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SELECTED REFERENCES

[illegible]

THE UNIVERSITY OF CHICAGO

From

A. O. Hume Esq. C. S.
Secretary to the Govt. of India

To

The Secretary of the Govt. of Bengal.

Dept. of Agriculture
Revenue and Commerce

Agriculture & Horticulture

Sir,

Calcutta, the June 1871.

I am directed to acknowledge the receipt of your letter, addressed to the Government of India in the Home Department, No 1309 dated the 3rd ultimo, submitting the report of the Commission appointed to enquire into the cultivation of Cinchona in British Bikaner and divers questions connected therewith.

I am desired, in reply, to state that the Governor General in Council entirely approves of the orders on the report already issued by the Lieutenant Governor, and I am to request that the following remarks on the cultivation of the plant, the export of the bark to England, and the local manufacture of alkaloids, may receive

His

His Honor's consideration.

3. As regards the first point, viz, the cultivation, it seems clearly proved that *C. officinalis* is unsuited to the soil and climate of the Government Plantations in Sikkim. It has been tried at various elevations without making any progress, and its extended cultivation would be unprofitable. His Excellency in Council, therefore, agrees in the recommendation of the Commission that its further propagation should cease. All the plants now standing should be cleared away, with the exception of those which it may be desired to retain for the supply of seeds, or for other sufficient reason. It seems advisable that vigorous efforts should be made to propagate *C. Calisaya* and *C. Betayensis*, which species yield a larger quantity of crystallisable alkaloid than *C. succirubra*, and which have a greater marketable value in Europe. The officers in charge of the gardens should also be directed to

No. 23 dated
4th April 1877

exert themselves to obtain for trial any other species or varieties, the yield of which in Alkaloids appears likely to be superior to that of *C. succirubra*. At the same time it is not intended that the further cultivation of this latter species should be interrupted. On the contrary, all healthy seedlings and cuttings now in stock should be planted out, and further supplies of plants should still continue to be raised from seed taken from sound and healthy trees. In connection with the subject of this paragraph, I am to invite the attention of the Lieutenant Governor in Bengal to paragraph 4 of the despatch from the Secretary of State, copy of which is forwarded herewith. His Excellency in Council is not disposed without further experiment and more careful enquiry to concur in the opinion expressed by Mr. Holbot regarding the destructive nature of the disease which has attacked some of the plants at Rangbée - a disease which

is shown to have existed in the plants originally sent up from the Neilgherries as stock for the Sikkim Plantations. Disease doubtless exists, and, unless care is taken, the results may prove serious but there appears to be no valid reason for apprehending anything like the general failure predicted by Mr. Milnor; nay more, the Governor General in Council hopes to hear that in the new plantations stocked from healthy seedling plants, the disease will occur more rarely, and there is reason to expect that even in the older plantations, it is gradually disappearing; and that the opinion of the Commission, that the vast majority of the plants are likely to last at least seven or eight years, will prove to be well within the facts. In order, however, that one test may be applied to the different opinions expressed on this point - a test which will be peculiarly valuable as being founded on that portion of

the plantation where the disease is likely to be most extensive and persistent. His Excellency in Council would be glad if His Honor the Lieutenant Governor would be good enough to issue orders that, of the 140 trees which still remain untouched from among those planted out in 1851, some may be cut under it should be found absolutely necessary to thin them, and that a half-yearly report may be submitted showing the progress and condition of these trees, whether the disease is increasing among them or not, and any other particulars of interest regarding them.

The Governor General in Council concurs in the Lieutenant Governor's decision regarding the experiment. For some years it was the only possible method of keeping a check on the expenditure, and of ascertaining the real commercial value of this experiment, will be

to export annually a considerable quantity
of the best bark produced, and sell it at the
highest price it will fetch in the open market.
I am to request further that His Honor will
favor the Government of India with the earliest
information of the financial results of the
exportation now authorized in a statement
indicating the estimated cost of production, the
actual cost of picking, drying, and packing,
the cost of transport to Calcutta, freight
charges, and landing charges, brokerage, and
other charges in England, and her country, the

same manner.

It is recommended that the following points be
considered. The quantity in demand would
be ascertained at the results of the ex-
periments being made by His Honor for a skilled
competent person to undertake the execution
of systematic experiments at Bangalore.

The Government of India have been informed

desirous that these experiments may be pro-
ceeded with energetically, and that the process
advocated by Doctor Simpson, as well as that
of Mr. Broughton, may receive full and fair
trial, and their respective merits be accurately
weighed. Mr. Broughton's process, which is already
in operation at Bangalore, should receive further
trial under skilled supervision, and Mr. Gam-
mon, the Head Gardener in charge, might be
directed to prepare a considerable quantity of
alcohol from hill maize, in order to ascertain
what it costs when made on extensive scale.
In the trial of Dr. Simpson's and Mr. Broughton's
process, a quantity of, say, 2000 of fresh
bark might be carefully worked up under
each system, and an accurate comparison of
the cost and results in each case instituted.
8. These experiments should be conducted
with the greatest care under skilled supervision

and I am directed here to invite His Honor's attention to the serious result of the absence of such shell in the experiments first made at Punghee, as shown by the analyses made by Mr. Macnamara and Simpson of the so-called "amorphous quinine" produced under Mr. Blachet's orders. His Excellency in Council cannot refrain from expressing the grave dissatisfaction with which he finds that a drug supplied from State manufactory to the medical stores for use in Hospitals was proved to contain upwards of 10 per cent of metallic copper.

The Govt of India is informed that Mr. Blachet received warnings that the alkaloid produced at Punghee apparently contained copper, and he fails to find any trace in the papers before him of Mr. Blachet having taken steps to ascertain the truth; and the Governor General in Council is accordingly bound to say that, in the circumstances, Mr. Blachet has incurred

a deep and serious responsibility. (5)

g. As regards the supposed discouragement of private enterprise which the Darjeeling Cinchona Association seem to believe involved in any further extension of the Government Plantations, I am desired to remark that in this as in similar cases of the introduction of exotic staples, the first step, towards enlisted the active co-operation of private capitalists generally is to prove by actual operations on a large scale, that their cultivation will really be remunerative. Until this has been done, no efforts that the Government ^{may} make to establish that cultivation thoroughly can, if rightly considered, be held to affect private enterprise injuriously.

h. Considered only in the light of this broad principle generally applicable to the cases of exotic staples, it is manifest that the time

has not yet come for Government to relax
its exertions in the matter of cinchona cultivation.
These very papers show that two of the most
practised experts in cinchona are of opinion
that the Kichine Plantations are dying rapidly
off, and will, in a few years, be altogether ex-
tinct. His Excellency concurs with the commission
in considering these gentlemen in error, but should
their conjectures unhappily prove well founded,
the Govt would probably erect other sites and
open out other plantations, in a word, would
persevere until cinchona cultivation was a
success, and until it had secured for the fever-
stricken millions of India the incalculable
benefits of cheap quinine.

Unfortunately the field is too wide to
be adequately occupied for many years to come
either by Government or private individuals,
and it will take labour as they say, from

the first Government has encouraged, and ⁶
will always encourage, private plantations.
Seeds and plants it freely gives, and throws
open to inspection its own plantations,
and does its utmost to make available
to all the experience gained in the work
by its own officers; but the Govt feels that
it could not, without the abnegation of
a vitally important duty, leave solely to
private enterprise the further prosecution
of those measures necessary to secure to the
people abundant and cheap supplies of the
"only efficient specific for the most deadly
of all Indian maladies".

14. I am finally desired to state that
the Governor General in Council appreciates
the satisfactory manner in which the President
and Members of the Commission have discharged
the important duty confided to them.

Shave 10

Secy to the Govt of India

Recd 12/6/75

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No. 11Q, dated Calcutta, the 14th June 1875.

From—GEORGE KING, Esq., M.B., Supdt., Royal Botanical Garden, Calcutta, and, in charge of Cinchona cultivation in Bengal,

To—The Assistant Secretary to the Government of Bengal.

I HAVE the honor herewith to forward a copy of a report from Mr. Wood, Government Quinologist, on the manufacture of cinchona alkaloid containing the result of Mr. Wood's labours during the year ending 31st March 1875.

Dated Rangbee, Darjeeling, the 24th May 1875.

From—C. H. WOOD, Esq., Government Quinologist,

To—The Superintendent, Botanical Garden, and in charge of Cinchona cultivation in Bengal.

I HAVE the honor to enclose, for the information of Government, a report on the manufacture of febrifuge from *cinchona succirubra*. If the report is printed, I should esteem it a favour to be allowed to see a proof. I would also ask to be supplied with four copies of the report.

Report from the Government Quinologist, Cinchona Plantations, British Sikkim, dated May 24, 1875.

I HAVE the honor to state, for the information of Government, that since the date of my last report (August 5th, 1874), I have been engaged in maturing the details of a process for the manufacture of a cheap febrifuge from the bark of *C. succirubra*, and in collecting data for ascertaining the economical results to be obtained therefrom.

1. With a view of determining the scale upon which the manufacture should be conducted, experiments were in the first place undertaken to ascertain the amount of bark which the *succirubra* trees now in cultivation are capable of yielding. By Dr. King's sanction a number of trees of different ages were cut down, and the bark stripped from each tree separately weighed in the green state. In order that the trees taken should fairly represent an average of the whole, a certain proportion of rows in a large patch was selected for cutting. Thus in some cases all the trees in every third or every fifth row of the patch were cut down. Mr. Gamble has had the marked, so that experiments may be subsequently made with the coppice shoots. The results are given in the following table:—

Table No. 1, showing average weight of green bark per tree at different ages.

	Number of Trees cut.	WEIGHT OF GREEN BARK YIELDED, lb.		WEIGHT OF GREEN BARK PER TREE, lb.	
		Peeled bark.	Scraped bark.	Peeled bark.	Scraped bark.
Trees planted in—					
1866 at Rangbee	101	825	107	801	105
1869 at Bishap	380	5,350	501	501	102
1867 at Dittu	323	2,753	424	803	102
1868 at Bahu Pani	257	1,109	643	431	103
1868 at Spicer's Ridge	229	1,795	328	347	103
1869 at Rangbee Bridge	122	2,443	887	308	104
1870 at Bishap Dukan	141	403	220	308	105
1871 at west of Chakya	100	145	49	140	0 40
1872 at Mongpoa Ridge	100	82	49	0 92	0 49
	2,382	12,012	3,007		

2. The foregoing table shows the average weight of wet bark yielded per tree of each successive year's planting; but this average includes a very wide range. Thus, of the trees eight years' old, some yielded as much as 30 to 35lb of wet peeled bark per tree, while others only furnished from 2 to 3lb. With a view of showing more exactly this variation of yield in trees of the same age, I have arranged the trees of each year into nine groups,

according to the weight of bark obtained per tree. The following table shows the percentage results:—

Table No. 2, showing percentage of trees yielding different quantities of bark.

PERCENTAGE OF TREES									
	1866	1867	1868	1869	1870	1871	1872		
Peeled bark (wet) per tree—									
From 0 to 1lb			4.85	10.73	24.45	21.59	10.31	62.0	100
" 1 1/2 to 3 "	15.84	12.85	16.72	28.40	31.63	32.15	43.54	35.0	100
" 3 1/2 to 5 "	20.70	17.74	23.68	31.13	25.33	24.77	31.63	3.0	
" 5 1/2 to 10 "	40.00	41.00	23.18	19.07	23.64	12.88	7.20		
" 10 1/2 to 15 "	11.86	18.51	20.09	2.75	1.51	2.11	0.71		
" 15 1/2 to 20 "	5.04	5.05	6.28	1.53	.44	1.13			
" 20 1/2 to 25 "	2.07	3.23	4.05	.39					
" 25 1/2 to 30 "	.98	.77	.93						
" 30 1/2 to 35 "	.00	.23	.93						
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

Thus, taking the trees of 1866 (Rishap), it will be seen that 41.9 per cent. of them yield from 5 1/2 to 10 1/2 lb of wet bark each, while 12.85 per cent. only yield 1 1/2 to 3 lb, and 2.32 per cent. furnishes from 20 1/2 to 25 lb each. It is probable that in every plantation of young trees there will be considerable disparity of growth observable; and when the plants are situated, as in this case, upon the steep and uneven ground of a hill sidewith rocks and the

of a heavy rainfall, such disparity is likely to be increased, because some of the trees must almost of necessity be more favourably placed than others.

3. Table 1 shows the average yield of *wet bark*. As I have stated, the green bark peeled from each tree was separately weighed. The total quantity from the trees of each year was then dried as a whole, and the weight divided by the number of trees. The green scrapings from the young branches were weighed in mass at the conclusion of each day's cutting. These scrapings also include those portions of thick bark which, from adhesion to the stem, could not be removed by peeling. The results of the drying were as follows:—

Table No. 3.—Dry Bark per tree.

	Peeled Bark 1.	Scraped Bark 2.
	lb	lb
1866	2.52	.41
1867	2.06	.33
1868	2.27	.33
1869	1.05	.34
1870	1.01	.33
1871	.92	.30
1872	.34	.12
1873	.26	.12

The numbers in column 1 are experimental, those in column 2 are calculated from the wet bark taking the loss which scrapings undergo in drying at 75 per cent. I should state here that Mr. Gammie has given me his assistance throughout these experiments, and one of his assistants superintended the cutting of the trees, &c.

4. From the data thus collected, it is possible to form an estimate of the amount of *succirubra* bark which these plantations are capable of furnishing. Table 3 shows that our trees of seven or eight years' growth will yield upon an average a trifle over 2 lb of dry stem bark per tree in addition to about five ounces of scrapings from the small branches. The latter item should properly be somewhat increased, because trees of this age have already furnished a certain amount of branch bark by pruning. There is no means of exactly estimating the amount thus yielded, but it probably does not exceed 2 or 3 ounces per tree. If we assume that the total branch bark obtainable amounts altogether to 8 ounces, and that this quantity is equal to 4 ounces of stem bark, we obtain 2 1/2 lb as the entire yield per tree. The total number of *succirubra* trees planted from the commencement down to the end of 1874 is 2,300,000. If these trees were regularly cut at the completion of their seventh year, there would be an average of 328,000 trees to cut, furnishing 788,000 lb of dry bark annually. But it may not be safe to reckon upon the total number of trees planted. Moreover, those planted in recent years may not attain such development as those planted in 1867; it will therefore be wiser to take a lower average per tree than 2 1/2 lb. Reckoning the number of trees in stock at 2,000,000, and allowing them to attain eight years before cutting, there would be 244,000 trees available every year; and assuming that they only furnished an average of 1 1/2 lb each, we should then have 366,000 lb of dry bark per annum to dispose of. It will probably be considered that this estimate is rather below than above what may fairly be expected.

5. The total amount of money expended upon these plantations up to the end of 1873-74 is Rs. 5,49,740, exclusive of interest. Adding on compound interest at the rate of 4 per cent., it will be found that the entire capital sunk up to the present time amounts in round numbers to Rs. 7,50,000. The yearly interest on this sum is Rs. 30,000, and taking the working expenses at Rs. 50,000 (which has been the actual expenditure for some years past), it results that the cost price of the 366,000 lb of bark is Rs. 80,000, or 3 1/2 annas per lb. It is obvious that an allowance of Rs. 50,000 per annum would suffice for raising fresh plants on new ground to replace those cut; but the method of coppicing would render this unnecessary, and it is probable therefore that the existing stock of plants could be maintained at a less cost than I have taken. But for the present purpose it is desirable to make such allowances as will show the minimum quantity of bark and the maximum cost that may reasonably be anticipated.

6. The next point for consideration is the alkaloidal value of the bark. Wishing in the first place to ascertain the maximum quality to which our *succirubra* attains, and having already examined bark taken from trees growing at different elevations, I requested Mr. Gammie to obtain for me samples from the stems of our finest trees of different ages. He therefore furnished me with seven samples.

The results of analysis were as follows:—

No. 1. trees planted in	Total Alkaloid.
2 " " " 1866	6.7 per cent.
3 " " " 1867	7.3 "
4 " " " 1868	6.8 "
5 " " " 1869	6.61 "
6 " " " 1870	6.63 "
7 " " " 1871	6.04 "
8 " " " 1872	7.68 "

The constituents of the total alkaloid from the eldest and youngest of these were determined:—

	No. 1. (1866.)	No. 8. (1872.)	No. 7. (1873.)
Total alkaloid	6.7	6.04	7.08
Cinchonidine	2.4	2.73	2.17
Cinchonine	1.0	1.99	2.95
	2.4	1.31	2.56
	1.3	1.95	.82

The peeled bark from the trees cut for experiments described in Tables 1 and 2 was also analysed with the following results:—

	Total Alkaloid.
1866	4.37 per cent.
1867	5.10 "
1868	4.85 "
1869	4.62 "
1870	4.65 "
1871	4.80 "
1872	4.23 "

In each case the whole weight of bark as recorded in Table 1, after drying was coarsely bruised and thoroughly mixed; a large sample was then taken from the mass and finely powdered for analysis. It must be remembered that in these and all other analyses the bark operated on is previously dried at a temperature of 100° C. Dry bark rapidly absorbs from 10 to 12 per cent. of moisture from the air, and in judging the value of our bark for manufacturing purposes from the analysis, an allowance should be made for this. Portions of the dry scrapings from the different years were mixed together, and the bulk analysed. It yielded 2.4 per cent. of total alkaloid. The bark of 1867 planting appears to be somewhat richer than that of other years. Some scrapings from the young branches of these trees were therefore tested separately; they yielded 3.06 per cent.

7. It appears from the foregoing results that while strips of bark taken from our good trees yield from 6 to 7 per cent. of total alkaloid, the bulk of bark obtained by cutting down the trees and peeling them only yields from 4 to 5 per cent. This may be due to the fact that in the latter case the weaker trees are included as well as the strong ones; but I am inclined to think that it is also, at any rate in part, attributable to a gradual diminution in the percentage of alkaloid as we ascend the tree; that the proportion of alkaloid in the bark at the lower portion of the stem is greater than it is in bark from the higher portions. At present this is not much more than conjecture based on very few facts, but I propose submitting it to investigation shortly. It is evident that the age of the *succirubra* tree up to 7 or 8 years, has very little effect upon the proportion of total alkaloid contained in the bark. In all the samples examined there is a remarkable uniformity observable. The composition of the alkaloid, moreover, is not subject to any great variation. These undoubtedly are very important and valuable features in the *succirubra* species as a source of chief febrifuge.

8. From all the foregoing facts it results that we may reasonably expect these plantations in a short time to yield 366,000 lb of *succirubra* bark per annum at a cost of 3 1/2 annas per lb, and containing an average of four per cent. of total alkaloid.

9. It remains to consider the form of febrifuge which should be adopted, and the most economical process for extracting it. In August last I forwarded to the Surgeon-General 5 lb of the total alkaloid in its precipitated form, and a month later I sent a further quantity of 25 lb. Portions of this preparation were, I believe, issued to the principal hospitals in Calcutta for

trial; and I understand both Dr. Chevers and Dr. Ewart are fully satisfied of its efficacy, and are quite prepared to recommend its adoption in all Government hospitals and dispensaries. But Dr. Ewart especially impressed upon me the great importance of maintaining uniformity of composition in the preparation. This I am well aware is a thing which the medical profession regard as most essential in all medicinal agents, and that to promote excellence in this respect has been the principal aim of modern pharmacy. In my report of August 5th, I stated as a chief reason for preferring the precipitated form of *succirubra* alkaloid to any crystalline compound, that greater uniformity of composition could be attained. Many experiments have convinced me of the difficulty of obtaining a crystallized salt from the mixed alkaloid that would not be subject to wide variations. On the other hand, if *succirubra* bark alone is allowed to enter the factory, care being taken by mixing to render this as uniform as possible, and if the product is allowed to accumulate until a large bulk can be adjusted by analysis, I am confident that the medical profession will have no reason to complain of any variation in the precipitated alkaloid. Of course without these precautions, and especially if the bark of different species were indiscriminately worked, much uncertainty would result. But the alkaloids in *succirubra* bark bear a pretty constant relation to each other. Differences are observable between individual trees; but taking the average over the whole plantation, the proportions are very regular, and a systematic method of cultivation, combined with judicious organisation in the factory, will suffice to secure the desired uniformity. The "cinchona febrifuge" (this name would seem to be the least exceptionable of any yet proposed) will be issued in the form of a white, or nearly white, powder. It is a question whether or not the absence of crystalline appearance will tend to create a prejudice against it if sold in the bazaar as a substitute for quinine, but this should not apply to the Government dispensaries, and these institutions alone will probably consume all that can be produced for some time. I am told that the present issue of quinine to Bengal is 4,000 lb per annum, and I am assured that there is a legitimate requirement for three or four times this amount. From 10,000 to 12,000 lb a year will represent the maximum quantity of febrifuge that these plantations at their present limit will be likely to furnish.

10. In the August report I adverted to two alternative processes for the manufacture of febrifuge. Both these have received further investigation. A trial of the spirit method with several forms of apparatus has been made; but looking at the large quantity of bark to be dealt with, it would involve a far heavier expenditure of capital for the necessary machinery and stock of spirit than I should feel justified in recommending Government to incur. In starting a manufacture of this kind, which introduced a new product for consumption, the sinking of a large capital should, as it seems to me, be avoided as far as possible—at any rate in the earlier stages. I therefore turned my attention to improving and modifying the alternative process involving the use of acid and alkali.

11. This method in its simplest form has been in operation here upon a small scale for several months, during which time over 300 lb of febrifuge have been produced by it. Since my return to Rungbee it has been extended, and is now in operation in comesheds at Mungpoo, under Mr. Gamble's superintendence, upon a scale sufficient to work 26 maunds of bark per week, or 110,000 lb per annum. There would be no difficulty in trebling this producing power if necessary; an expenditure of Rs. 800 or Rs. 700 would suffice for the purpose. But the existing scale will probably prove equal to the present supply of bark, and no advantage therefore would result from further extension for some months to come. Up to the present time 16,450 lb of dry bark have been worked by this plan, and the yield of febrifuge has been 2.17 per cent. But this includes all the bark consumed in experimental operations, and much also that was of very poor quality. In some recent results 2½ and 3 per cent. have been obtained, and I believe the method upon an average will furnish three-fourths of the alkaloid present in the bark. But taking as our basis what has been actually obtained upon a manufacturing scale, which, after a slight deduction for bark wasted in experiment, is 2.25 per cent., then the present appliances will furnish 2,500 lb of febrifuge a year. The following is an estimate of its cost based upon past results, but not including any thing for Quinologist.

	Rs.	A.	P.
Dry bark 1,352 maunds, at 34 annas per lb	24,251	8	0
Chemicals (including carriage) and labour	10,555	0	0
	34,807	8	0
Produce (2½ per cent.)—2,494 lb at Rs. 16	39,904	0	0

By about trebling this scale of production, we arrive at the full working power of the plantations, and our estimate would then stand as follows:—

	Rs.	A.	P.
Dry bark 366,000 lb at 34 annas	80,000	0	0
Chemicals, carriage and labour	35,455	0	0
Quinologist	10,000	0	0
Interest on capital for Quinologist's establishment	1,200	0	0
	1,26,655	0	0
Produce (2½ per cent.) 8,235 lb, at Rs. 15-7	1,27,127	8	0

It will be observed that I have included Quinologist's pay in the latter estimate. If so simple a method as the one under consideration, however, were adopted, the exclusive services of a professional Chemist would scarcely be necessary. I believe, moreover, that in endeavouring to keep on the safe side, I have somewhat overrated the expenditure and under-estimated our producing power; consequently the cost price of the febrifuge would probably be rather less than that shown.

12. It results that if the cultivation of cinchona and production of alkaloid be regarded as one operation, then Government, by simply extending existing appliances, will be in a position to supply the dispensaries with large quantities of an efficient febrifuge at a rupee an ounce, after covering every expense and paying interest at 4 per cent. on all the capital sunk on cinchona in Sikkim from the commencement down to the present time. This I understand to be the principal object which Government has had in view.

13. Although the object can be thus accomplished, there is much room for improvement. The acid and alkali process in the simple way in which it is worked here does not make the most economical use of the bark. I have already stated that finding the spirit method involved such a heavy capital, my attention was turned to effecting some improvement in the acid process. While I was in Calcutta some apparatus was fitted up in the Presidency Jail for exhausting the finely powdered bark with acidulated water by the aid of steam heat. The result was entirely successful. The model apparatus I had in use at the jail enabled me to work a maund of bark a day, and I obtained an average of 3½ per cent. of product from the bark, which showed by analysis 4 per cent. of total alkaloid. The chemicals used were the same, and in the same proportion as those employed here. The additional outlay involved therefore would be for fuel and machinery. It is difficult to estimate what this would amount to. The best computation I have been able to make shows the following:—

	Rs.	A.	P.
Bark, 366,000 lb, at 3½ annas per lb	80,000	0	0
Working expenses	68,000	0	0
	1,48,000	0	0
Produce, 12,810 lb (3½ per cent.) at Rs. 11-9 per lb	1,48,115	0	0

The Rs. 68,000 includes carriage of bark to Calcutta, chemicals, fuel, rent, Quinologist, labour (with European foreman), repairs, and interest on machinery. If this estimate is within the mark, then the adoption of this method will enable Government to produce febrifuge at a cost price of about 14 annas the ounce. Even if the cost should prove to be more than I have computed it at, nevertheless I think considerable economy must result, and a much larger amount of product will be furnished by the total quantity of bark available.

14. I would therefore recommend that a factory should be fitted up in Calcutta upon a moderate scale for working on this plan. The appliances existing here might be still maintained in full operation; there will always be a certain quantity of poor bark (from the branches) which could be advantageously worked on the plantations, the richer bark alone being transmitted to Calcutta.

15. It does not appear that there would be any advantage in attempting to bring the requisite machinery to Rungbee. The cost of carrying 300,000 lb of bark to Calcutta will be at the maximum Rs. 18,000; but the cost of bringing up the chemicals for working that quantity to Rungbee will be certainly Rs. 16,000, while the repairs of machinery and the outlay in starting will be very much less in Calcutta than it would be at Rungbee. In commencing a new thing of this kind, improvements and modifications in the will certainly suggest themselves as experience is gained. These can be readily and economically effected in Calcutta, while at Rungbee they would involve great delay and large expenditure. A great portion of the current expenses on the factory will be for acid, of which considerable quantities are consumed in the process. It will probably therefore be worthwhile to manufacture the acid required. This could be accomplished in Calcutta; but it would be a very difficult undertaking in so remote a place as Rungbee. The acid employed is muriatic, and it is obtained at present from Dr. Waldie's chemical works at a cost of three and a half annas a lb in Calcutta. Its carriage to Rungbee, including bottles, packing cases, &c., brings up its cost to eight annas per lb.

16. It will be observed that I have abandoned the idea of working green bark. After several trials upon a large as well as a small scale, I have satisfied myself that it presents no advantages whatever; on the contrary it interposes some obstacles, and certainly interferes to a material extent with the efficient organisation of a factory. The drying of the bark involves but a very trifling cost. It is far better therefore to have the bark collected at the most convenient seasons only, and stored. The manufacture can thus be conducted upon a uniform system all the year round.

17. Should the Government be pleased to approve of starting a factory in Calcutta, as I have suggested, it would be desirable that I should be instructed to draw up an estimate of the expenditure required for machinery, &c.; and in this the assistance of Mr. Donaldson,

Superintendent of Jail Manufactures, would be of great value. I would take this opportunity of expressing my thanks to Mr. Heeley and Dr. Mackenzie for the facilities they afforded me in carrying out my experiments in the jail workshops, and especially to Mr. Donaldson for the engineering help he afforded me in designing and constructing the apparatus required.

18. It is to be borne in mind that the estimate submitted in the foregoing paragraphs involve the necessity of working these *succirubra* plantations to the extent of 366,000lb of dry bark per annum. I have shown that this is well within their capabilities, but it may take another year before the maximum rate of production is attained. In view of such a development, it is desirable that the financial arrangements of the undertaking should be clearly defined and settled. I would therefore respectfully suggest that all the bark yielded by the plantations should be made over to the Quinologist at its cost price. The Quinologist, in his turn, should make over to the Medical Department all the febrifuge he produces, at whatever it costs. Upon this plan, exact financial results will always be attainable, and the efficiency or otherwise of each branch of the undertaking can at any time be easily tested by Government. Any attempt at taking the commercial value of bark in the London market as a basis would, I submit, be unsatisfactory, because such rates are fluctuating and uncertain; but with the cost prices regularly recorded from year to year, a comparison with market value can be always made, and the full economical results readily ascertained.

W. H. D'C

FINANCIAL DEPARTMENT.

AGRICULTURE.

CALCUTTA, THE 27TH JULY 1875.

RESOLUTION.

READ--

Mr. Wood's report on manufacturing cinchona products, dated 24th May 1875.

1. BEFORE entering on the review of this report, it will be advantageous to reconsider the papers regarding the cultivation of *C. succirubra*, or the red bark trees. In his report for the year ending 31st March 1874, Dr. King made the following remarks as to the relative values of the *succirubra* and *calisaya* :--

The great preponderance of *succirubra* trees in the plantation is not due to a preference for that species over *calisaya*, but to the fact that the red bark tree is hardier, much more easily propagated, and has a much wider range as regards conditions of growth than *calisaya*. Artificial propagation of *calisaya* by cuttings proved very much more difficult than similar propagation of *succirubra*, and until two years ago (owing to the slowness of the *calisaya* trees to yield seed) we had to depend entirely on such means for multiplying it, whereas *succirubra* has been seeding freely for years. At last, however, we have raised a large supply of *calisaya* seed, and I trust before many months are over to be able to report half a million of plants in the nursery beds; and if the funds at my disposal be sufficient, a large proportion of these may be permanently planted out before the end of the current financial year. Red bark, although rich in its total yield of alkaloids, contains less quinine than yellow bark, and in a less easily extracted form. It is therefore less esteemed by manufacturers of quinine. Moreover, red bark can still be procured in considerable quantity from South America, while yellow bark, on the contrary, is scarce. The yellow bark tree promises to grow well in Sikkim; and now that Government have the means of extending its cultivation, I am strongly of opinion that they should do so.

2. On this report the Secretary of State* made the following remarks :--

* Despatch of 5th November 1874.
Communicated with Revenue, Agriculture, and Commerce Department,
No. 2763, dated 9th December 1874.

"So much importance need not be attached to the cultivation of quinine-yielding species, if the species rich in cinchonidine is more suitable to the soil and climate of Sikkim; for the reports of the Cinchona

Commissions are unanimous as to cinchonidine being equal to quinine as a febrifuge. If this view is confirmed by the medical officers whose duty it will be to watch and superintend the administration of the large quantity of cinchonidine which has lately been despatched to India, this question may be considered to have been finally settled. The cheap form of the febrifuge manufactured at Rungbi will contain all the alkaloids formed in the bark; but as the *C. succirubra* trees are by far the most numerous, cinchonidine must always predominate. Hence, very considerable importance attaches to the results of the use of the latter alkaloid, 1,700 ounces of which have now been despatched to Calcutta. I therefore desire that full reports may be called for on the efficacy of this form of the cinchona febrifuge, the successful use of which in India will so much increase the value of the Sikkim plantations."

3. Before this despatch arrived and was communicated to Dr. King, the first report of Mr. Wood, the Government Quinologist, had been considered, and orders passed on it. This report showed that the *succirubra* trees seven years old, which were examined, yielded from 0.90 per cent. to 2.20 per cent. of quinine, and from 1.73 to 2.87 of cinchonidine; whilst the *calisaya* trees of five and seven years old yielded from 4.53 to 6.92 per cent. of quinine, and no cinchonidine. Mr. Wood was of opinion that, by selecting the best varieties of *calisaya*, there was a possibility of growing very rich bark capable of easily furnishing pure sulphate of quinine; to which he added the following remarks :-- "On comparing the analyses of the barks thus far examined, it will be found that certain varieties of *calisaya* are decidedly superior to any of the

succirubra. It is true that the total alkaloid in the latter species is as much, or even a fraction per cent. more than in the former; but in the one case the total is made up of a mixture in nearly equal proportions of different alkaloids, while in the other it consists almost entirely of quinine. For the manufacture of alkaloid in this country, a great advantage would be gained by the employment of a bark yielding quinine to the exclusion of the other alkaloids, because the product would be more readily obtained in a pure and well-defined condition. Operating upon *succirubra* bark, the total yield must either be issued as a mixture of alkaloids in no very definite proportions, or methods of separation must be resorted to which will necessarily complicate the process. In addition to this, *succirubra* bark presents peculiar obstacles to the extraction of the alkaloids in a state of purity, which is not the case with *calisaya*."

4. On this report Dr. King recommended, and this Government sanctioned his recommendation, that all further planting of the *succirubra* species should cease. Dr. King has now reported, in his annual report on the cinchona plantation for 1874-75, that the experiments with *calisaya* seed have proved a failure. As far as the Secretary of State's despatch is concerned, the final decision of the question of the species which it is most advantageous to cultivate depends upon the reports which he called for from the medical officers on the 1,700 ounces of cinchonidine which he sent to India.

5. No report has been received by Government upon this point, and accordingly the Surgeon-General will now be asked to report specially on the cinchonidine received from the Secretary of State, and also on any febrifuge sent to him by the Quinologist for trial.

6. The Government Quinologist now reports the results of his further inquiries and experiments for maturing the details of a process for the manufacture of a cheap febrifuge from the bark of *C. succirubra*. He calculates that each tree will yield 2½ lb of dry stem bark, and that, if these trees were regularly cut at the completion of their seventh year, there would be an average of 328,000 trees to cut, furnishing 738,000 lb of dry bark annually. To be on the safe side, however, in his calculations, he takes the number of trees at 2,000,000; and allowing them to attain eight years before cutting, he would obtain 244,000 trees every year. Assuming that they only furnished an average of 1½ lb each, the yield would be 366,000 lb of dry bark per annum. He further calculates that the cost of producing the 366,000 lb of bark is Rs. 80,000, or 3½ annas per lb, and that the bark will yield 4 per cent. of total alkaloid. Mr. Wood has been informed that the legitimate requirements of Bengal for quinine amount to from 12 to 16,000 lb per annum, whilst the cinchona plantations at their present limit will only yield from 10 to 12,000 lb a year of the total alkaloid in its precipitated form, of the efficacy of which Mr. Wood understands both Dr. Chevers and Dr. Ewart are fully satisfied, and are quite prepared to recommend its adoption in all Government hospitals and dispensaries. This should not, however, be left as a matter of speculation, but should be definitely ascertained; otherwise the calculations may be materially vitiated. A report has been called for on the subject in the resolution of this date on the annual report of cinchona cultivation. Mr. Wood gave up the spirit process for the manufacture on account of the heavy expenditure of capital involved and the cost of spirit, and confined his attention to the process involving the use of acid and alkali. By this method he estimates the results of the full working power of the plantations as below:—

	Rs.	A.	P.
Dry bark 366,000 lb, at 3½ annas	80,000	0	0
Chemicals, carriage, and labour	35,455	0	0
Quinologist	10,000	0	0
Interest on capital for Quinologist's establishment	1,200	0	0
Total	1,26,655	0	0
Produce (2½ per cent.) 8,235 lb, at Rs. 15-7	1,27,127	8	0

He adds that, if such a simple method were observed, the exclusive services of a professional chemist would scarcely be required; and further, that "if the cultivation of cinchona and production of alkaloid be regarded as one operation, then Government, by simply extending existing appliances, will be in a position to supply the dispensaries with large quantities of an efficient febrifuge at a rupee an ounce, after covering every expense and paying interest at 4 per cent. on all the capital sunk on cinchona in Sikkim from the commencement down to the present time."

7. His experiments in Calcutta for exhausting the finely-powdered bark with acidulated water by the aid of steam heat proved entirely successful, and he obtained an average of 3½ per cent. of product from the bark, which showed by analysis 4 per cent. of total alkaloid. The best computation he can make as to the financial results of this process is—

	Rs.	A.	P.
Bark 366,000 lb, at 3½ annas per lb	80,000	0	0
Working expenses	68,000	0	0
Total	1,48,000	0	0
Produce 12,810 lb (3½ per cent.), at Rs. 11-9 per lb	1,48,115	0	0

8. The Rs. 68,000 includes carriage of bark to Calcutta, chemicals, fuel, rent, Quinologist, labour (with European foreman), repairs, and interest on machinery. The adoption of this method would enable Government to produce febrifuge at a cost price of about 12 annas the ounce. He therefore recommends that a factory should be fitted up in Calcutta upon a moderate scale for working on this plan. The appliances in Sikkim he would still maintain in full operation to work up the inferior bark from the branches, the richer bark alone being transmitted to Calcutta.

9. These proposals commend themselves to the Lieutenant-Governor as deserving of consideration; but the final acceptance of them must manifestly depend on the reports which may be received from the Medical Department upon the value of the febrifuge which it is intended to produce by the process which Mr. Wood proposes to adopt.

10. At the same time, the Lieutenant-Governor would make the following remarks for the particular attention of the Quinological Department under the Government of Bengal.

11. Mr. Wood has virtually recommended that the bark available from the Sikkim cinchona plantations should be used solely for the production of what he has termed "cinchona alkaloid," and it is further proposed to issue this new compound authoritatively to the medical institutions of Government as a febrifuge in lieu of quinine.

12. No doubt the proposals would be very good if sufficient medical testimony of the value of the new compound, namely cinchona alkaloid, were forthcoming, but as such is not the case, it would appear to be inadvisable to issue, under the authoritative stamp of the Government, and for the treatment of the most prevalent disease of the country, a drug of which the medical officers have had as yet no experience, and which is, as far as the great majority of practitioners are concerned, an untried remedy.

13. The remedy (cinchona alkaloid) may ultimately prove to be a good one, but probably medical authorities will at the outset be unwilling to consider it as an equivalent for quinine in any case involving anything like serious responsibility; and the result will be a call upon Government for the latter remedy, quinine, which would cause as great an expense as if no cinchona plantation in Sikkim existed.

14. Mr. Wood, in making his recommendation, appears to have been actuated by a commendable desire to obtain for Government a good financial return for the capital outlay on the Sikkim plantation: but nevertheless it might be premature to adopt his valuable suggestions in their entirety, and the better plan would be to consider them purely as experimental until sufficient

medical testimony to the efficacy or otherwise of the new drug had been collected.

15. In the meantime, the Quinologist may be directed to continue to manufacture the "new drug" from a certain proportion of the *succirubra* barks available; but from the remainder, and from the *calisaya*, he might be asked to prepare the orthodox cinchona alkaloids, namely, cinchonidine, cinchonine, quinine, &c., which have been proved by experience to be specific in the treatment of Indian fevers.

ORDERED, that a copy of the Resolution, with copies of the Reports, be submitted to the Government of India in the Department of Revenue, Agriculture, and Commerce for information; that a copy, with printed copies of the Report, be forwarded to the Superintendent of the Botanical Gardens for information and guidance, with reference to his letter No. 11Q, dated the 14th June, and for communication to the Quinologist.

Also, that copy be forwarded to the Surgeon-General, Indian Medical Department, for information, with a request that he will be so good as to furnish the report called for in paragraph 4 of the Resolution.

By order of the Lieutenant-Governor of Bengal,

H. J. REYNOLDS,

Offg. Secy. to the Govt. of Bengal.

No. 2601.

Copy forwarded to

By order of the Lieutenant-Governor of Bengal,

H. J. REYNOLDS,

Offg. Secy. to the Govt. of Bengal.

CALCUTTA,

The 27th July 1875.

No. 53C., dated Calcutta, the 16th June 1875.

From—GEORGE KING, Esq., M.B., Superintendent, Royal Botanical Garden, Calcutta.
To—The Assistant Secretary to the Government of Bengal.

I HAVE the honor to submit herewith the Annual Report of the Government Cinchona Plantations, British Sikhim, for the year ending 31st March 1875.

Thirteenth Annual Report of the Government Cinchona Plantations in British Sikhim, by
GEORGE KING, Esq., M.B., F.L.S., Superintendent, Royal Botanical Garden, Calcutta, and
in charge of Cinchona cultivation in Bengal.

1. As Government are aware, the plantations consist practically of the two sorts of cinchona trees yielding the barks respectively known as red and yellow. The cultivation of the species producing grey and crown bark has been abandoned; grey bark being so poor in the more valuable alkaloids, and the crown bark tree, although at one time it promised well, having ultimately proved unsuitable to the climate of Sikhim.

2. During the past year, the older red bark trees have been on the whole healthy, and their growth has been fairly good. The younger plantations in the better soil and climate of the lower part of the valley are looking extremely well, and in many places the growth has been very luxuriant indeed. The number of red bark trees planted out during the year is 310,000, bringing the total number in the permanent plantation up to 2,300,000. These 310,000 represent young plants put into the ground in extension of the permanent plantation, and do not include the numerous plants required to fill the vacancies in the older parts of the plantation caused by death and accident. There are, besides, a large number of seedlings in the nurseries, and a quantity of seed has been sown; large extensions will therefore be made before the end of the year that has now been entered on, the Secretary of State having directed the more extensive cultivation of this species.

3. To the yellow bark plantation 60,000 plants have been added during the year. The total number is now therefore 354,000 young trees, exclusive of the stock in the nursery beds. As I have mentioned in former reports, this species did not for a long time seed freely in Sikhim. During the last two years, however, a considerable quantity of seed was produced, and this was carefully saved, care being taken to collect only from the varieties which Mr. Wood's analysis showed to yield the best quality of bark. It has long been suspected that *calisaya* is, in the language of gardeners, rather liable to sport; in other words, that seeds taken from the same tree often produce plants very dissimilar to their parents, and also to each other, in habit and shape of leaf. Mr. Wood's analysis, and also those of Mr. Broughton, go to prove that difference in these respects is accompanied by difference in the chemical composition of the bark. Of six varieties of our *calisaya* analysed during the year by Mr. Wood, one was found to contain as much as 7.4 per cent. of total alkaloid, of which no less than 6.2 were of crystalline sulphate of quinine; a second yielded 7.1 per cent. of total alkaloid, of which 6.9 were crystalline sulphate quinine; while a third specimen gave so poor a result as 1.6 per cent. of total alkaloid, of which no part was quinine. The seed saved from the finer sorts was carefully collected and sown. It produced, however, a large proportion of seedlings with such unmistakable resemblance to the worst varieties, that it was decided not to plant out any of them, and in future to trust to propagation by cuttings alone for any extensions which may be made in our plantations of this species.

4. A third species, referred to in former reports as a "hybrid," having been found to yield a bark rich in alkaloid, and being of vigorous growth, has received attention; and since last year the number of plants in permanent plantation has been increased from 6,000 to 21,000; there is, besides, a nursery stock of 23,000.

5. In round numbers, then, the Government cinchona property in Sikhim consists of three millions of red bark-trees, of half a million of other sorts, and of a nursery stock of about half a million plants. There is still much excellent land within the reserve well suited for cinchona; and as our nurseries are well stocked with young plants, especially of cinchona *succirubra*, considerable extensions can be undertaken without difficulty.

6. During the year some experiments were made in taking bark by Mr. McIvor's mossing process. This, as Government are aware, consists in partially denuding the trunk of a cinchona tree of its bark, and of applying moss to the denuded portion with the view of promoting a fresh formation of bark thereon. In making this experiment, Mr. McIvor's published accounts of his method were strictly followed. Sufficient time has not yet elapsed to allow me to report decidedly regarding the result, but it does not promise well. The soft newly forming bark proves highly attractive to ants, which are very numerous in Sikhim, and

these insects in many cases removed much of it as fast as it was formed; moreover, in a good many cases no new bark whatever was formed over the wounds. Coppicing has been carried on to a considerable extent. This, although undertaken primarily as a means of thinning the plantations where that was necessary, has also served as an experiment in this method of harvesting the bark-crop.

The result has been satisfactory. It has confirmed our former experience that red bark trees in Sikkim shoot freely from their cut stumps, and that, if the resulting shoots are judiciously reduced in number, they grow with great rapidity and vigour.

7. From these thinnings, and also from some pruning operations, 39,405 pounds of dry bark have been obtained. Of this quantity, 15,160 pounds have been made over to Mr. Wood, the Government Quinologist, and 4,047 pounds have been supplied to the Medical Storekeeper, Calcutta. The remainder is in stock, and will be made over to Mr. Wood, as he can manufacture it. In my last report I estimated 70,000 pounds of dry bark as the probable outturn for the year. The deficiency now reported is entirely due to the long-protracted and comparatively severe cold season, which necessitated the suspension of all cutting for an unusually long period of the year. For it has been the invariable experience on the plantation that during cold weather the bark clings so tenaciously to the wood that great labour and loss are involved in removing it, whereas during warm and moist weather it is readily separable. But although not collected before the end of the financial year, and therefore not returnable as part of last year's produce, the 30,000 pounds by which the outturn falls short of the estimate were collected during the first month of the year now entered on. The estimated yield has therefore been substantially reached.

8. Several facts point to the conclusion that the time at which cinchona *succirubra* trees are most profitably cut for their bark is when they are about eight years old; in other words, that red bark is an eight years' crop. The earliest year during which any considerable number of trees was planted in Sikkim is 1867. Prior to that, only a few trees had been put out. These trees of 1867 are now therefore in their eighth year. Moreover, the recently appointed quinologist has now settled on a cheap and efficient method of extracting the total febrifugal alkaloids from cinchona bark. The time appears now, therefore, to have arrived at which the plantation must begin to be worked on some systematic plan. As a basis for such a plan, an accurate survey of the area actually planted, and an estimate of the probable yield of bark per tree, become objects of much importance. The former is now being carried out by an officer of the Revenue Survey Department, who is located on the plantation, where he will remain until the work is finished. The calculation of the actual yield of bark per tree was undertaken by Mr. Wood, who has submitted a report on the subject, which is now before Government.

9. During the year now begun I see no difficulty in furnishing 200,000 pounds of dry bark, but I think it would be better for the present to be guided as to the quantity harvested by the capabilities of the quinologist's factory than to fix any definite amount, and to insist on so much being taken. Bark does not improve by being stored; on the other hand, it increases in weight by being left on the trees until actually wanted for the factory.

10. Arrangements have been made for drying and storing the bark at Mungpoo, where also a number of tubs for carrying out Mr. Wood's process of extraction have been put in position.

11. As mentioned in last report, some trees were treated with manure of different sorts. Mr. Wood has examined the bark of these, and reports regarding it as follows:—

"The trees were planted out at Mungpoo in April 1872. To one portion farm-yard manure was applied in June 1873, and in June 1874 sulphate of ammonia (3 oz. per plant) was applied to a second portion; guano (6 oz. per plant) to a third, and oil-cake (2 lb per plant) to a fourth portion; one patch remaining unmanured for comparison. Strips of bark were taken from the stems of a number of trees in each group in September 1874, and the total alkaloid determined, with the following result:—

"Bark from unmanured plants	7.4	per cent. total alkaloid.
"trees manured with cattle droppings	6.33	"
" " " fixed guano	6.68	"
" " " sulph. ammon.	7.27	"
" " " castor-oil cake	7.60	"

It will be seen that no appreciable effect had been produced upon the proportion of total alkaloid in the stem bark. But I do not think that any useful inference can be drawn from this result. If the manure will increase the growth of the tree, the effect will be nearly as valuable as if it had augmented the proportion of alkaloid within the bark. I would suggest, therefore, that the application of manure to this experimental patch should be repeated every second year;

and when the trees are seven or eight years old, they should be cut down and the total result determined."

12. The budget allotment for the past year was Rs. 89,525, and the total expenditure was Rs. 60,280-4-6, being Rs. 48,238-3-6 on plantation account, and Rs. 12,050-12-0 drawn by the Quinologist. This shows a saving of Rs. 29,244-11-6. The largeness of the amount saved is due chiefly to the determination to incur no expense on factory buildings while Mr. Wood's experiments on a manufactory process were pending. Previously existing and temporary buildings were therefore used, and nothing new was erected. The sum of Rs. 2,820-14-0 was credited to the plantation for the 4,047 pounds of bark supplied to the Medical Storekeeper, and Rs. 700-12-6 of land revenue were paid into the Darjeeling treasury.

13. Seed to the following amount was distributed to various applicants during the year:—

	Ozs.
<i>C. Succirubra</i>	280
<i>C. Officinalis</i>	50
<i>C. Calisaya</i>	18
Total	358

14. A beginning has at last been made in the manufacture of a cheap, efficient alkaloid, and the great object of Government in establishing these plantations appears on the point of realization. Mr. Wood's cinchona febrifuge is an amorphous powder of a very pale buff color, and entirely free from resin. It is readily soluble in water slightly acidulated with sulphuric acid. About thirty pounds of this powder were sent to the Surgeon-General, Indian Medical Department, during August and September. This quantity was distributed amongst four medical officers of much experience for the purpose of being submitted by them to a comparison as regards febrifugal power with the sulphate of quinine in ordinary use. Their reports, which are understood to be highly favourable, are now, I believe, before Government. I may mention that this alkaloid has also been given, with the best results, to coolies suffering from fever both in the plantation in Sikkim and in the Botanical Garden, Calcutta. I have also had some given to villagers living outside the garden. In all cases I have found it an efficient remedy, and it is highly prized as such by the people who have been cured by it.

15. Mr. Biermann, the second gardener, returned from sick furlough to Europe in November, and Mr. Kennedy, who had been acting for Mr. Biermann, retired from Government service on the return of the latter.

16. In conclusion, I have to express my best thanks to Mr. Gammie, the resident manager of the plantation, for his continued good service. My acknowledgments are also due to Messrs. Biermann and Jeffrey for the way they have conducted their duties. Mr. Kennedy, although now no longer a Government servant, also merits my thanks.

17. The usual returns are annexed.

Table showing the Number and Distribution of Cinchona Plants in the Government Plantations at Darjeeling on the 1st April 1875.

Names of species of Cinchona.	Number in permanent plantation.	Number of stock plants for propagation.	Number of seedlings or rooted cuttings in nursery beds for permanent plantations.	Number of rooted plants in cutting beds.	Number of cuttings made during the month.	Total number of plants, cuttings, and seedlings.
<i>C. Sphenoloba</i>	21,000	1,000	15,000	5,000	2,000	44,000
<i>C. Succirubra</i>	2,390,000	...	35,000	200,000	20,000	2,635,000
<i>C. Calisaya</i>	665,500	...	116,000	125,000	...	806,500
<i>C. Miconia</i>	50,000	...	...	...	...	50,000
<i>C. Officinalis</i> and varieties	125,000	...	...	...	...	125,000
<i>C. Robinsoniana</i>	5,000	...	...	...	...	5,000
<i>C. Platyphylloides</i>	...	...	...	...	...	...
Total	3,415,500	1,000	200,000	330,000	24,000	3,954,500

MUNGPOO,
The 7th April 1875.

J. GAMMIE,
Head Gardener, in charge of Cinchona
Plantations, Darjeeling.

Table showing the growth of Cinchonas in the Darjeeling Plantations during the six months ending 31st March 1875.

NAMES.	Numbers.	3rd Plantation (Risbap), altitude 2,000 feet.				4th Plantation (Rungthu), altitude 3,302 feet.				5th Plantation (Rungthu), altitude 2,550 feet.					
		Date of planting, 1867.	Height in inches on 1st January 1868.	Height on 1st October 1874.	Growth during six months.	Date of planting, 1864.	Height in inches when planted.	Height on 1st October 1874.	Growth during six months.	Date of planting, 1864.	Height in inches when planted.	Height on 1st October 1874.	Growth during six months.		
C. Saccubra.	1	20th March	23	259	280	20th July	6	330	339	15th Oct.	6	352	300		
Ditto	2	20th "	30	280	300	20th "	6	374	382	"	10	244	244		
Ditto	3	20th "	37	279	279	20th "	7	283	288	20th July	5	264	264		
Ditto	4	20th "	24	292	293	15th Oct.	10	342	343	29th "	5	247	247		
Ditto	5	20th "	37	293	293	29th July	4	302	312	"	5	379	380		
Ditto	6	20th "	30	300	309	29th "	4	296	300	10	29th "	3	213	216	
Ditto	7	20th "	37	210	216	29th "	3	307	401	"	4	306	308		
Ditto	8	20th "	30	276	284	"	3	338	350	12	29th "	4	306	310	
Ditto	9	20th "	39	192	192	29th "	3	338	344	11	29th "	4	304	308	
Ditto	10	20th "	25	243	252	10	29th "	3	296	279	12	29th "	4	274	274
C. Miconia.	1	16th "	17	205	213	0	15th Oct.	2	208	303	2	29th "	5	268	268
Ditto	2	16th "	10	204	204	2	29th July	6	349	343	3	29th "	5	268	267
Ditto	3	16th "	4	244	240	2	29th "	3	284	384	1	15th Oct.	0	323	324
Ditto	4	16th "	40	246	241	1	29th "	2	168	169	1	29th July	4	346	346
Ditto	5	16th "	45	305	305	1	15th Oct.	8	280	293	1	15th Oct.	2	322	324
C. Callaya.	1	20th June	25	288	288	1	29th June	15	164	164	1	1st January	2	179	181
Ditto	2	20th "	10	309	312	3	29th "	8	168	170	2	1st "	3	258	260
Ditto	3	20th "	15	250	259	2	29th "	12	183	187	4	1st "	3	229	234
Ditto	4	20th "	18	320	309	2	29th "	19	204	204	1	1st "	3	186	186
Ditto	5	20th "	23	250	258	3	29th "	11	240	240	1	1st "	3	227	230
Ditto	6	20th "	24	257	289	2	29th "	10	168	168	1	1st "	3	182	182
Ditto	7	20th "	23	300	309	2	29th "	10	210	220	10	1st "	4	239	239
Ditto	8	20th "	19	274	275	3	29th "	13	160	160	1	1st "	2	228	234
Ditto	9	20th "	21	213	210	2	29th "	12	Dead.	...	1	1st "	7	223	223
Ditto	10	20th "	21	250	237	1	29th "	19	190	192	12	1st "	3	147	147

GEORGE KING,

Supdt., Botanical Gardens, and in charge of
Cinchona Cultivation in Bengal.

Table showing the number and Distribution of Cinchona Plants in the Government Plantations at Darjeeling on the 1st October 1874.

NAMES OF SPECIES OF CINCHONA.	Number in permanent plantation.	Number of stock plants for propagation.	Number of seedlings or rooted cuttings in nursery beds for permanent plantations.	Number of rooted plants in cutting beds.	Total number of plants, cuttings, and seedlings.
C. New variety	21,000	1,000	15,000	5,000	42,000
C. Saccubra	2,300,000	...	125,000	193,000	2,618,000
C. Callaya	354,500	5,000	115,000	125,000	599,500
C. Miconia	50,000	...	...	...	50,000
C. Officinalis and varieties	125,000	...	...	...	125,000
C. Pahadiana	5,002	...	...	...	5,002
C. Mayensis	...	18	...	...	18
Total	2,855,502	3,018	253,000	298,000	3,407,520

J. GAMMIE,

Head Gardener, in charge of Cinchona
Plantations, Darjeeling.

No. 67C, dated Howrah, the 25th October 1875.

From—GEORGE KING, Esq., M.B., Superintendent, Royal Botanical Garden,
Calcutta, and in charge of Cinchona Cultivation in Bengal.
To—The Secretary to the Government of Bengal, Financial Department.

I HAVE the honor to forward herewith the returns of the Government
Cinchona Plantation in Sikkim for the half-year ending 30th September 1875.

Table showing the number and distribution of Cinchona Plants in the Government Plantations at Darjeeling on the 1st October 1875.

NAMES OF SPECIES OF CINCHONA.	Number in permanent plantation.	Number of stock plants for propagation.	Number of seedlings or rooted cuttings in nursery beds for permanent plantation.	Number of rooted plants in cutting beds.	Number of cuttings made during the month.	Total number of plants, cuttings, and seedlings.
C. New variety	21,000	1,000	None	1,000	None	27,000
C. Saccubra	2,300,000	...	None	250,000	None	2,550,000
C. Callaya	354,500	...	None	150,000	None	504,500
C. Miconia	50,000	...	...	...	...	145,000
C. Officinalis and varieties	125,000	...	...	...	...	125,000
C. Pahadiana	5,002	...	...	...	...	5,002
Total	2,855,502	3,018	4,000	401,000	500	3,732,022

Table showing the growth of Cinchonas in the Darjeeling Plantations during the six months ending 30th September 1875.

3RD PLANTATION (RISBAP). ALTITUDE 2,000 FEET.										4TH PLANTATION (RUNGTHU). ALTITUDE 3,302 FEET.										5TH PLANTATION (RUNGTHU). ALTITUDE 2,550 FEET.									
NAMES.	Numbers.	Date of Planting, 1867.	Height in inches on 1st Jan. 1868.	Height on 1st April 1875.	Height on 1st October 1875.	Growth during six months.	Date of Planting, 1864.	Height in inches when planted.	Height on 1st April 1875.	Height on 1st October 1875.	Growth during six months.	Date of Planting, 1864.	Height in inches when planted.	Height on 1st April 1875.	Height on 1st October 1875.	Growth during six months.													
C. Saccubra	1	20th March	23	259	236	29	29th July	5	339	331	12	15th Oct.	6	352	269	586	6												
Ditto	2	20th "	30	299	298	0	29th "	6	374	385	22	15th "	10	244	244	244	10												
Ditto	3	20th "	37	279	260	21	29th "	7	283	288	17	20th "	5	264	267	280	1												
Ditto	4	20th "	24	304	304	0	15th Oct.	10	343	343	0	29th "	5	247	296	240	2												
Ditto	5	20th "	37	303	303	36	29th July	4	302	313	30	29th "	3	310	303	308	1												
Ditto	6	20th "	30	300	315	0	29th "	4	286	300	34	29th "	4	306	304	0	0												
Ditto	7	20th "	37	210	210	20	29th "	3	307	401	42	4	310	310	318	18	0												
Ditto	8	20th "	30	276	291	7	29th "	3	338	350	23	29th "	4	306	310	318	18												
Ditto	9	20th "	39	192	192	12	29th "	3	338	344	10	29th "	5	274	274	274	0												
Ditto	10	20th "	25	243	252	10	29th "	3	296	279	19	29th "	5	274	274	274	0												
C. Miconia	1	16th "	17	206	213	0	15th Oct.	2	208	300	...	29th "	5	268	268	264	0												
Ditto	2	16th "	10	204	204	2	29th July	6	349	343	...	29th "	0	307	307	307	0												
Ditto	3	16th "	4	244	240	2	29th "	3	284	384	...	15th Oct.	0	323	323	324	0												
Ditto	4	16th "	40	246	241	1	29th "	2	168	169	...	29th July	4	346	346	346	0												
Ditto	5	16th "	45	305	305	1	15th Oct.	8	280	298	9	15th Oct.	2	322	324	324	0												
C. Callaya	1	20th June	25	288	302	14	29th June	15	164	173	12	1st January	2	181	181	181	0												
Ditto	2	20th "	10	312	326	14	29th "	0	179	179	...	1st "	3	260	276	276	1												
Ditto	3	20th "	13	298	300	14	29th "	12	187	187	...	1st "	3	234	240	240	0												
Ditto	4	20th "	18	303	293	22	29th "	10	244	234	...	1st "	0	184	180	180	0												
Ditto	5	20th "	23	250	272	17	29th "	11	240	244	...	1st "	1	230	230	230	0												
Ditto	6	20th "	24	257	289	0	29th "	10	168	168	...	1st "	4	182	179	179	0												
Ditto	7	20th "	23	300	304	4	29th "	10	210	220	23	1st "	4	233	248	248	1												
Ditto	8	20th "	19	279	273	24	29th "	13	160	160	...	1st "	2	228	234	234	0												
Ditto	9	20th "	21	213	210	13	29th "	12	Dead	...	...	1st "	7	223	223	223	0												
Ditto	10	20th "	21	250	237	21	29th "	19	192	201	0	1st "	3	147	147	147	0												

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* Height on 1st January 1868.

GEORGE KING,

Supdt., Botanical Gardens, and in charge of
Cinchona Cultivation in Bengal.

No. 3643.

COPY submitted to the Secretary to the Government of India, Department
of Revenue, Agriculture, and Commerce, for information, in continuation of
this office endorsement No. 2589, dated 26th July 1875.

By order of the Lieutenant-Governor of Bengal,

GEO. EASTON,

Acting Asst. Secy. to the Govt. of Bengal.

CALCUTTA;

FINANCIAL DEPT.—Agriculture,
The 1st November 1875.

C. E. G.—Reg. No. 3995.

Table showing the growth of *Cinchona* in the Injecting Plantations during the six months ending 1st October 1874.

NAMES.	No. of plants.	2nd Plantation (Ranch), altitude 2,000 feet.					4th Plantation (Ranch), altitude 2,000 feet.					5th Plantation (Ranch), altitude 2,000 feet.				
		Date of planting, 1873.	Height in feet on 1st January 1874.	Height in feet on 1st April 1874.	Height in feet on 1st July 1874.	Growth in feet in 6 months.	Date of planting, 1873.	Height in feet on 1st January 1874.	Height in feet on 1st April 1874.	Height in feet on 1st July 1874.	Growth in feet in 6 months.	Date of planting, 1873.	Height in feet on 1st January 1874.	Height in feet on 1st April 1874.	Height in feet on 1st July 1874.	Growth in feet in 6 months.
<i>C. Saponaria</i>	1	25th March	58	60	65	7	25th July	4	815	820	5	25th Oct.	4	820	825	5
Do.	2	25th "	60	62	67	7	25th "	5	820	825	5	25th "	5	825	830	5
Do.	3	25th "	62	64	69	7	25th "	6	825	830	5	25th "	6	830	835	5
Do.	4	25th "	64	66	71	7	25th "	7	830	835	5	25th "	7	835	840	5
Do.	5	25th "	66	68	73	7	25th "	8	835	840	5	25th "	8	840	845	5
Do.	6	25th "	68	70	75	7	25th "	9	840	845	5	25th "	9	845	850	5
Do.	7	25th "	70	72	77	7	25th "	10	845	850	5	25th "	10	850	855	5
Do.	8	25th "	72	74	79	7	25th "	11	850	855	5	25th "	11	855	860	5
Do.	9	25th "	74	76	81	7	25th "	12	855	860	5	25th "	12	860	865	5
Do.	10	25th "	76	78	83	7	25th "	13	860	865	5	25th "	13	865	870	5
<i>C. M. Saponaria</i>	1	25th "	78	80	85	7	25th "	14	865	870	5	25th "	14	870	875	5
Do.	2	25th "	80	82	87	7	25th "	15	870	875	5	25th "	15	875	880	5
Do.	3	25th "	82	84	89	7	25th "	16	875	880	5	25th "	16	880	885	5
Do.	4	25th "	84	86	91	7	25th "	17	880	885	5	25th "	17	885	890	5
Do.	5	25th "	86	88	93	7	25th "	18	885	890	5	25th "	18	890	895	5
Do.	6	25th "	88	90	95	7	25th "	19	890	895	5	25th "	19	895	900	5
Do.	7	25th "	90	92	97	7	25th "	20	895	900	5	25th "	20	900	905	5
Do.	8	25th "	92	94	99	7	25th "	21	900	905	5	25th "	21	905	910	5
Do.	9	25th "	94	96	101	7	25th "	22	905	910	5	25th "	22	910	915	5
Do.	10	25th "	96	98	103	7	25th "	23	910	915	5	25th "	23	915	920	5
<i>C. Calceaya</i>	1	25th "	98	100	105	7	25th "	24	915	920	5	25th "	24	920	925	5
Do.	2	25th "	100	102	107	7	25th "	25	920	925	5	25th "	25	925	930	5
Do.	3	25th "	102	104	109	7	25th "	26	925	930	5	25th "	26	930	935	5
Do.	4	25th "	104	106	111	7	25th "	27	930	935	5	25th "	27	935	940	5
Do.	5	25th "	106	108	113	7	25th "	28	935	940	5	25th "	28	940	945	5
Do.	6	25th "	108	110	115	7	25th "	29	940	945	5	25th "	29	945	950	5
Do.	7	25th "	110	112	117	7	25th "	30	945	950	5	25th "	30	950	955	5
Do.	8	25th "	112	114	119	7	25th "	31	950	955	5	25th "	31	955	960	5
Do.	9	25th "	114	116	121	7	25th "	32	955	960	5	25th "	32	960	965	5
Do.	10	25th "	116	118	123	7	25th "	33	960	965	5	25th "	33	965	970	5

GEORGE KINC.

Super., Botanical Gardens, and in charge of
Cinchona Cultivation in Bengal.

FINANCIAL DEPARTMENT

AGRICULTURE

CALCUTTA, the 26th JULY 1875.

RESOLUTION.

READ—

The Annual Report of the Government Cinchona Plantations, British Sikkim, for the year ending the 31st March 1875.

1. The operations connected with the Cinchona cultivation exhibit a continued measure of success which is satisfactory. The number of trees planted out during the year in the permanent plantations was—

Red bark trees	310,000
Yellow bark trees	60,000
Hybrids	15,000
Total	385,000

This brought up the total number of plants in the permanent plantations to—

Red bark trees	2,300,000
Yellow bark trees	554,000
Hybrids	21,000
Total	2,705,000

Or, in round numbers "the Government Cinchona property in Sikkim consists of three millions of red bark trees, of half a million of other sorts, and a nursery stock of about half a million plants." The red bark trees, the younger plantations in particular, have been in good condition during the year. The experiments with *calisaya* seed have proved a failure, owing to the uncertainty which was found to attend the result of planting those seeds which appeared to promise best. The following account is given of the analysis of some plants and of the trial of their seeds:—"Mr. Wood's analysis, and also those of Mr. Broughton, go to prove that difference in these respects (i.e., in results) is accompanied by difference in the chemical composition of the bark. Of six varieties of our *calisaya* analysed during the year by Mr. Wood, one was found to contain as much as 7.4 per cent. of total alkaloid, of which no less than 6.2 were of crystalline sulphate of quinine; a second yielded 7.1 per cent. of total alkaloid, of which 6.0 were crystalline sulphate of quinine; while a third specimen gave so poor a result as 1.6 per cent. of total alkaloid, of which no part was quinine. The seed saved from the finer sorts was carefully collected and sown. It produced, however, a large proportion of seedlings with such unmistakable resemblance to the worst varieties, that it was decided not to plant out any of them, and in future to trust to propagation by cuttings alone for any extensions which may be made in our plantations of this species." The hybrid plants promise great success; they yield a bark rich in alkaloids and are of a vigorous growth.

2. The extension of the red bark tree cultivation meets the views of the Secretary of State expressed in his despatch of the 5th November 1874. It appears that though the red bark is not so rich in quinine as the yellow variety, it nevertheless yields a greater total of alkaloid, which is as efficacious a febrifuge as quinine itself. If the further enquiries which are now being instituted should prove this to be the fact, the resolution of the 15th December 1874, which prohibited the extension of *C. Saccorubra* cultivation, will require to be modified. The reports called for in the same despatch as to the efficacy of cinchonidine have not been received, but Mr. Wood, in his report of the 24th May 1875 (paragraph 9), states that he supplied to the medical authorities an alkaloid consisting of cinchonidine and cinchonine, and he understands that

both Dr. Chevers and Dr. Ewart are fully satisfied of its efficacy and are quite prepared to recommend its adoption in all Government hospitals and dispensaries. It also appears that this alkaloid was administered in some cases to coolies suffering from fever on the Sikkim plantation and at the Botanical Garden in Calcutta, and was found to be an efficient febrifuge.

3. With reference to the remarks made in the 5th paragraph of last year's review, regarding Dr. King's recommendation of an alternative preparation of bark instead of the sulphate of cinchonidine, he has explained that he did not make the proposal to use a decoction of twig bark in ignorance or depreciation of the merits of that alkaloid as a febrifuge, but merely as a means of utilising *twig* bark from which the Quinologist informed him he would not be able to extract any of the alkaloids with profit, and which was not worth sending to England.

4. Some experiments were made during the year in taking bark by Mr. McIvor's mowing process. Dr. King reports that sufficient time has not elapsed to allow him to report decidedly regarding the result, but that it does not promise well. The result of coppicing, on the other hand, has been quite satisfactory. The coppicing and pruning operations produced 39,405lbs of dry bark, of which 15,160lbs were made over to Mr. Wood, and 4,047lbs were supplied to the Medical Storekeeper. The remainder was kept in stock until Mr. Wood was ready to receive it. In these cases there are no separate reports of the results obtained. Dr. King sees no difficulty in furnishing 200,000lbs of dry bark during 1875-76.

5. Owing to the long-protracted and severe cold season, the yield of bark did not reach the estimate of 70,000lbs, but the 30,000lbs by which the amount fell short was collected in the first month of the financial year 1875-76.

6. The enquiries of the Government Quinologist have resulted in a cheap and efficient method of extracting the febrifugal alkaloids from cinchona bark. The report of these enquiries and their result has been reviewed in a separate resolution. The Lieutenant-Governor approves of the measures taken to effect a survey of the plantation.

7. The experiments made on the application of manure to the plants had no appreciable effect upon the proportion of total alkaloid yielded. Further experiments must be made before any opinion can be formed on the subject.

8. The Lieutenant-Governor notices with satisfaction the approval expressed by Dr. King of the services of the resident manager of the plantation, Mr. Gammie, and of the subordinate gardeners.

ORDERED, that copies of this Resolution and of the report be submitted to the Government of India, in the Department of Revenue, Agriculture, and Commerce; also that copy, with 100 copies of the report, be forwarded to the Superintendent of the Botanical Gardens and in charge of Cinchona cultivation, for information, with reference to his letter No. 53C., dated the 16th June 1875.

By order of the Lieutenant-Governor of Bengal,

H. J. REYNOLDS,

Offg. Secy. to the Govt. of Bengal.

No. 2589.

Copy forwarded to

By order of the Lieutenant-Governor of Bengal,

GEO. EASTON,

Acting Asst. Secy. to the Govt. of Bengal.

CALCUTTA,

The 26th July 1875.

A. T.—Reg. No. 635.

DEPARTMENT.

No. 2589.

From

Secretary to the Government of Bengal.

To

Calcutta, the 7th January 1876.

Sir,

I have the honor to acknowledge the receipt of your letter of the 24th inst. and in reply to inform you that the same has been forwarded to the Government of India, in the Department of Revenue, Agriculture, and Commerce, for their consideration. I have also the honor to inform you that a copy of the report on the manufacture of cinchona alkaloid, dated the 24th inst. 1875, of the Lieutenant-Governor's resolution thereon, together with a copy of the paper

Annual Report of the Govt. Cinchona Plantations 1874/75. Letter from the Dep. Secy. Botanical Garden to the Secy. of the Govt. of Bengal, dated the 26th July 1875. marked on the margin, regarding Cinchona plantation.

Bengal

The officer in charge of Cinchona
cultivation in Bengal has been asked
to furnish further information regarding
the mode of harvesting the bark & a
receipt of his reply & further communi-
cation will be made to you.

Share the honor to be

Yrs,

Your most obedient servant

J. A. Boudman

Acting Assistant Secretary
to the Government of Bengal.

Recd 12/4/76

HWS

1. 1st

Botanum d
Cinchona Plant
21st March 1876

H. G. Fisher Esq
Superint' Govt. (Cinch Plant)
Botanum d

J. W. Jackson Esq
Commissioner of Police
Botanum d

I have the honor to return the papers
concerning the manufacture of Cinchona
bark to the cultivation in Bengal.
I have perused these papers with interest,
and am not being able to return them
for information in my office.

I would respectfully direct your
attention to the report of the Superintendent
of the Cichina plantations dated 1st July 1876
where it is stated at para 27/B that
"any future quantity of succinbark
required by Government can be grown at
"half the cost in Cichina that it can in
"the other species," and in the same para
(C) it is observed "Now at Rishap (in these
"Cichina plantations) C. Calicaya grows
"just as luxuriantly, and healthily as does
"C. succinbark. Good specimens in two years
in permanent plantations reached 12 feet
high

high, and would then cut 2 lbs of good dry
bark each."

3. The above statements naturally
caused alarm as to the safety of our under-
taking, and led to the expenditure on our
cultivation being limited to a point which
seriously retarded the progress of our
plantations. The last sentence quoted
conveys the impression that in British
Columbia a cherry at five years old
would produce 20 lbs of good dry bark.
If the bark of a tree covers the circumference
of the stem and branches, and therefore
increases in the ratio that the circumference
of a cone bears to its height and diameter.
For example a tree of 2 years old, 12 feet
high, and 4 inches in diameter, and giving
2 lbs of good dry bark, would one the 3rd year
be 18 feet high, 6 inches in diameter, and
give 4 lbs of dry bark, and so on in each
succeeding year a proportionate increase.

4. One year's experience has led to
this estimate being greatly modified, as
we find that instead of 20 lbs of good
dry bark per tree, that the *Quercus* at
page 11 of his report, now estimates the
yield of a tree 5 or 6 years old at 1 1/2 lbs
including branch bark.

5. The present report on the *Quercus*
plantations carefully considered in connection
with our experience, leaves the impression
that time will indicate the necessity for
important modification; but, be this as
it may, it is evident that the pleasing
prospect now set before us prevents
quite opposite features when examined from
another point of view. A paragraph of the
Quercus report that gentlemen are
remarking, "It appears from the foregoing
results that while strips of bark taken
from our *Quercus* yield from 6 to 7 per cent
of total alkaloid, the bulk of bark obtained
by cutting round the tree, and peeling them
only yield from 10 to 15 per cent," and at
page 11 observes, "Up to the present time
10,000 lbs of dry bark have been worked
by this plan, and the yield of petrifying
has been 2.17 per cent. But this includes all
the bark consumed in experimental opera-
tions, and much also that was of very
poor quality. In some recent results 2 1/2
and 3 per cent have been obtained, and I
believe the method upon an average will
furnish three-fourths of the alkaloid present
in the bark." These statements merit
serious

serious consideration as they show that from
bark containing 4 to 5 lbs of alkaloid,
2.47 lbs only was extracted. In other words,
one half of the whole alkaloid contents of
the bark was either lost or destroyed in the
process of manufacture. . . . I read
these statements, they indicate that by the
local manufacture of the alkaloide a
loss is sustained of over one half of the
productive power of the pekinia plantations.
Thus depriving the population of the
poor stricken districts of India of more
than one half of the benefits these planta-
tions are capable of bestowing.

At para 8 Mr Wood gives
estimates showing that the mixed alkalo-
id can be manufactured in Bengal
at 16 Rs per lb or 25 p. oz. in addition of the
salary of the Chemist. I notice however
that this result is obtained by placing
the price of the dry bark used in manufacture
at under 40 Rs the price which the bark would
realize if sold. At para 18 Mr Wood remarks
"any attempt at taking the commercial value
of bark in the London market, as a basis would
be untenable, because the factory, because such
prices are fluctuating and uncertain; but
with the cost price regularly recorded from year
to year, a comparison with market value can be
always

always made, and the full economical
results readily ascertained. (1)

The Quinologist however, does not
appear to have accepted either the cost price
or commercial value in fixing the price
at 25 p. oz. of dry bark.

The Chinese operations in Sikkim
were begun about 16 years ago, and it will
be admitted that the time has now arrived
when the value of the produce of these planta-
tions should at least equal the expenses.
I have perused the report of the
Commissioner of the plantations dated
16 June 1895 the whole harvest of that
year is stated to be 39,403 lbs of dry
bark, and at para 12 the current expenditure
on the plantations is given as Rs. 60,280. 4. 6.
Therefore if current expenditure only be
charged against the total produce of the
plantations, we find the actual cost
of the bark 4 p. lb is not 1/2 anna as put at
1. 8. 5. Thus when the true cost of the bark
is charged the price per lb of the alkaloid
produced is increased to Rs. 43 p. lb or fully
9 s. p. oz. Mr Whiffen the eminent
Gummi manufacturer quotes this pro-
position at 2 s. p. oz. Mr Wood objects
to adopt the market price of the
bark

bark same as before. The Right
Honorable the Secretary of State for
India in para 2 of his despatch of
16th December 1873 (Record in G.O. of the
2nd March 1874) lays down that the
market value of the bark should be
accepted in valuation of the cost of our
amorphous quinine.

8. Red bark containing 9 to 10.5%
of alkaloid is of high value for pharma-
ceutical preparations, and at present
price is worth at least 2 6 pth in
the London market.

Yours the honor able
servant

Jas. MacArthur Esq. M.C.

J. S. MacArthur

Chief of the Govt. (Ind. Plant.)

Commissioner's Office

Portacarnend 25th March 1896.

✓
1000

J. P. Lockwell Esq
Commissioner

Chromolaena

Belgavia

1781

The Secretary of Government

Revenue Department

Carl St. George

Memorandum from your office dated
13th instant N^o. 39, requests the return
of two Resolutions of the Government
of Bengal on the report of the Sikkim
cinchona plantations for 1874-75 and
on a report from the Bengal Govern-
ment Quinologist respectively, which
were forwarded for the information
of Mr. Eric Sore and myself.

2. I enclose the papers. I also

Amelia

100

[illegible]

1890

27th December 1961

188

1895

1940

M. A. B. 10-10-19

[Faint handwritten notes, possibly "The end of the world"]

Alfred J.

W. C. Hoffman

Charles W. Henry

enclose a letter from Mr. In-Loo, remarking upon the statements made in the reports.

3. Mr. Clarke, the then Superintendent of the Sikhim plantations, in his report for the year 1870 wrote "that Saccarubra bark can be grown at half the cost in Sikhim, than it can on the Nilgiris."

This report, no doubt, led to the reduction of expenditure on the Nilgiri Plantations, which was ordered by Government under 21st December 1870, & 20th February Department, and to a consequent under cultivation that has recently been rectified.

4. Mr. In-Loo now points out that the lapse of 5 years since the publication of Mr. Clarke's report, has materially modified Mr. Clarke's anticipation. Mr. Clarke calculated that every Saccarubra tree in Sikhim would, at 4 years old, cut 34½ lbs of good dry bark. The estimate

returned in the present papers is reduced to 1½ lbs of good dry bark. (3)

5. Mr. Clarke went, it para 5 of his report, in terms indicating his impression that the Sikhim plantations were altogether superior to the plantations on the Nilgiris. I observe from the present papers that the yield in 1870-71 was 40,000 lbs of dry bark including branch bark and scrapings. The yield of that year of the Nilgiri plantations was 28,660½ lbs of dry bark which fetched an average of nearly 4s 8 per lb in the London Market and 8½ cwt of green bark supplied to Mr. Bronghton and kept the Sikhim plantations as stated in the present Resolution of the Government of Bengal contain 300,000 lbs bark & 50,000 of other sorts while the Nilgiri plantations contain 100,000 trees only in round numbers. With regard to age the Sikhim plantations

are nearly as old as the Sikkim plantation.

6. Mr. Clark gave, in para 27 of his report, a very encouraging description of *C. Calisaya* as grown in Sikkim. He stated "I believe the only locality yet discovered where it can be grown to any economic advantage is at Risikp." In the present papers it is shown that it has been determined not to continue the propagation of *C. Calisaya* except by contract with the Government with remainder.

That Mr. Mac Ewen has always condemned the variety of Cinchona as a plant too delicate to be grown with good economic results.

Mr. Mac Ewen's description in his letter of the prospects held out by Mr. Wood of a cheap local manufacture of Cinchona alkaloids. Mr. Wood estimates the cost of production at $8\frac{1}{2}$ annas per lb of good dry bark at Sikkim. Mr. Mac Ewen

Mr. Mac Ewen maintains that as the yield of the plantation in 1894-95 was only 20000 lbs and the cost of maintenance including the Quinologists salary was 60000 Rupees, each lb of dry bark cost Rs 1-2-0 to produce. At that rate Mr. Wood's alkaloids cost the Government not one Rupee per lb as Mr. Wood estimates, but more than 4 Rupees per lb. This estimate is taken from Mr. Wood's own figures. He states that he extracted $2\frac{1}{2}$ - $3\frac{1}{2}$ from every hundred lb of bark. One hundred lb worth 150 Rupees yielded 35 lb of alkaloids. But it is evident that anticipation - implying a cheap local manufacture - will require to be modified when it is found that, as Mr. Wood reports, he loses by his process half the alkaloids. He states that the Sikkim bark contains from 4 to 5 per cent of alkaloids and he extracts $2\frac{1}{2}$ per cent only. It must be observed that manufacturers in England

and

lose very little of the alkaloids. Were it otherwise, they could not afford the price now paid in the Market for bark. It is difficult to understand how a process carried out in India which loses half the alkaloids can compete with a process in England that extracts nearly the whole.

8. Another point for observation in connection with the value at which the bark should be taken in the London Market. The value of 1 lb bark yielding 10 or 15 percent of alkaloids is about 2s 6d per lb. Applying this test, the Woods estimate of 3½ annas should be an advance to the plantations at least 2 p per lb. In a letter from the Secretary to the Government of India to the Government of Bengal dated in June 1895 it is stated that "The Governor General in Council became in the Resident General

(39)

Governor's decision regarding the export of bark. In some years to come the only possible method of keeping a check on expenditure and of ascertaining the real commercial value of this experiment will be to report annually a considerable proportion of the best bark produced, and sell it for the highest price it will fetch in the open market."

9. In conclusion I would say that if the prices realized for the Sikkim bark could be obtained, this information would afford the best test of the relative results of the Sikkim and Nilgiri plantations.

I have the honor to be
Sir,
Your most obedt Servt
W. C. Cresswell
Colonial Secretary

