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MADRAS RECORD OFFICE.

Government of Madras.

Revenue **DEPARTMENT.**

G.O. No. 1686. Press / ~~Mis.~~

Dated 26. 9. 1871 18 .

Not to be folded or roughly handled

Read the following letter from J. BROUGHTON, Esq., Government Quinologist, to the Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 31st July 1871 :—

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

——	1868.	1869.	1870.	1871.
Total alkaloids	6·74	7·43	7·60	7·85
Total sulphates obtained	6 06	6·43	6·00	5 45
Quinine	2·40	1·72	1·73	1·80
Cinchonidine and cinchonine	4·34	5·71	5·87	6·05
Sulphate of quinine obtained crystallized ...	2·21	1·51	1·40	1·15
Sulphate of cinchonidine obtained crystallized.	3·85	4·92	4·60	4·30

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

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

4. In a report appearing, Proceedings Madras Government, 22nd February 1869, No. 235, paragraph 4, I had occasion to mention that the amount of quinine had diminished during past years in the red barks, although that of the total alkaloids had increased. During the last two years it appears that the amount of quinine has remained nearly constant, and probably in years to come, its amount will hereafter remain nearly stationary in our red bark.

5. From the above analyses it also seems probable that the amount of obtainable crystallized sulphate of cinchonidine, is diminishing with the increase of age.

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5. From the above analyses it also seems probable that the amount of obtainable crystallized sulphate of cinchonidine, is diminishing with the increase of age.

But with the present evidence, I cannot hold this yet to be quite clear; since the determination of the amount of crystallized sulphates is apt to be modified by circumstances other than the real amount of pure alkaloid, which latter it only approximately indicates.

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

Crown Bark from Dodabetta Plantation.

	I.	II.	III.	IV.
	Trees of good growth, 6 years 6 months of age.	Trees of good growth, 5 years 9 months of age.	Oldest trees.	Trees of fine growth.
Total alkaloids	5·26	3·10	6·53	6·91
Quinine	3·48	1·62	4·18	4·71
Cinchonidine and cinchonine	1·78	1·50	2·35	2·20
Sulphate of quinine obtained crystallized ...	3·25	1·64	4·17	4·80
Sulphate of cinchonidine obtained crystallized.	2·04	1·14	1·57	1·60

Crown Bark from Neddivuttum Plantation.

	Trees 6 years 9 months of age.	Trees 6 years 3 months of age, of good growth.
Total alkaloids	4·96	6·01
Quinine	3·03	4·19
Cinchonidine and cinchonine	1·93	1·32
Sulphate of quinine obtained crystallized	3·14	4·24
Sulphate of cinchonidine obtained crystallized	1·05	1·39

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

8. In total yield the bark of *C. succirubra* is the richest, but in its natural state at least, this consists mainly of cinchonidine, cinchonine, and occasionally quinidine—alkaloids which custom and the addition of fresh names, coincident with the first separation of these substances, have kept out of extensive therapeutical use. The medical reports of the Cinchona Commissioners of the Indian Presidencies and the report on the medical use of "Amorphous quinine" appear to indicate that these alkaloids—and consequently red bark, is the kind that can be employed most usefully in India. In Europe the price of the natural red bark will hereafter sink, when it is brought into competition with crown bark. How far by careful special cultivation of the red bark it may hereafter be possible to modify this result, it would at present be premature to speculate.

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

Trunk Bark of C. calisaya grown at Neddivuttum.

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

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

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

Dodabetta.		Neddivuttum.	
Total alkaloids	2·06	Total alkaloids	6·25
Quinine	0·79	Soluble in ether	0·41
Cinchonidine and cinchonine ...	1·27	Cinchonidine	2·00
		Cinchonine	3·84
Sulphate quinine obtained crystallized	0·67		
Sulphate cinchonidine obtained crystallized	0·94	Sulphate cinchonidine obtained crystallized	1·80

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

12. The occurrence of several remarkable varieties among the trees raised from seed has directed my attention to the occurrence of hybrids among our species of Cinchona. In one instance I was able, from the account given by Mr. C. Dawson, then Assistant Superintendent at Neddivuttum, to directly trace the origin of a very beautiful plant, which was found to be a hybrid between *C. succirubra* and *micrantha*. This plant was picked up a seedling under a tree of the latter. I analysed its bark, and found its yield was poor, but represented a mean between the qualities of the two species. Examination among seedling trees led to the discovery of many other examples of hybridism, especially to cross-breeds between *C. succirubra* and *officinalis*. In 1870 I communicated a short memoir on the subject to the Linnæan Society.* The occurrence of the dimorphic varieties, "*macho*" and "*hembra*," in each species of Cinchona was shown in this communication to render cross-breeding highly probable; in the same manner as has been shown by Darwin to occur in *Primula*, *Oxalis*, and other plants. I learn from the

* Read, March 3rd 1870.

discussion which took place on the subject at the Society's meeting, that the fact of the tendency of Cinchona to hybridism was considered proved. Since that time I have made numerous analyses of the bark of various hybrids that I have observed, but in no one instance have I found any of special excellence. In fact, it appears to me that these hybrids combine the bad qualities of both their parents. I therefore do not quote the analyses.

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

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

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

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

——	North side.	South side.
Total alkaloids...	3·18	3 80
Quinine	0·62	1·40
Cinchonidine and cinchonine ...	2·56	2·10

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

No. 362. ORDER THEREON, 26th September 1871, No. 1,686.

Miscellaneous.

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

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

(True Extract.)

(Signed) W. HUDLESTON,
Secretary to Government.

To J. Broughton, Esq.
„ the Commissioner of the Nilgiris.
„ the President of the Cinchona Commission.
„ the Board of Revenue.

Exd. F. R. Bantleman.

Extract

Sir,

I am directed by the Secretary to Government to forward herewith for the information of the Board of Revenue a duplicate of the Statement of Sulphate of Quinine extracted from the Cinchona bark grown in the Government Plantations on the Neilgherries during the year 1871, and to request that the Board will be pleased to submit a report on the subject.

2. The Government observe with satisfaction the increase in the out-turn of Sulphate of Quinine from the bark of the Government Plantations, and they request that the Board will be pleased to state whether the price realized for the Sulphate is remunerative.

3. The Government would also be glad to receive the opinion of the Board on the question whether the Cinchona plantations should be extended.

I have, &c.,
(Signed) W. Huddleston, Esq.,
Secretary to Government,
Revenue Department.

Ootacamund
8th October 1871.

From Mr. Secretary Brightman
Government Quinologist

	1868	1869	1870	1871
Total Alkaloids	6.42	7.43	7.60	7.85
Total Sulphates obtained	6.00	6.43	6.00	5.45
Ditto	2.40	1.42	1.43	1.80
Cinchonidine & Cinchonine	4.34	5.41	5.84	6.05
Sulphate of Quinine obtained	2.21	1.51	1.40	1.15
Crystallized				
Sulphate of Cinchonidine obtained	3.85	4.92	4.60	4.30
Crystallized				

Extract

Revenue & Agl. Proc. 21 Nov 1871
No 45 Mad.

V No 3776 1871.

Govt. of {1871} Madras. 16

REVENUE.

To

J. BROUGHTON, Esq.,

&c., &c., &c.

Dated September 26th.

Recd. Encl.

G. O., 26th September 1871, No. 1,686.

SEPTEMBER.
Nos. 361-362.

Cinchona barks of Government Plantations.—Quinologist's report on the —, with orders thereon.

The above analyses show that up to May 1871, the total amount of alkaloids in the red barks had continued to increase. But, as I had the honor to mention in a report dated August 17th 1868, (Proceedings Madras Govt 22 September 1868. N° 334. Revenue Department) as being highly probable to occur, the annual increments diminish in amount, which indicates that the bark is arriving at its maximum of yield. The numbers which approximately express the annual increments during the period of my observations are 0.75. 0.69. 0.15. 0.25. The circumstance that these numbers do not accurately express a regular diminution of increment, is doubtless attributable to the difficulty which occurs in collecting on successive years, a sample, which shall accurately represent the mean yield of the bark of a large number of trees, together with the difficulty in collecting the samples each year under precisely comparable circumstances.

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have very nearly approached it. As this is a point of some importance, which cannot be held decided without positive proof hereafter be obtained, I here merely mention my personal opinion.

In a report appearing Proceedings Madras Govt 22 February 1869. N° 235. para 4. I had occasion to mention that the amount of quinine had diminished during past years in the Red Barks, although the total alkaloids had increased. During the last two years it appears that the amount of quinine has remained nearly constant, and probably in years to come its amount will hereafter remain nearly stationary in our Red Barks.

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

The large amount of variation according to circumstance of growth met with in the barks of C. officinalis renders a precise determination of its mean quality a work of great difficulty. I have [illegible]

certain analyses of this bark calculated in per centages of its dry state.

Crown Bark from Dodabetta Plantation

	I Trees of good growth 6 years 6 months of age.	II Trees of good growth 6 months of age	III Oldest trees	IV Trees of fine growth
Total alkaloids	5.26	3.10	6.53	6.91
Quinine	3.48	1.62	4.18	4.71
Cinchonidine & Cinchonine	1.78	1.50	2.35	2.20
Sulphate of quinine obtained crystallized	3.25	1.62	4.14	4.80
Sulphate of Cinchonidine obtained crystallized	2.04	1.14	1.57	1.60

Crown Bark from Neddiwattum Plantation.

	Trees 6 years 9 months of age	Trees 6 years 3 months of age of good growth
Total alkaloids	4.96	6.01
Quinine	3.03	4.19
Cinchonidine & Cinchonine	1.93	1.32
Sulphate of quinine obtained crystallized	3.14	4.24
Sulphate of Cinchonidine obtained crystallized	1.05	1.39

The above analyses, though comparatively useless to determine the alteration of the bark with age, are adduced as showing [illegible] of the barks. Though [illegible]

of the improvement in the growth of the C. Officinalis trees, yet I cannot forbear to remark that a low yield is getting much less frequent in their barks than formerly. But the barks of Dodabet Plantation, which consists entirely of this species, and those of Neddiwattum are improving in quality. The increase in the yield of alkaloids is quite apparent although I cannot with accuracy express its actual amount. This increase is due to quinine, and at present it actually appears probable that hereafter the total yield of alkaloids will equal that of the red bark. These two kinds divide between them nearly the whole of our plantations. For European quinine manufacture, the bark of C. Officinalis is admirably suited, as it is so rich in quinine. In addition, it is easy to work, and the sulphate of quinine crystallizes with great readiness and purity. It is especially the bark for export to Europe. A small quantity is now packed for sending to England, and I trust that from time to time its export may be continued.

In total yield the bark of C. Succirubra is the richest, but in its natural state at least, this consists mainly of Cinchonidine, Cinchonine, and occasionally

grinding alkaloids which custom and the addition of fresh names, coincident with the first separation of these substances, have kept out of extensive therapeutical use. The Medical reports of the Cinchona Commissioners of the Indian Presidencies, and the report on the medical use of "Amorphous quinine" appear to indicate that these alkaloids, and consequently red barks, is the kind that can be employed most usefully in India. In Europe, the price of the natural Red Bark will hereafter sink, when it is brought into competetion with Crown barks. How far by careful special cultivation of the Red bark, it may hereafter be possible to modify this result, it would at present be premature to speculate.

After the above kinds the most important at present cultivated on the plantations, is undoubtedly that of C. Caliaya. As on my former reports the trees of Caliaya were very young, it is quite natural to find the amount of alkaloids in the bark, has increased. [illegible] about the [illegible] the great number

of varieties. These display almost every habit. As it was necessary to examine the bark of the trees of most marked character, in order to determine the kind most suitable for cultivation, these varieties have taken up much time. I have the honor to quote the analyses of several of these varieties. The alkaloids are given in per centages contained in dry bark

Trunk Bark of C. Caliaya grown at Neddiwattum

	I	II	III	IV	V
Total alkaloids	3.95	3.93	5.28	4.16	5.36
Quinine	2.64	3.18	1.02	2.50	4.07
Cinchonidine & Cinchonine	1.28	0.75	4.26	1.66	0.69

These represent fairly the different yields I have met with among the kinds of C. Caliaya raised from seed obtained from Mr Money. They are as a whole of good quality; but No V. is the bark of a variety with broad leaves, which are red on the under surface, and its porous habit is the kind which should be propagated; as it is the one whose cultivation, can be most profitably extended. I have examined the bark of several other varieties besides those [illegible]

analyses are given above, but find them all inferior to N.V, and promising nothing remarkable in their qualities. The bark of our C. Calisaya is of excellent quality, and is better suited for genuine manufacturers use than that of C. Succirubra. I regret that a larger number of the trees has not been planted, but as the yield of bark from the present plantations will shortly be so large, I cannot now recommend any considerable extension, even with this sort.

In a report appearing in Proceedings Madras Govt. Revenue Department No 334 paras 22, & 23, I had occasion to remark that in the barks of C. Succirubra, and Officinalis, a high mean temperature appeared unfavorable to the production of genuine; that alkaloid occurring more readily in the bark of trees grown at high elevations within certain limits. I have met with a remarkable illustration of this principle also in the bark of C. Peruviana

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Dodabetta		Neddiwattum	
Total alkaloids	2.66	Total alkaloids	6.25
Quinine	0.79	Soluble in Ether	0.41
Cinchonidine & Cinchonine	1.27	Cinchonidine	2.00
Sulphate quinine obtained crystallized	0.67	Cinchonine	3.84
Sulphate Cinchonidine obtained Crystallized	0.94	Sulphate Cinchonidine obtained crystallized	7.80

Though the bark of C. Peruviana from Neddiwattum contained a small amount of alkaloid soluble in Ether, it was not genuine. But by growing the same species at the higher elevation of Dodabet plantation its bark quite alters its character, and yields in analyses an amount of genuine, which readily crystallizes as sulp-

Indeed the bark thus grown, far more resembles the bark of C. Succirubra than a grey bark. I cannot but consider this instance of a total change of alkaloid, by increase of elevation, a most interesting one.

The occurrence of several remarkable varieties among the trees raised from seed has directed my attention to the occurrence of hybrids among our species of Cinchona. In one instance I was able from the account given by Mr. C. Dawson, then Asst. Superintendent at Neddiwatham, to distinctly trace the origin of a very striking plant which was found to be a hybrid between C. Succirubra and Micrantha. This plant was picked up a seedling under a tree of the latter. I analyzed its bark, and found its yield was poor, but represented a mean between the qualities of the two species. Examination among seedling trees led to the discovery of many other examples of hybridism, especially to cross-breeds between C. Succirubra and Officinalis.

In 1870 I communicated a short memoir on the subject to the Linnean Society.* The occurrence of the same

* Read March 3rd 1870

species of Cinchona, was shown in this communication to render cross-breeding highly probable, in the same manner as has been shown by Darwin to occur in Primula, Oxalis and other plants. I learn from the discussion which took place on the subject, at the Society's meeting that the fact of the tendency of cinchona to hybridism was considered proved.

Since that time I have made numerous analyses of the bark of various hybrids that I have observed, but in no one instance have I found any of special excellence. In fact it appears to me that these hybrids combine the bad qualities of both their parents. I therefore do not quote the analyses.

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not improbable that several species to which a separate name has been attributed may be only South American hybrids. It is to be hoped that in any future botanical classification of the genus this circumstance may be borne in mind.

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

I observe that Dr Weddell in his "Notes sur les quinquinas" (Annales des Sciences naturelles 5e série, tomes XI and XII.) and at the suggestion of Mr Howard calls the valuable variety I called "lancifolia" above alluded to "Cinchona Officinalis Pavonlandiana Augustifolia", remarking well as augustifolia the peculiar shape of leaf. I would suggest that the name augustifolia be in future adopted as the name of the variety.

In several preceding papers I have abundantly stated my convictions and their grounds for considering the living Cinchona bark has its yield of alkaloids injured by exposure to sun. The experimental evidence of this already adduced appears to me to be quite conclusive of the fact, so that further proof is scarcely needed. Further proof appears however in the circumstance of which I have been for some time aware that the bark of opposite sides of the same tree, differs in yield of alkaloids. This of course is only fully apparent in trees that are equally exposed to the light on each side, which from the form of the plantations does not generally occur. But the following analyses express the yields of the bark taken respectively from the North and South sides of a tree which is equally exposed on both sides. The bark was taken July 25th - 6

	North side	South
Total Alkaloids	3. 18	3.
Quinine	0. 62	1
Cinchonidine & Cinchonine	2. 56	2

Ootacamund
4th August 1871.

From

W. John Broughton
Government Quinologist

To,

W. Huddleston Esq.
Secretary to Government
Revenue Department

Sir,

In forwarding the accompanying report, I have the honor to request that I may have the opportunity of correcting the printers' proofs as on former occasions.

I have the honor to be.
Sir,
Your most Obed.t Serv.t

John Broughton.
Gov.t Quinologist

As the sun has been on the stock side of the tree for the last four months, the effect has been that the yield of alkaloids has been diminished 0.58 per cent. This decrease apparently consists of quinine, which is commercially the most valuable of the alkaloids. This effect has been produced, in spite of its being the most cloudy period of the year.

I have the honor to be.
Sir,
Your Most Obed.t Serv.t

John Broughton.
Gov.t Quinologist.

Rec'd 9/8/71

C. No. 2492.

No. 1686 26-Sept/71

From the Govt. Chemist
Colaccamund

To the Secretary to Govt.
Revenue Department
Colaccamund

Dated 4th } August 1871
Recd }

VC No. 3861/71.

SCO No. 1686. 26 September 1871

Enclosures — 1.

Forwards report on the Cinchona barks & the Govt. Plantations, and requests to be favored with printer's proofs.

C. 20 Sept 5/71. R. 25 Sept

Rec'd 18th/ Dep
From, No 2492.
The Govt. Chemist
Colaccamund

To The Secretary to Govt.
" Revenue Department
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C. 20 Sept 5/71. R. 25 Sept

of much interest.
Especially as regards
the effect of altitude
and of sunlight
on the production of
Quinine.

The attention of
H.M. Govt. to suggest
of the above Plantations
might be specially directed
to the fact apparent
early Exhibition
Noticed by H.M. Consul Cinchona
in Bolivia States having taken
2 isolated plants of the
three valuable kinds for
the production of pure Sulph

1 H.J. Broughton
3 The Commissioners
11 The President of
14 The Board of

Copy sent to Col
ver of the Nilgiris
the Cinchona Commissioners
&c.

No 361-362