SMITH, M.D., Indian Medical Department, to C. G. MASTER, Esq., Secretary to Government, Revenue Department, dated Fort St. George, 8th August 1878, No. 447.

ADVERTING to the orders of Government marginally cited, I have the honor, in submitting a tabular statement showing the results of certain experiments on the therapeutic action of Mr. Money's tincture of Cinchona, to offer the following remarks for the information of His Grace the Governor in Council.

G. O., No. 2,129, dated 27th June 1877.
" " 2,559, " 23rd August 1877.
" " 2,641, " 4th September 1877.
" " 1,055, " 11th July 1878.

2. Mr. Money obligingly placed at my disposal 100 quart bottles of his tincture prepared from crown and 100 from red bark. The precise mode of preparing the tincture was not indicated, but the ingredients were stated to comprise five ounces of pounded dry bark to the quart bottle* of "pure alcohol." Mr. Money refers to the preparation as a "decoction," but as the more accurate term would be tincture, I shall use that designation in this communication.

* The average capacity of a quart bottle is about twenty-five fluid ounces.

3. The supply of Mr. Money's tincture was distributed to the Medical Officers of Civil Dispensaries, &c., at the stations marginally noted along with a memorandum from this office which is embodied in the Proceedings of Government (Revenue Department), No. 2,641, dated 4th September 1877. The reports called for having come to hand the principal facts in connection with the inquiry will be found arranged in a tabular form in the appendix.

1. Guntoor.
2. Bellary.
3. Kurnool.
4. Coimbatore.
5. Salem.
6. Calicut.
7. Mysore.

4. Stated broadly the conclusions arrived at are that Mr. Money's tincture cannot act as a substitute for quinine in the treatment of the severer forms of malarial fever, or in those cases in which local complications exist; that in less severe cases its action, even when successful, is slower and more uncertain than that of quinine, and that quinine has at times to be used to complete the antiperiodic action of the tincture; that in ordinary uncomplicated cases it acts at times as satisfactorily as quinine; that its therapeutic value is probably not inferior to that of the secondary alkaloids; and that it is to be regarded as a useful antiperiodic and general tonic.

5. Certain drawbacks to the employment of the tincture have also been alluded to. In severe cases of malarial fever and in those complicated with local inflammations the administration of large doses of Money's tincture would be most dangerous, owing to the large proportion of "pure alcohol" present in the preparation. A further drawback to the tincture is to be found in the fact that under its use nausea, vomiting, diarrhœa, and dysentery sometimes occur, proving that the preparation is not free from toxic elements possessing an action of serious importance when fever patients are reduced in strength by debilitating causes.

6. It is seldom that medical men use the tincture of Cinchona of the British Pharmacopœia except as a valuable addition to the decoction or infusion of bark, for the simple reason that administered *per se* in severe cases the dose must necessarily be large and contain an inconveniently large proportion of proof spirit. The objection is more serious in the case of the tincture prepared by Mr. Money, inasmuch as he uses pure alcohol in lieu of proof spirit. In other respects the two tinctures differ very little except that the tincture of the British Pharmacopœia is made from the yellow bark, whilst Mr. Money's tincture is from the crown and red barks. The tincture of the pharmacopœia is a preparation carefully made by percolation, whilst that of Mr. Money is probably only a somewhat unscientific imitation of the pharmacopœial tincture. The tincture of the pharmacopœia, however, is not so rich in alkaloids as that of Mr. Money.

7. There is, however, one great objection to the general use of Mr. Money's preparation in connection with the supply of an antiperiodic cheap and efficient among the masses of the people, and that objection has reference to bulk. Each quart bottle contains but twenty-five one-ounce doses, or fifty-four drachm doses; consequently the expense of transporting the preparation throughout the Presidency would be so great as to amount to an actual prohibition of its use. I may be permitted to add that whilst acknowledging the value of Mr. Money's tincture as an antiperiodic in ordinary and uncomplicated cases of malarial fever, I am inclined to look in another and totally different direction for a cheap and efficient febrifuge which from its portability, safety, and proved potency will be likely to accomplish all that can be desired in the way of meeting the medical wants of the fever-stricken masses of this Presidency.

Results of Experiments with Money's Tincture of Cinchona Bark with reference to the Orders of Government, Revenue Department, Nos. 2,129 *of* 27*th June* 1877. 2,559 *of* 23*rd August* 1877, *and* 2,641 *of* 4*th September* 1877.

Station.	Medical Officer.	Type of Fever.	Number of Cases Treated.	Number of Days under Treatment.	Average Dose administered.	Special Therapeutic effects noted.	Results. Successful.	Results. Unsuccessful.	Remarks by the Medical Officer conducting the experiments.
Guntoor ..	Surgeon P. J. Farrell, M.B. A further report promised but prevented by the death of the Medical Officer.	Intermittent ..	5	1 day.	ʒss to ʒij four times a day.	Stated to have a primary stimulant and secondary sedative effect. Its administration up to doses of ʒij has not been attended with any symptoms of Cinchonism. Useful in some cases of long continued suppuration attended by great prostration.	4	5	"Had to cease its administration (in ʒi doses) and give quinine in 4 grain doses which cut short the fever."
		Do. ..	4	1 day.	ʒij four times a day.				Experience too limited to report "on its advantages or otherwise," but found it so far a valuable as it is a pleasant antiperiodic in dose of ʒij. Used it "with most apparent advantage in some cases when malaria was as it were lurking about the system constantly showing itself in a subdued form."
Bellary ..	Surg. Lionel Beech.	Slight intermittent.	A large number.	A little over 2 days.	Half a drachm crown bark tincture.	Found when administered in either large or small doses to patients who were also suffering from general debility it had a tendency to produce diarrhœa, but is doubtful whether this is really due to the tincture; occupies a place between quinine and the other alkaloids of Cinchona.	A considerable number.	..	Similar cases were contemporaneously treated with 2 grain doses of Cinchona alkaloids other than quinine and with like results.
Do. ..	Do. ..	Severe cases of ague.	A few ..	3½ days ..	Two drachms of the crown bark tincture.	....	..	..	Similar cases were contemporaneously treated with 5 grain doses of the Cinchona alkaloids and with like results.
Do. ..	Do. ..	Very severe intermittent.	Very few.	7 days ..	More than ʒij crown tincture.	....	Very few.	..	Cases of same type treated with over 5 grain doses of quinine gave similar results.
Do. ..	Do. ..	Do. ..	Do. ..	..	6 drachms ..	....	..	All ..	Of these one or two cases were complicated with delirium, and all yielded immediately on the administration of quinine in 10 grain doses. "Considers that this drug will never supersede quinine; up to a certain point it may be used with benefit, and like the other Cinchona alkaloids, must give way to quinine; thinks in mild or moderately severe cases it may be substituted for quinine. Used it for children in doses of a few drops up to ʒj according to age without any deleterious effect. To sum up thinks "it is an antiperiodic that ought to be in all hospitals."

Kurnool ..	Surgeon J. Fitzpatrick, M.D.	From the simple quotidian to severe remittent.	17	5	ʒj crown bark tincture three times a day.	In the treatment of the severer forms of malarial fevers it was found quite useless. Found its action generally uncertain, and that it never had any decided effect until the fourth or fifth day. The disadvantages experienced in its use were (*a*) its uselessness except in mild cases; (*b*) it frequently gives rise to nausea and vomiting; (*c*) sometimes diarrhœa; (*d*) no action even in mild cases before the fourth or fifth day; (*e*) no effect whatever in the severer forms of malaria when quinine acts so magically.	51	29	To the 29 cases which proved unsuccessful in five days quinine had to be given and effected a cure.
			63	..	ʒij crown bark tincture three times a day.				The 26 unsuccessful cases were finally treated with quinine in doses of from 3 to 4 grains three times daily and got well on the third day under this change of treatment.
			16	5	ʒj red bark tincture three times a day.				
			54		ʒij red bark tincture three times a day.		44	26	
									Found no difference in the relative value of the crown and red bark tinctures. Tried the tincture of crown bark in ʒj doses three times a day in twelve cases of children "all of whom were cured in an average of six days;" at the same time in 27 other cases of children gave quinine in doses of 3 grains three times a day which cured them on an average in three days. Considers its therapeutic value so far as rapidity of action is concerned "much inferior in mild cases" in the treatment of which only he found it of use.
Nellore ..	Surgeon-Major A. M. Ross.	"Uncomplicated cases" of intermittent (7 cases doubtful).	65	2·89	ʒij (2 drachms) ..	In two cases treated with Money's tincture the fever ran very high, and the dose of the tincture was raised to 4 drachms with the immediate effect of lowering the temperature and checking a return of the paroxysm. "In no case did the tincture appear to give rise to any nervous symptoms," the headache noted in a few being of the character generally observed when the disease is not treated at all, as was also the vertige complained of by a few.	65	..	The cases were not specially selected except as regards absence of complications. During the period they were in hospital 28 cases of a similar character were treated with quinine in 5 grain doses three times a day. Of these two were doubtful. The average number of days under treatment was 3·53.
									The experience of this reporter leads him to set a high value on it as an efficient (I believe a cheaper) substitute for the other Cinchona preparations. He states that taking everything into account Money's tincture in 2 drachm doses was slightly more successful than quinine in 5 grain doses, and the addition of alcohol is in many cases valuable; he prefers it in ordinary cases to quinine.

Results of Experiments with Money's Tincture of Cinchona Bark with reference to the Orders of Government, &c.—(Continued).

Station.	Medical Officer.	Type of Fever.	Number of Cases treated.	Number of Days under Treatment.	Average Dose administered.	Special Therapeutic effects noted.	Results. Successful.	Results. Unsuccessful.	Remarks by the Medical Officer conducting the experiments.
Coimbatore.	Surgeon-Major G.S. W. Ogg, M.B.	Nineteen cases mild uncomplicated intermittent, and 8 febricula.	27	4	2 drachms three times a day.	In several cases diarrhœa and dysentery supervened during or after the administration of the drug, but as these diseases were very prevalent in the jail in which the trials were conducted does not think that the bowel-complaint can be attributed to the action of the drug. Can offer no opinion as to its efficacy in large doses in the treatment of severe cases of fever, but considers that an obvious drawback to its employment in such cases lies in the large quantity of alcohol that would have to be administered in the exhibition of a full dose of the Cinchona alkaloids, the equivalent of 20 grains of the alkaloids being from 3 to 6 oz. of Money's tincture.	..	..	The cases of intermittent fever that occur at Coimbatore are according to Dr. Ogg in most instances "owing rather to sudden changes of temperature than to the presence of a special malarial poison." For this reason he considers that its apparent success can scarcely be taken as a test of its value in combating severer types of malarious fever. "Cases in which the treatment had to be modified in consequence of intercurrent attacks of pneumonia or other disease were eliminated from the general return." Dr. Ogg is of opinion that Mr. Money's tincture may be regarded as a useful antiperiodic in the treatment of mild cases of intermittent fever.
Salem ..	Surgeon D. H. Cullimore.	Intermittent ..	8	..	Half a drachm to 2 drachms.	In one case it gave rise to diarrhœa; otherwise it had no bad effect.	..	8	In none of these cases was its administration satisfactory. Quinine and arsenicals were found necessary to effect a cure.
Do. ..	Do. ..	Do. ..	1	8	One ounce reduced to 2 drachms three times a day.	Occasionally Money's tincture produced diarrhœa.	..	1	Was cured by arsenic and quinine.
Calicut ..	Surgeon H.D. Cook, M.D.	Do. ..	1	5	One ounce three times a day.	The Cinchona failed to stop the fever and produced head symptoms and some diarrhœa.	..	1	Quinine at once checked the paroxysm.
Do. ..	Do. ..	Do. ..	1	6	Do. ..	The tincture of bark failed and produced some diarrhœa.	..	1	Quinine at once checked the fever.
Do. ..	Do. ..	Do. ..	1	6	One ounce once a day.	....	..	1	Was discharged on the 5th and admitted on the 9th November with fever which was checked by quinine.
Do. ..	Do. ..	Do. ..	1	6	One ounce before and one ounce after a paroxysm.	....	..	1	It was found necessary to stop the tincture and give quinine which arrested the fever.
Do. ..	Do. ..	Do. ..	1	2	Do. ..	....	..	..	Cured by quinine. "Is not prepared at present to give any definite opinion as to the value of the drug, owing to the few cases he has had under observation."
Mysore ..	Surgeon T. J. McGann.	..	..	..	The dose was from one to two drachms.	....	..	..	Having returned from leave to Europe and received no specific instructions from his *locum tenens* is merely able to say that it is a febrifuge of some value; that in ordinary mild intermittents which is what generally prevails in the jail it checked the fever, but that it failed in cases of remittent fever.

(Signed) G. SMITH, M.D.,
Surgeon-General, I.M.D.

ORDER THEREON, 22nd August 1878, No. 1,351.

COMMUNICATED to the Committee now sitting under G.O., 1st June 1878, No. 830.

2. It is observed that 50 lb. of renewed red bark (green) and 50 lb. of renewed crown bark (green) were supplied to Mr. Money from the Government plantations for the preparation of the tincture furnished by him to the Surgeon-General for experiment, and that the value of this bark at the rates realized at the last sales was at lowest upwards of Rupees 120.

(True Extract.)

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

4th September 1877, No. 2,641.

Read the following paper:—

Endorsement of the Surgeon-General, Indian Medical Department, dated Fort St. George, 30th August 1877, No. 550.

Read the following Memorandum from Surgeon-Major G. BIDIE, M.B., Secretary to the Surgeon-General, Indian Medical Department, to the Medical Officers in charge of Civil Dispensaries at Guntoor, Bellary, Kurnool, Nellore, Coimbatore, Salem, Calicut, and Mysore, dated Fort St. George, 30th August 1877, No. 5,469:—

GOVERNMENT having directed* that the efficacy of Mr. Money's tincture of Cinchona bark as a febrifuge be tested, the Surgeon-General has directed that two dozen quarts† of it be sent you for trial in the treatment of malarious fever.

2. Mr. Money's tincture contains 5 oz. of crown bark (*C. officinalis*) or red bark (*C. succirubra*) to the quart bottle of spirit, *i.e.*, 24 oz. The British Pharmacopœia *Tinctura Cinchona Flavæ* has 4 oz. of bark to 20 oz. of proof spirit.

3. It has been roughly estimated that Mr. Money's tincture contains from 3 to nearly 6 grains of Cinchona alkaloids per ounce. The dose of the Pharmacopœia tincture is ½ to 2 drachms. It will be your duty to determine by careful trial the minimum, medium, and maximum antiperiodic doses of Mr. Money's tincture.

4. The object of this trial is to determine the therapeutic value of Mr. Money's tincture relatively to that of quinine and the other Cinchona alkaloids at your disposal. In summarizing the results of your trials, it will be necessary to state what quantity of the tincture is, in your opinion, equal to the ordinary antiperiodic doses of quinine; whether it is more successful when used in large medium or small doses; whether it has any advantages over the other preparations of Cinchona now in use; and if not, what are the drawbacks you have experienced in its employment.

Its use in the case of children, and in cases in which the employment of stimulants would be inexpedient, must be avoided.

* Proceedings of Government, Revenue Department, No. 2,129, of 27th June 1877.
Proceedings of Government, Revenue Department, No. 2,559, of 23rd August 1877.
† One dozen red bark preparation.
One dozen crown bark preparation.

FORWARDED to the Secretary to Government, Revenue Department, with reference to G.O., No. 2,559, dated 23rd August 1877.

(Signed) G. SMITH, M.D.,
Surgn.-Genl., Indian Medl. Dept.

ORDER THEREON, 4th September 1877, No. 2,641.

RECORDED.

(True Extract.)

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

G-0 / Simo / 78 Aug-11
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Revenue 1878. Department.

No. 153 No 4988.

Date 11 November/78

Rec'd 13th do Ootacamund.

COMMISSIONER'S OFFICE,

The Secy: to Govt:
Revenue Department
Madras.

Enclosures. 1 - V

SUBJECT.

Chinchona Committee Report.

Forwards 142 Copies of the

No 2782
Recorded

18: Nov /78:

7/6/95