M.R.O. 14–5,450—22-10-25.

MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No. 855 Press ~~Mis.~~

206-207

Dated 12—4—1867.

Not to be folded or roughly handled

No. 206. Read the following letter from J. BROUGHTON, Esq., Quinologist, to Government, to the Secretary to Government, Revenue Department Fort Saint George, dated Ootacamund, 2nd April 1867 :—

1. I have the honour to enclose a preliminary report on the Chinchonæ of the Government Plantations.

2. I would request permission to proceed on duty to Madras on the arrival of the Government vessel containing my laboratory stores, in order to superintend personally the transit of the same to this place. Any damage to the apparatus would seriously impede my future work.

From J. BROUGHTON, Esq., Quinologist to Government, to the Secretary to Government, Revenue Department, Fort Saint George, dated Ootacamund, 1st April 1867.

1. I have the honour, in the subsequent pages, of submitting such part of the results of my examination of the various products of the Government Chinchona plantations, that possess sufficient interest and definitiveness to be brought under the notice of Government.

Present want of Chemical appliances.

2. This examination has been conducted under considerable difficulties, arising from the want of many of the chemical appliances which are requisite for the analysis of Chinchona barks. Notwithstanding the kind assistance I have received from Mr. McIvor and Mr. Batcock on all occasions when the establishment at the Botanic Gardens could supply my wants, much time has been consumed in improvising substitutes for lacking implements, and in making such arrangements as are incident to a new establishment.

C. Succirubra.

3. The greater part of my attention has been devoted to an examination of C. Succirubra. Of all the species yet naturalized in India, this exhibits the most vigorous growth. It is numerically the most important since, nearly 800,000 plants are now growing in the several plantations. It is, moreover, the bark of this kind that will first find its way into actual consumption. For these reasons the products of the Red Bark trees and the conditions of their occurrence merit an early and careful study.

Marked differences in habit of individual trees.

4. A slight inspection of the more advanced portions of the plantations at Neddivuttum reveals considerable differences in the habit and appearances of the individual Red Bark trees. This has already been remarked by Mr. C. R. Markham, who suggested that these variations in the colouring and habit of the trees might probably be connected with differences in their yield of alkaloids. The accuracy of this conjecture is rendered evident by the results of the analyses of the trunk bark of four trees, which are calculated in per-centages of dry bark, as given below :—

Statement of analyses.

	I.	II.	III.	IV.
Total alkaloids (hydrated)	4·85	7·00	6·40	6·4
Alkaloid soluble in Ether (Quinine)	3·25	4·25	4·75	1·7
Chinchonidine and Chinchonine	1·60	2·75	1·65	4·7
Sulphate of Quinine obtained crystallized...	3·00	4·00	4·55	1·7

In the above analyses, as well as those given subsequently, the sulphate of Quinine has been obtained in as pure a state as possible.

Remarks on analyses of Red Barks.

5. Of No. I., it may be remarked that though the poorest specimen that has come under my notice, it gives at least an equal yield to the best Ecuador Red Barks. Nos. II., III., and IV.

are considerably richer. Seven per cent. of alkaloids in the natural (unmossed) bark appeared to me so large an amount that I was led to repeat the analyses by a different method, which, however, closely corroborated the former results. No. II. owes its richness in alkaloids to the presence of an unusually large amount of Chinchonine, which crystallized from an alcoholic solution with the greatest readiness. No. IV. contained comparatively but a small amount of Quinine, but in its stead a large amount of Chinchonidine, which easily yielded a sulphate not distinguishable by the eye from that of Quinine. In this sample of bark the total quantity of crystalline sulphates obtained was no less than 5·2 per cent. of the weight of the dry bark. All the barks contain a certain amount of quinine apparently not susceptible of crystallization.

Bark of branches.

6. These analyses were made in all cases with the bark of the trunk, which (doubtless on account of superior age) is much richer than that of the branches yielding "quill bark." Some of the latter, which I examined, yielded but three per cent. of alkaloids, from which 1·4 per cent. of crystalline sulphates was obtained.

Yield of alkaloids in bark still probably increasing.

I am of opinion that the foregoing data, compared with those of Mr. Howard's earlier reports, afford grounds for believing that the amount of alkaloids in the barks is still on the increase.

Considerations affecting value of Red Barks.

7. It should be stated that the richness of the Red Barks in alkaloids, though doubtless entitling them to the first place among our Indian barks, is not in many respects a true measure of their intrinsic value for manufacturing purposes. This value depends also on the readiness with which the Quinine, &c., can be obtained in a pure and crystalline form. In this respect the natural unmossed Succirubra bark is at some disadvantage, since its alkaloids are more difficult to obtain in a pure form than those yielded by some other kinds.

Mossed Red Bark.

8. Mr. McIvor's valuable and interesting method of treatment of the barks by mossing has already been fully described by himself. Unfortunately I was unable to obtain a specimen of bark that had been under this treatment for more than six months. A sample of bark of a tree of four years and a half old, renewed under moss, yielded (in per-centages of dry bark) :—

Analyses of mossed renewed Bark.

Total alkaloids (hydrated) ...	7·10 per cent.
Alkaloid soluble in Ether (Quinine)	3·95 ,, ,,
Chinchonine and Chinchonidine	3·15 ,, ,,
Crystallized sulphate of Quinine obtained	3·45 ,, ,,

9. In this instance the comparative youth of the renewed bark does not permit me to quote so high a per-centage of alkaloids as that found some time since by Mr. Howard in bark that had been longer under treatment.* Nevertheless, the advantages of the mossing process applied to this bark, makes itself at once evident to the worker by the readiness and purity with which the sulphates crystallize. The amount of the latter would be much larger had sulphate of Chinchonidine been included.

Root Bark.

10. An examination of the root bark of C. Succirubra enabled me to corroborate the statement of Dr. De Vrij that it contains a large amount of alkaloids.

The dried bark yielded—

Total alkaloids (hydrated)	6·0 per cent.
Alkaloid soluble in Ether (Quinine)	2·15 ,,
Chinchonidine and Chinchonine	3·85 ,,
Crystallized sulphate of Quinine obtained	2·00 ,,

* Government Return, 1866, p. 141.

Remarks on analyses.

From the above it appears that the greater part of the alkaloids in this root-bark consists of Chinchonidine and Chinchonine. The former alkaloid occurs in considerable quantity. In no case, however, could the roots be a remunerative source of alkaloids, since their bark is thin, contains 74 per cent of water, and is laborious to procure.

Leaves of C. Succirubra.

11. The occurrence of alkaloids in the leaves of the Chinchonæ has been the subject of numerous and conflicting statements. In order to enquire into this interesting and important point, I worked with four lbs. of the leaves of C. Succirubra.* From these I succeeded in obtaining 3·1 grains of alkaloid, of which about 1 grain was soluble in Ether, and gave a faint indication of Quinine when tested with Chlorine water and Ammonia. From none of the alkaloid obtained from the leaves was I able to obtain a definite crystalline sulphate or oxalate.

Probable value of leaves.

Though I would refrain from advancing a decisive opinion until I have examined the leaves at another period of the year, it appears to me to be probable, from the above examination, that the leaves of C. Succirubra (even in the fresh green state) are worthless as a source of febrifuge alkaloids. They appear to owe their bitterness to the presence of Quinovin, a substance which may probably possess some tonic qualities.

C. Officinalis.

12. Next to the C. Succirubra the most important species we at present possess is the C. Officinalis, whose varieties yield the Crown Barks. The three varieties, *Bonplandiana*, *Uritusinga*, and *Crespilla*, greatly resemble one another, and appear to differ even less among themselves than some individuals of C. Succirubra, of which Botanists recognize but one variety.

Var Bonplandiana.

Of these varieties, *var. Bonplandiana* is the most important, since upwards of 750,000 are now growing on the plantations. This variety also comprises the most advanced trees, whose identity with their name could be considered certain. The trunk bark of a tree from Dodabetta plantation yielded in the dry bark the following per-centages :—

Analyses of Crown Bark.

Total alkaloids (hydrated)	3·6 per cent.
Alkaloid soluble in Ether (Quinine) ...	2·8 ,, ,,
Chinchonine and Chinchonidine ...	0·8 ,, ,,
Sulphate of Quinine obtain crystallized	2·8 ,, ,,

The fresh bark contained 66 per cent. of water.

A second specimen of somewhat different habit yielded—

Total alkaloids (hydrated)	3·8 per cent.
Alkaloid soluble in Ether (Quinine)	3·0 ,, ,,
Insoluble in Ether (Chinchonine)...	0·8 ,, ,,
Crystallized Sulphate of Quinine obtained	2·9 ,, ,,

Value of Crown Bark.

Hence it appears that even at their present age the trees of C. Officinalis *var Bonplandiana* yield a bark of admirable quality, and nearly equal to the fine Calisaya bark of Bolivia. In the last quoted analysis no alkaloids were found, except Quinine and Chinchonine, the latter occurring

* The method of proceeding adopted was as follows :—The bruised leaves were boiled in a chattie with water acidulated with Sulphuric Acid, and the bitter greenish decoction was separated by drainage and strong pressure through a cloth. It was then concentrated by evaporation, allowed to cool, and made strongly alkaline by the addition of milk of lime. A considerable precipitate was thus obtained, which was separated by filtration, and purified by careful washing ; then dried at 200 F and powdered. This powder was then repeatedly boiled with strong spirit, and the alcoholic extracts evaporated to dryness. The residue consisted mainly of a bitter yellow resin. It was boiled with acidulated water (by which but a small proportion dissolved) and filtered. The solution was then made alkaline with Caustic Soda and shaken up in a separator with Chloroform. The Chloroform was then separated, and being evaporated by a gentle heat in a capsule, left the purified alkaloid as residue.

in but small quantity. I am of opinion that this bark possesses, for manufacturing purposes, certain advantages over the Red Bark, that in some measure tend to compensate for the smaller yield and slower growth of the tree producing it. The Crown Bark yields its alkaloids with greater ease, owing to the small amount of resin and colouring matter with which they are associated.

Mossed Crown Bark.

13. An analysis of similar bark that had been renewed six months under moss yielded—

Total alkaloids (hydrated)	6·8 per cent.
Alkaloid soluble in Ether (Quinine)	4·8 ,,
Chinchonine and Chinchonidine	2·0 ,,
Sulphate of Quinine obtained crystallized	4·1 ,,

Increased yield produced by mossing.

This analysis shews that the mossing process, though only applied for six months, has greatly increased the yield of alkaloids in this variety of bark.

14. I would here beg permission to state, without advancing any new hypothesis, such known facts that appear in a great measure to explain the increased amount of alkaloids produced by mossing the bark.

Deleterious action of light on bark.

The injurious action of light on the Chinchona bark and alkaloids was clearly pointed out many years ago by Pasteur,* a Chemist, to whom our present knowledge of these alkaloids is largely indebted. It is on account of this destructive action of light that he recommended shielding the bark from sun-light while drying; pure, colourless solutions of the alkaloids are soon coloured brown and partially decomposed by exposure to sunshine. The same change takes place when dry or moist sulphate of Quinine is insolated.

Experimental verification.

15. In order to verify these facts in the climate of the Neilgherries, I prepared from Red Bark pure colourless solutions of each alkaloid and sealed them up in vacuo in glass tubes, in order to eliminate possible oxidation. After three days' exposure to the sun's rays they all became coloured, while similar solutions I reserved in the shade remained unaltered. The tube containing Quinine was opened after a fortnight's exposure, and its contents examined. It was then found that a considerable quantity of a dark coloured resinous substance had been formed, and that much of the alkaloid had lost its power of crystallizing. I would submit that these circumstances are very significant, when applied to the elucidation of the cause of some of the changes occurring in the living bark, and are most suggestive of futuro experiments in the cultivation of the latter.

Moss does not prevent oxidation.

16. It has been stated that the action of the moss is to protect the alkaloids from oxidation. This is contradicted by the circumstance that moss does not exclude either air or oxygen. It is also incompatible with the fact that the Quinidine produced under moss in Micrantha bark is really a more oxidized substance than the Chinchonine produced in the natural bark when fully exposed to the air.

Natural renewed bark.

17. It appeared to me that an examination of bark that had been renewed by natural processes, without the application of moss, would possess considerable interest. It was suggested by a statement in Howard's "Nuera Quinologia of Paron," and also given on the authority of Ruiz.† I was able to obtain a small quantity of such renewed bark from two Succirubra trees which had been injured and partially stripped of their bark by the falling of a log in October 1864. The

* Comptes Rendus XXXVI. p. 26, and XXXVII. p. 162. Also Koppe Jahresbericht 1853, p. 419.

† Nuera Quinologia. C. Uritusinga, p. 3.—"They cut off (Don Ricpio told me) the whole of the bark of the trunk of a small tree, leaving only a broad strip so as not to destroy the tree, which gradually replaces its loss; and the second time of cutting the bark is called *cascarilla renovata*, and esteemed of superior quality."

renewed bark was thicker than that of the natural bark, measuring 0·19 to 0·22 inches, instead of 0·16 inches, and had replaced itself mainly from the edges of the wound; not from the surface, as is the case in mossed bark, but its analysis gave but five per cent. of alkaloids, of which about 3·25 appeared to consist of Chinchonidine and Chinchonine. Unless, therefore, the effect had been impaired by the lapse of time or the character of the injury, the quality of this renewed bark does not appear to corroborate the statement I have had the honour to cite above.

Rationale of mossing the bark.

18. I would submit that the foregoing facts and considerations render it highly probable that the exposure of the *living* bark to direct sun-light has the effect of diminishing the yield in alkaloids, and hence the advantage of direct protection.

I would beg leave to defer a comparative estimate of the respective values of the three varieties of C. Officinalis till a subsequent report.

C. Lancifolia.

19. An analysis of the bark taken from a plant of C. Lancifolia, two years' old, yielded 0·8 per cent. of alkaloids, in which (though but a very small amount of bark was at my disposal) I was able to obtain distinct traces of a crystalline sulphate.

C. Micrantha.

20. An analysis of the trunk bark of C. Micrantha of four and a half years' old yielded the following numbers expressing per-centages in dry bark :—

Total alkaloids	7·1
Alkaloid soluble in Ether...	0·3
Chinchonine	6·8
Crystalline Sulphates	None

Value of Micrantha bark.

This large amount of Chinchonine crystallized from solution in alcohol with the greatest readiness and purity, forming splendid crystals 0·18 inches long. Huanuco bark contains usually only about 2·0 per cent. of alkaloid. Should Chinchonine come into use as a febrifuge (as appears not improbable from the experimental results of the Chinchona Commission,*) this Micrantha bark will furnish a most easy and abundant source. The tree rivals C. Succirubra in rapidity of growth, and the bark at present is 0·17 inches thick. It loses on drying 73 per cent. of water.

Advantages of working with fresh bark.

21. Nearly all the above analyses were made with the fresh undried bark of the trees. Some preliminary experiments shewed me that the bark in the "green" condition presented several advantages which facilitate its examination for alkaloids. The latter are extracted with far greater ease from the fresh than from the dried and powdered bark; and with much less expenditure of acid and labour, and consequently with diminished risk of error or alteration in composition. I am of opinion that this property of the fresh bark will eventually become of considerable importance. For purposes of quotation, it is of course indifferent whether the analyses are conducted with the fresh or the dried bark, provided the process of drying be conducted with proper care.

Results communicated to Mr. McIvor.

22. I have communicated these and other results of my observations to Mr. McIvor, and have discussed with him various applications to future cultivation. I have had to thank Mr. McIvor for much kind assistance, and also for some valuable information concerning the plantations and their products.

Present success of Chinchona plantations.

23. I trust I may be pardoned for expressing my gratification at finding, from personal examination, that the Government Chinchona plantations offer in their present stage such unmistakeable indications of success.

24. I have the honour to forward by banghy four specimens of alkaloids prepared from Red Bark, and illustrative of the foregoing report.

* Proceedings of the Madras Government, No. 302, 1867.

No. 207. ORDER THEREON, 12th April 1867, No. 855.

Miscellaneous.

1. The Government have perused with much interest Mr. Broughton's very encouraging Report, which will be forwarded to the Secretary of State, and communicated, with the recent Report of the Chinchona Commission, to the Governments of India and of the other Presidencies.

2. They note with satisfaction Mr. Broughton's testimony to the value of the mossing process introduced by Mr. McIvor, and request that the results may be recorded in all reports of bark analysis when the tree has been thus treated.

3. Mr. Broughton will proceed to Madras on duty on the arrival of the ship containing his apparatus, for the purpose of taking charge of the cases and superintending their conveyance to Ootacamund.

(True Extract.)

(Signed) W. HUDLESTON,
Secretary to Government.

To J. Broughton, Esq.
,, the Board of Revenue.
,, the Inspector General, Medical Department.
,, the President Chinchona Commission.
,, the Superintendent Government Chinchona Plantations.
,, the Accountant General.

Ed. S. T. Augustin.

Revenue 1867 - Oct^r -
Pro of Govt for April
to Sept 1868 - 5

Ar. 14 Decemb^r 1866 p. 248 -

Reported to England
D/ 25th April No 28 of 67.
Mint

Jirom J. Broughton
Asst Engr. & Asst
Meteorologist to Govt.

Dated 2d. } Apl.
Received 4th } 1867.

E-S

Forwarding a preliminary report on the Chinchona of the Govt Plantations
& requesting permission to proceed on duty to Madras to personally superintend the transit of the laboratory stores to Ooty -

No 855 - 12th Apl

From Asst J Broughton
Meteorologist to Govt
dated Ootacamund D/ 17 May
C. No: 1291 -

A. 206 & 207

C. Mansfield