Revenue (1899) Department.

PRESS SERIES.

G.O., No. 608

Dated 8th September

[Despatch Abstract.]

Cinchona cultivation in Java

Reviewing Mrs. Standen's report on ———.

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Revenue (1897) Department.

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From W. M. Standen Esqr. Director Govt. Cinchona Plantations, Nilgiris.

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No. 34

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SUBJECT.

Report on the cultivation of Cinchona in Java.

Forwards the

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No. 34

Office of the Director of
Government Cinchona Plantations.

Ootacamund, 28th July 1899.

From

W. M. STANDEN, Esq.,

Director of the Government
Cinchona Plantations,
Nilgiris.

To

The Secretary to Government
Revenue Department.
Ootacamund.

Sir,

With reference to G.O. No. 1394 dated 17 April 1899, Revenue, I have the honor to forward a Report embodying the results of the observations and inquiries made by me on the cultivation of cinchona in Java.

2. I left Ootacamund on the 23rd April 1899 arrived at Batavia on 3rd May and left the island on the 23rd Idem. My time was thus somewhat limited but it sufficed to enable me to visit several private cinchona Estates as well as the extensive plantations belonging to Government and to acquire a good general idea of the condition and prospects of the cinchona Industry in the island.

3. From Batavia I proceeded to Calcutta and thence to the Government cinchona Plantations in Sekkim where I met Major Prain, the Dirg

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Director with whom I discussed all the points on which I had been able to obtain information in Java.

4. Leaving Calcutta on the 20th June I arrived in Ootacamund on the 27th June and assumed charge of my office on the following morning.

I have the honor to be,

Sir,

Your Most obedient Servant,

Wm Standen

Director.

Report on Cinchona in Java.

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II Area under Cultivation

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XII. Manuring

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Report on Cinchona in Java

I History

The history of Cinchona in Java dates from the year 1852, when a single plant of Calisaya, which had been grown in Paris from seed Collected by Weddell in South America, was received by the Curator of the Botanical Gardens at Buitenzorg. Further supplies of seed and plants were subsequently received from South America, and at the end of 1863, the cultivation had been so vigorously pushed forward, that there were more than half a million of Cinchonas permanently planted out on the Government Estates. Nearly the whole of these plants Consisted of Pahudianas, and as it was soon found that this species Contained very little Quinine, its cultivation was given up, and propagation was Confined to Calisaya, Officinalis, and Succirubra. In December 1865, a small parcel of seed was purchased by the Dutch Government from Mr. J.W.B. Money, who had bought it from a Mr Ledger, and in the following year 12,000 plants raised from this seed were put out and were Called Ledgerianas. The bark from these trees was first analysed in 1872 and was found to be exceptionally rich in Quinine. No effort was spared in propagating

from the richest of these trees, by means of seed, cuttings and grafts; and the result has been that Java, at the present time, produces the richest bark in the world, and exports about 80 per cent of the amount required by the trade

II Area under Cinchona. I regret to say that I found it impossible to ascertain precisely the extent of land now under Cinchona cultivation, but it is generally supposed that the total area is about 20,000 acres. The low prices for bark, which ruled a few years ago, led to the uprooting of a considerable quantity of Cinchona to make room for Tea, so that the area under Cinchona is not so great now, as it was five years ago. On the other hand, the present advance in the price of bark has ~~received~~ revived interest in Cinchona planting, and I heard of several new clearings being made. In addition to the Government Cinchona Plantations, which Cover 2205 acres, there are said to be 83 private plantations in Java, of which 58 are in the Preanger Residency of Western Java, a district which is admirably suited for Cinchona cultivation. The remaining plantations are chiefly in Central Java, while the number in the eastern part of the island is

so small. Ledgeriana is almost universally grown, but Hybrids between Ledgeriana and Succirubra, which have been proved to contain a high percentage of Quinine, are also cultivated, and there is still a small area under Succirubra and Officinalis.

III Climate. The climate of the Preanger Residency of West Java is admirably suited to the growth of Cinchonas. The annual rainfall averages about 130 inches, and is well distributed throughout the year. At Tjinjirocan, which is one of a group of four Estates, belonging to Government, Covering 1196.25 acres, the average number of rainy days per annum is about 215, and even in the dry season, no single month passes without several rainy days. The prolonged droughts from which the plantations suffer in Southern India are quite unknown in Java, and it is not surprising, therefore, that the growth of the Cinchonas, as well as that of vegetation generally, should be more luxuriant than it is in India. The shade temperature ranges from 60° to 78° Fahrenheit, and the mean average temperature for the year is about 62°.

The rainy season lasts from October to April

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the wettest month of the year is March and the driest August.

IV Soil—. The volcanic soil of Java bears a very high reputation for fertility, but it is a curious fact that analysis shows the soil to be by no means rich, as compared with rich European soils, and the forest soils of Southern India. Even the grass lands of the Nilgiris compare favorably with Java soils, as regards the actual quantity of plant-food available. No one, however, who has seen the luxuriant vegetation of Java can doubt that the soil is fertile to a high degree; and this fertility must be in a great measure due to its fine physical condition, and to the favorable climatic conditions which render the constituents of the soil readily available as plant food.

The following table of analyses is given to show that in the most important constituents, Viz. Nitrogen, Potash, Phosphoric acid, and Lime the soils of the Nilgiris compare very favorably with Java soils.

	Java soil	Dodabetta Forest soil	Kodaikanal grass land
Water	2.14	4.14	3.45
* Organic matter and Combined water	18.91	50.71	23.44
Ferric oxide	12.50	5.03	8.54
Alumina	26.20	4.72	12.35
Lime	.51	1.71	.28
Magnesia	.47	.72	.18
Potash	.22	.41	.36
Manganese Oxide	.41	—	—
Soda	.33	.20	.23
Phosphoric acid	.11	.30	.17
Sulphuric acid	—	.23	.19
Silica	38.20	31.83	50.81
	100.00	100.00	100.00
* Containing nitrogen	.310	1.360	.341

From a comparison of the above it is very evident that soil analysis alone affords no explanation of the richness of the Cinchona barks grown in Java. The soil on which the Cinchonas thrive best is a dark chocolate colored loam rich in humus, and with a free subsoil. Generally speaking the soil on the Government Plantations answers to this description. It is of great depth, entirely free from stones, and very pervious to air and moisture; but there are a very few

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fields where the subsoil is of rather stiff clay. In such ground, the growth is not so luxuriant and the trees suffer from Canker.

Elevation. The elevation that has been found most suitable for Ledgers is from 4000 to 5000 feet, and the majority of the Estates in the Peranger Residency are at this level. One of the Government plantations however - Kawah Tjiwidee - is about 6000 feet above sea level, but this is found too high for Ledgers, and the Estate Contains only Succirubra and Officinalis. In making a Comparison between the elevations at which Cinchona is successfully grown in Java, with that at which it is grown in India, it must not be forgotten that the Cinchona districts of Java are about 7° South of the Equator, those of Southern India are about 12° north, and the plantations in Sikkim are about 27° north.

Lay of land. — The sites for the Cinchona Plantations have been Carefully chosen, steep slopes have been avoided, and for the most part only gently undulating land has been planted. On the Government Plantations the whole of the land has been carefully terraced. The

The terraces are 4 feet in width, and are accurately traced across the slopes of the hills. The plants are put out in the Centre, and the cultivation is done along the terrace, care being taken to avoid breaking down the edges. The soil is so deep and the slope of the land so gradual, that there is no danger of cutting into inferior soil in making these narrow terraces. As a result of this system of terracing, there is an entire absence of wash on the Government Estates; no drains are required, and the rain water, instead of flowing over the land, carrying all the finer particles of soil to the nearest stream, penetrates freely into the soil, adding to the natural store of fertility, the ammonia, nitric acid, and salts, that it has became [charged with in its course through the air. I was not able to obtain an analysis of the rain water of the Cinchona districts, but judging from the number of active volcanoes in the island, I should think it must be rich in the elements that are Conducive to fertility.

Propagation

Propagation.- At a very early date in the history of Cinchona in Java, it was recognized that the future Success of the enterprise depended on the selection of seeds and cuttings from trees, which had a high alkaloidal value; but it was not until 1872, when the bark of the Ledgerianas was found to be so much richer than that of any other Cinchonas, that special attention was given to the propagation of this species. The richest trees were reserved for the yield of seed and Cuttings, and it was found that individuals of the second generation occasionally had a higher alkaloidal value than the parent trees. The work of selection was at first solely in the hands of Government, who were in possession of the original Ledgers, and for some years, the seed was distributed gratis; but from the year 1883 it has been sold, and the private planters have been able to grow their own stock trees, and take seed and cuttings from the richest of these. The Government, however, still Continues to make a Considerable revenue from the sale of seeds and grafts. In 1894 the sum realized

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realized was only 275 guilders, but in 1897 with the revival of interest in Cinchona planting, the income from this source amounted to 12065.25 guilders, as much as 260 guilders being paid for a packet of 25 grammes of some specially fine seed, and 10 guilders each for well established grafts of Ledger on Succirubra. These high prices are a very good indication of the importance attached by planters to selection from good stock. The highest price paid for seed in 1897, viz 260 guilders for 25 grammes, works out to 10.4 guilders per gramme, or ~~Rs 4700~~ Rs 5896 per ℔. One gramme of Ledger seed is said to Contain 3500 seeds, 25 grammes would therefore Contain 87,500 seeds. The seed from the Government Estates is sold periodically by public auction at Bandoeng, the upset price is 10 guilders per packet of 25 grammes, and the bidding for the best seed is always Keen. Seed is not obtainable by private treaty with the Director of the Cinchona Plantations, and as the planters are naturally unwilling to part with seed from their own trees, the only Course open to planters in India, who wish to procure a supply of the best Ledger seed, is to authorize an agent to bid for the

at the auctions: The trees from which the seed is taken on the Government Estates are not isolated, they are in close proximity to Succirubras, and it would seem that there is great danger of hybridizing; but I was surprised to hear that Cross-fertilization does not take place to any appreciable extent, and that although a few hybrids may be found among the seedlings grown from Ledger seed, the number of these is very small, and they can be readily identified and rejected while in the nursery beds. No Special treatment is given to the seedbearers with a view to increasing their vigour, and upto the present time, no deterioration of the seed has been observed. Seedlings from seed taken from the original Ledgers, which are now 33 years old, and found to be quite as vigorous and healthy as those raised from seed taken from younger trees, and the subsequent growth of the plants on new land is as free and healthy as it was in the early days of the enterprise. Experience with regard to officinalis and Succirubra is the same, there has been no deterioration of seed, either in vigour or in type.

The grafting of Ledgers on Succirubra which

which was first tried in 1879 has been Continued to the present day with great success. Succirubra being of a more robust habit than Ledgerianas it has been found advantageous to put out grafts of Ledger on Succirubra on land which is not Considered so suitable for Ledgers. Where there is any indication of stiffness of soil and a nonporous subsoil, Ledgers will not develop well, and are liable to suffer from Canker. On such ground, as well as on old land, which has already borne a crop of cinchona, grafts are found to do well. The system of grafting is that known as "side grafting" and is generally done in the open Nurseries. The Succirubra seedling is grown in the Nursery bed for a year or two, until the stem is of the thickness of the little finger. A small cutting of about 3 inches in length is taken from a branch of a Ledger tree, and a sloping cut of about 1½ inches in length is made at one end. A small strip of bark, corresponding in breadth to the diameter of the cutting, is lifted from the stem of the Succirubra seedling, close to the ground, and turned back to form a flap. The Scion is now

inserted, the flap of bark is divided vertically into two narrow strips, and these strips are bound firmly to the scion in such a way as to exclude air from the opposed edges of scion and graft. The material used for binding is jute fibre, obtained by unravelling ordinary gunny bags. Melted wax is applied round the binding to save it from rotting, to the top of the scion, and to the angle between scion and graft. A few leaves are tied round the stem of the Succirubra plant, immediately above the scion, to protect it from sun and rain. When the scion begins to grow, which is usually in 3 or 4 weeks from the time of grafting, the Succirubra seedling is shortened, and as the scion increases in vigour the stock is further reduced. Finally when the graft is well established, the remnant of the Succirubra stem is cut away, immediately above the point of union. The Javanese are very quick at grafting, trained Coolies turning out 200 to 300 grafts a day. They are paid according to the number that succeed. Before this method of payment was introduced the number of successful grafts was about 10 per cent, whereas 95 per cent is the proportion of successful grafts under the present system. The stocks used for grafting are almost invariably Succirubras, but scions are taken from Hybrids between Ledgeriana and Succirubra, and from Officinalis, as well as from pure Ledgers. On the Government Estates I saw a very flourishing field of hybrids that had been grafted on to Hybrid stocks in the open ground. The original field of hybrids analysed only 4 per cent, and instead of uprooting the trees and replanting with other plants, grafts were made on the shanding trees from Hybrids, which had given 11% to 12% Sulphate of Quinine. These grafts at 6 years old were about 15 feet high and well branched. Grafting in the open ground on old trees is not however generally done, it is Considered better to graft in the Nurseries.

Propagation by cuttings seems to have been given up, as this method was found less satisfactory than seed and grafts. As to the respective merits of seed, grafts and cuttings, it might be expected that cuttings would resemble the parent trees most closely in alkaloid Contents, that grafts would

total number of Ledgers being 67.94 % seedlings, 31.78% grafts, and .28 % cuttings. I was not able to ascertain the proportions of the different Kinds grown by private planters, but I was given to understand that the plantations generally Consist of Ledgers grown from seed, and that neither Succumbra nor officinalis is largely grown. Ground is cleared for planting in Java in the same way as in India. The forest is felled and burnt, and the size of the pits is usually 2 feet Cube. Ledgers are planted 4'x4', Hybrids 5'x4' or 5'x6', and Succinubras 6'x4' or 6'x6'. Planting is done during the wet months of December January and February, and the young plants are not shaded or protected in any way, and during the first year Cultivation is limited to Keeping down the weeds. The cost of opening and planting forest land, including the cost of Nurseries is about 60 guilders per acre, or 60 Indian Rupees. This figure does not include the cost of terracing which is said to be 10 guilders per bouw (1 bouw = 1¾ acres) or about Rs 7 per acre

Labor. That the supply of Javanese labor should be plentiful is not surprising when

when one Considers the density of the population. The area of the island is about 50,000 Square miles, and it supports a population of about 26 million, or 520 to the square mile. The daily pay of a Cooly is about the same as in India, viz from 20 to 25 Cents (4 as to 5 as) per man, and 10 to 12½ Cents (2 as to 2½ as) per woman, but the Dutch planters have a great advantage over planters in India in being able to recruit labour without advances. The system of making advances to Coolies was formerly in vogue, but the Dutch Government Considered that the practice was being abused, and that Coolies who had received large advances, which they could not liquidate for years, were practically in the position of slaves. A remedy was found in the non recognition by the Courts of advances made to Coolies, and this at once led to the system being abandoned. "Mandors" or Maistries whose duty is to supervise the work of the Coolies receive from 10 guilders to 50 guilders a month.

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IX Diseases and Pests. — The Ledger plant is very liable to Canker where the subsoil Contains much clay and is retentive of moisture. Two forms of the disease are

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would be next in value, and that seed would show the greatest variety in types, but Mr Van Leersum the Director of the Cinchona Plantations has shown in his interesting pamphlet on the alkaloid Contents and yield of graft, cuttings, and seedling plantations, that neither grafts nor cuttings Can be relied on to give the same yield of alkaloids as the parent trees. Grafts from a tree analysing 10.33% were found to vary in yield from 3.35% to 11.45%, while Cuttings from a tree analysing 11.68% gave from 4.57% to 7.94% Sulphate of Quinine. Plants raised from seed also show Considerable variation, but they yield so much more bark than grafts or Cuttings that there Can be no doubt that it is more profitable to grow seedlings than either grafts or cuttings, provided the soil is suitable. —

Mr Van Leersum has given particulars of the yield for 7 years, from the time of first harvest, of fields of Cuttings, grafts, and Seedlings, and has shown that during the 7 years the cuttings gave 1516 lbs bark per acre, the grafts 2288 lbs, and the seedlings 3209 lbs.

Seed ripens in Java towards the end of the year. When the seed vessels are beginning to

to burst they are gathered and dried in the shade until the seeds fall out. Nurseries are prepared, and worked in the same manner as in India and Ceylon, and plants are put out in the field about 12 months from the time the seed is sown, when they are from 6 to 9 inches high. Plank baskets are not Considered Necessary. The number of seedlings in the Government Nurseries at the end of March 1899 was 1,580,000; Consisting of 1,240,000 Ledgers and grafts, 315000 Succirubras, and 26,000 Hybrids, and on the same date, the plants in the open ground numbered 2,602,300, or 1180 per acre, as shown below:-

	Number of plants	Proportion to Total plants	
Ledgers grown from Seed	1,098,000	42.17%	
Grafts of Ledger or Succirubra	518,500	19.74%	62.10%
Ledger Cuttings	4500	.17%	
Hybrid - (Succirubra & Ledger)	494,000	18.98%	
Succirubra	444,300	17.08%	37.90%
Officinalis	48000	1.84%	
	2,602,300		

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It will be seen from the above that Ledger seedlings have been preferred to grafts and cuttings, the relative proportion to the

total number of Ledgers being 67.94 % seedlings, 31.78% grafts, and .28 % cuttings. I was not able to ascertain the proportions of the different Kinds grown by private planters, but I was given to understand that the plantations generally Consist of Ledgers grown from seed, and that neither Succumbra nor officinalis is largely grown. Ground is cleared for planting in Java in the same way as in India. The forest is felled and burnt, and the size of the pits is usually 2 feet Cube. Ledgers are planted 4'x4', Hybrids 5'x4' or 5'x6', and Succinubras 6'x4' or 6'x6'. Planting is done during the wet months of December January and February, and the young plants are not shaded or protected in any way, and during the first year Cultivation is limited to keeping down the weeds. The cost of opening and planting forest land, including the cost of Nurseries is about 60 guilders per acre, or 60 Indian Rupees. This figure does not include the cost of terracing which is said to be 10 guilders per bouw (1 bouw = 1¾ acres) or about Rs 7 per acre

Labor. That the supply of Javanese labor should be plentiful is not surprising when one Considers the density of the population. The area of the island is about 50,000 Square miles, and it supports a population of about 26 million, or 520 to the square mile. The daily pay of a Cooly is about the same as in India, viz from 20 to 25 Cents (4 as to 5 as) per man, and 10 to 12½ Cents (2 as to 2½ as) per woman, but the Dutch planters have a great advantage over planters in India in being able to recruit labour without advances. The System of making advances to Coolies was formerly in vogue, but the Dutch Government Considered that the practice was being abused, and that Coolies who had received large advances, which they could not liquidate for years were practically in the position of slaves. A remedy was found in the non recognition by the Courts of advances made to Coolies, and this at once led to the system being abandoned. "Mandors" or Maistries whose duty is to supervise the work of the Coolies receive from 10 guilders to 50 guilders a month.

IX Diseases and Pests. — The Ledger plant is very liable to Canker where the subsoil Contains much clay and is retentive of moisture. Two forms of the disease are

recognized, one that begins at the root and another that attacks the branches. In the case of branch Canker, the removal and burning of the diseased branches is the course usually adopted, but when the disease has attacked the roots, the tree is doomed, and has to be uprooted. A good deal of damage is also done by the Tea Mosquito (Helopeltis antonii) and by a Caterpillar (Euproctis flexuosa). On the Government Estate Tertasari which consists of 428·75 acres, no less than 100,000 lbs of wet bark or about 35,000 lbs of dry bark were harvested in the first quarter of the Current year from diseased trees and branches.

x Cultivation. — The system of cultivation is very similar to that followed in India. No attempt is made ~~to made~~ to keep the plantations absolutely clean. The growth of weeds is checked during the rains by a rough weeding, and at the Commencement of the dry weather, trenches are dug measuring about 4 feet long, by 1 foot broad, and 1 foot deep, weeds are buried in these trenches, and the soil is then dug to the depth of 1 foot, all weeds being turned into the soil. Great importance is attached to

to this mode of cultivation, which is known as "intensive Culture" and on the Government Estates some experimental plots have been set apart to show the effects of non cultivation, rough weeding only, and the intensive culture described above. Plots A, B, C were planted in 1894 on old land with Hybrids between Ledger and Succirubra - Plot A had been well cultivated from the Commencement, the trees were looking remarkably healthy, and their average height was about 8 feet. The Cultivation on plot B had been limited to Sickling down weeds and clearing round the plants to prevent their being choked. The trees on this plot looked unhealthy and stunted, their average height was about 2 feet only, and from their general appearance, I should think it unlikely that they will live much longer - Plot C had been rough weeded only. No digging had been done, and there had been no burying of weeds. The trees on this plot looked rather poor, being deficient in foliage, and their average height was about 6 feet.

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An estimate of the amount of Sulphate of Quinine in these plots was made at the end of 1897, which showed that the highly

highly cultivated plot A. Contained 1·51 Kilos of Sulphate of Quinine per bouw, the non-Cultivated plot B Contained no Quinine, and the indifferently Cultivated plot C Contained .79 Kilos per bouw.

The total expenditure to the end of 1897 on the three plots was as follows:— A 68·70, B 36·80, and C 43·90 guilders per bouw, so that the cost of a Kilo of Quinine (2·2nd) on Plot A was 38·87 guilders, on Plot C, 46·58 guilders, while the expenditure of 36·80 guilders on Plot B had been entirely unproductive. The sum spent on the actual field work ie. weeding and digging on the Government Estates during 1897 was 10·60 guilders per bouw, or 7·56 Rupees per acre, but on private Estates 20 guilders per bouw or about Rs 14 per acre per annum is Considered a reasonable allowance for Cultivation.

XI Growth and general appearance. — The original Ledgers on the Government Estate Tjinjiroean of which 1280 remained on 31st March 1899 are now 33 years old. They are very fine healthy trees, 50 to 60 feet high, with good Crowns, and with stem about 1 foot in diameter at 5 feet from the ground. They stand on 4 bouws or 7 acres of ground, so that the average number of these trees per acre is only 183. Ledger Cuttings on Tjikasari, 20 years old average about 30 feet high, but are of a rather spindly habit, their stems measuring about 4 inches in diameter at 5 feet from the ground. On Gamboeng - a private Estate belonging to Mr Kerkhoven - 12 year old Ledgers grown from seed measure 30 feet high, with stems about 6 inches in diameter. Hybrids grafted on Succirubras on the Government Estates show very fine growth; At the age of 5 years, they are from 12 to 20 feet high, with a stem diameter of 2½ inches 3 feet from the ground. One year old Ledgers grafted on Succirubra are 3 to 4 feet high, with fine healthy Crowns and branching 6 inches from the ground. Hybrids grafted on hybrid stocks show an average height of 15 feet at 6 years, and Hybrids on Succirubra, 3 to 4 months old, measured 1 foot. Succirubras 20 years old are from 30 to 40 feet high, and Succirubras over 30 years old are about 70 feet high with stems of 1½ to 2 feet diameter at 5 feet from the ground. The officinalis

trees

trees at 20 years are about 30 feet high, but their stems are not so large as those of the finest trees at Dodabetta.

The most marked characteristic of the Cinchonas in Java is the luxuriance of their foliage. The trees have fine healthy Crowns, and show very little tendency to run to seed. In this respect, they present a striking Contrast to the Cinchonas grown on the Nilgiris and in the Wynaad, which ripen seed at an early age; and are generally somewhat deficient in healthy foliage.

XII Manuring.— Little or no manuring seems to be done on private Cinchona Estates, but on the Government Estates experiments are being made with Sulphate of ammonia, Castor Cake, stable manure and lupins. The lupins are grown from seed in the Nurseries, are planted out in the terraces, and are turned into the soil before flowering. This system of green manuring has been found to add about 1% to the alkaloids. Castor cake has been applied on a small experimental plot at the rate of 5 lb per tree, and has had a good effect

effect on the trees, the leaves being of a darker green than those of unmanured trees, but its influence on the alkaloidal value of the bark has not yet been determined. Stable manure has been found to increase the alkaloids from 1 to 2%, but the effect of the application of Sulphate of ammonia has been to cause a slight diminution in the alkaloids.

XIII Harvesting.— The bark crop is obtained by the removal of extra stems and redundant branches, and by the uprooting of crowded trees. The plantations are worked as "high forest" with the object of securing the greatest possible development when the final crop is taken. Coppicing does not appear to find favor, partly because the Ledger tree does not reproduce fruly from coppice, and partly because this system of working is unsuited to graft plantations. The stripping process introduced by McIvor was tried, but was abandoned as it was found to seriously affect the health of the trees, and the shaving system of Moens was given up, after a fair trial, for the same reason. Close planting and

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and the gradual thinning of the plantation from the 4th year is the system invariably followed. An Estate planted 4×4 Contains 2722 trees per acre. In the 4th year it is found necessary to thin out by prunings and by the uprootal of trees that have not sufficient space for free development. This first crop gives about 100 tts of bark per acre. In the 6th year, a second crop is taken which gives about 176 tts per acre. The crops in the 6th and 7th years are 300 tts and 450 tts per acre respectively, and from the 8th year upwards, the ordinary annual crop is estimated at 500 Kilos per bouw, or about 630 tts per acre. Although these figures appear to be high, they do not represent the maximum yield. On the private plantation "Lodaja", Ledger seedlings planted in 1884 gave as much as 365 Kilos per bouw, when the first crop of thinnings was taken in 1888-89, the total yield up to 1895-96 was 3585 Kilos per bouw, or 4507 tts per acre, and the subsequent annual yield was estimated at 500 Kilos per bouw or about 630 tts per acre. The high yield of the Java plantations is due, in a great measure, to the fact that bark from

bark is taken from branches, as well as from the stem and root. Ledger branch bark gives about 5 per Cent Sulphate of Quinine, and therefore well repays harvesting. The proportions of stem, branch, and root bark harvested show great variations. Some figures for the Government Estate Tjinjirotan give 53.53 % stem, 17.16 % branch and 29.31 % root bark, and a private Estate "Pasir Malang" shows 39.68 % stem, 30.72 % branch, and 29.60 % root bark. The yield of individual trees varies very Considerably. at 6 years, the yield of stem, branch, and root is from 1 to 3 tts per tree, and at 8 years, when a plantation has been judiciously thinned, the yield per tree ranges from 2 tts to 7 tts. The original Ledger plantation at Tjinjirotan affords a very good example of a plot that has been systematically thinned. The trees are 33 years old, the area of the plot is 7 acres, and the number of trees standing on 31 March 1899 was 1280 or 183 per acre. In 1897, 64 trees were uprooted, and gave 4172 tts of bark, or 596 tts from about 9 trees on each acre. I am not able to give figures showing the yield of this plot before 1891, but during

during the 7 years 1891 to 1897, the total yield was 36,314 tbs or 741 tbs per acre per annum.

The area of the Government Estates is 2206 acres. The total crop in 1897 was 657,744 tbs, or 298 tbs per acre, and the average annual yield per acre for the period 1888 to 1897 was 286 tbs per acre. The system of harvesting by uprooting necessitates the replanting of old land. I gave particular attention to this subject, as the future of the industry appears to me to depend largely on the degree of success which attends such replanting. On the Government Estates, where as I have mentioned above, the land has all been carefully terraced, interplanting is done, when the plots have been sufficiently thinned out, to allow light and space for the young plants; but although this interplanting may be said to be successful, the growth and development of the plants cannot be compared with plantations made on new soil. Some of the private planters disapprove of interplanting, and prefer to continue thinning out until a plot has been entirely cleared. The ground is then replanted without being allowed

allowed a period of fallow. On the Government Estates, where inferior varieties were uprooted, and the land replanted, the second planting has come on well, but the growth is not so good as on virgin soil. I saw no instance of a second planting, which could compare with a first planting, and I am inclined to think that in the course of time, when original plantations have been worked out, the planters will find that unless they make new plantations on virgin soil, it will be impossible to keep up the present maximum yield of 500 Kilos of bark per bouw.

XIV. Drying and Packing.— The bark is dried in the sun and also by artificial heat. On some Estates, Siroccos are used when the bark has been partially dried in the sun, and on other Estates, drying rooms heated by flues are used. Great care is taken with the preparation of Succirubra quills. The bark is taken from the uprooted tree in strips, varying in size from 12½ Centimetres x 5 Centimetres, to 1 metre x 16 Centimetres; each strip after being partially dried in the sun is curled round a piece of bamboo, and firmly tied to it.

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during the 7 years 1891 to 1897, the total yield was 36,314 ℔s or 741 ℔s per acre per annum. The area of the Government Estates is 2206 acres. The total crop in 1897 was 65,744 ℔s, or 29½ ℔s per acre; and the average annual yield per acre for the period 1888 to 1897 was 286 ℔s per acre. The system of harvesting by uprooting necessitates the replanting of old land. I gave particular attention to this subject, as the future of the industry appears to me to depend largely on the degree of success which attends such replanting. On the Government Estates, where as I have mentioned above, the land has all been carefully terraced, interplanting is done, when the plots have been sufficiently thinned out, to allow light and space for the young plants; but although this interplanting may be said to be successful, the growth and development of the plants cannot be compared with plantations made on new soil. Some of the private planters disapprove of interplanting, and prefer to continue thinning out until a plot has been entirely cleared. The ground is then replanted without being allowed

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The bamboo is removed when the bark is dry, and the quills after trimming and sorting are packed in wooden cases, Containing 150 ℔. This Druggists Quill realizes a high price at Amsterdam, as much as 1¼ guilders per ℔ having been paid recently for mette quills from the Government Estates. The cost of harvesting, packing, and transport to the Coast is 6 Cents per ℔ for Quill bark, and 4 Cents for Manufacturer's bark. The whole Crop Charges on the Government Estates in 1897, for manufacturers and Druggist's bark amounted to 9.6 pias per ℔, the freight and home charges amounted to 8.7 pias per ℔, or a total of 1. 6.3 per ℔; and on private Estates, the harvesting transport and sale charges on Ledger bark are estimated at 12 Cents per Kilo, or about 1. 2 per ℔.

Cost of production.— As the Government plantations in Java are worked as a Commercial undertaking, and the bark is shipped to Amsterdam for public sale, the figures given in the most recent annual report may fairly be taken as representing the average cost of bark-production throughout the island. The total

total expenditure on the Government plantations in 1897 was 93198.87 guilders, or ℞ 116,498.98. The area of the Estates is 2206 acres, and the expenditure was therefore at the rate of ℞ 52.83 per acre. This sum was distributed as follows:—

	℞
Establishment	18.19 per acre, per annum
Nurseries and Field work	13.68 " "
Buildings	2.94 " "
Miscellaneous	3.21 " "
Crop including transport to F.O.B.	14.81 " "
	℞ 52.83

Apart from the crop, the ordinary upkeep of the Estates Cost ℞ 38.02 per acre. The crop amounted to 65,744 ℔, or 295.5 ℔ per acre, and as the total Cost was ℞ 116,498.98 the Cost per ℔ F.O.B. was 2. as 10.3 p per ℔. Freight and home charges amounted to 8.7 pias per ℔, so that the total cost was 3. as 7 p per ℔. This figure may be further analysed as follows:—

	as p
Cost of Establishment and general upkeep	2-0.7 per ℔ of bark
Harvesting and transport to F.O.B.	9.6
Freight and Home charges	8.7
Total	3-7 per ℔

The most important Consideration however is

is the cost per unit of Sulphate of Quinine. The 578,298 lbs of Ledger bark, averaged 7.16% Sulphate of Quinine, and for the present purpose this figure may be taken as representing the average of the whole Crop. For the 73,476 lbs of Succirubra quill bark cost more to harvest than the Ledger, and was not sold to Manufacturers on the Sulphate of Quinine basis. The cost per unit therefore was 5.8 pies or rather less than ½d. The average analysis of the whole Crop from Java is not much above 5¼% Sulphate of Quinine, so that the cost of production of a unit is about ¾d.

The average unit price in Amsterdam in 1897 was 4.7 Cents or rather less than 1 penny and the net profit for that year on the Government Plantations was 97,213 guilders or Rs 121516.4 which is equal to a net profit per acre of Rs 55.

The planters in Java have always recognized the fact that the chief object of Cinchona cultivation is to produce Quinine rather than bark, and the success they have achieved is very largely due to their perseverance in selection based on analysis.

It is usually assumed that the soil and climate

total

at last been made, and that it has

climate of Java are sufficient to account for the superiority of the bark over that grown in India, but if this were the Case, the Succirubra bark of Java, which is grown to meet the demand for Druggists quills, and not as a yielder of Quinine would be richer than the Succirubras grown in India. As a matter of fact, however, the Composition of the barks is almost identical. An average of 42 samples of Java Succirubra shows 1.45% Quinine, while the average of 50 samples of Indian Succirubra analysed by Mr Hooper was 1.40% Quinine. This Comparison is interesting, for it shows that in the Case of Succirubra, the one species which has not been propagated from trees with a high quinine yield, and which has been grown for its bark rather than for its Quinine, the results have been very much the same as in India.

The officinalis in Java, which was raised from seed received from the Government plantations in India, is grown to a very small extent, but with this species as with Ledgers attention has been given to propagation from the richest trees.

The average of 30 analyses of this bark made by Mr Van Leersum shows 8·25% Sulphate of Quinine, but as each sample measured only half a metre (19·68 inches) and was taken at a height of half a metre from the ground, where the greatest deposit of alkaloid occurs, this high figure cannot be taken as the average for Officinalis stem barks.

Future of Cinchona. The extraordinary fluctuations in the Bark market in the Course of the last few months, have shown that the Java planters are in a position to cause a rise or fall in prices in proportion to the amount of barks they export; but the planters have hitherto failed to take advantage of this position, and by shipping large quantities of bark whenever the market has improved, have invariably sent prices down. From time to time, efforts have been made at Combination, with a view to regulating shipments, but they have not been successful, and the Bandoeng Quinine Factory has not met with the support which it deserves. Since my visit to Java however, it appears that a Combination has at

at last been made, and that it has been decided to establish a Cinchona market in Batavia, where all the bark grown in the island is to be sold. It is anticipated that this action on the part of the planters will give them a better Control over the market, and will force up the price of bark and Quinine.

The exports of bark from Java from the 1st of January to the end of June of the Current year amounted to 5,090,800 lbs which is the highest total that has ever been shipped during the first half of the year. I am of opinion, however, that these large shipments cannot be kept up without discounting the yield of the plantations in the future, unless new land is opened to Counter-balance the lower yield from ground which has been replanted.

In regard to Cinchona Cultivation in India, the principle suggestions I have to make are as follows:—

(1) Further attempts should be made to cultivate Ledgers from seed obtained from Java. They should be grown at an elevation of from 4000 to 5000 feet in

in rich well drained soil, and the richest trees only should be propagated from.

(2) The grafting of Ledgeriana or Succirubra at low elevations, and of Officinalis or Succirubra at higher elevations should be tried.

(3) Officinalis seed should be taken only from trees showing a high percentage of Quinine.

(4) Succirubra bark should be shipped in the form of quills.

(5) High cultivation should be adopted, and where the lay of land and the nature of the soil are suitable, the ground should be terraced before planting.

In Conclusion I beg to express my thanks to the officials and planters generally for their Courtesy and hospitality, and to Mr Van Leersum, the Director of the Government Cinchona plantations, in particular, for the valuable information he gave me on every detail of the working and management of the Estates under his charge.

Wm Standen

Director

Ootacamund
28th July 1899

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well, and are liable to suffer from canker
which has already borne a crop of cincho
of grafting is that known as "side gr
nurseries. The Succirubra seedling is g
until the stem is of the thickness of th
inches in length is taken from a branch
1½ inches in length is made at one end
breadth to the diameter of the cutting,
seedling, close to the ground, and turne
inserted, the flap of bark is divided ver
are bound firmly to the scion in such a v
of scion and graft. The material used f
ling ordinary gunny bags. Melted wax
rotting, to the top of the scion, and to
leaves are tied round the stem of the Suc
protect it from sun and rain. When the s
or four weeks from the time of grafting, t
scion increases in vigour the stock is fur
established, the remnant of the Succirub
point of union. The Javanese are very
200 to 300 grafts a day. They are
Before this method of payment was intro
about 10 per cent., whereas 95 per cent.
the present system. The stocks used
bras, but scions are taken from hybrids h
officinalis, as well as from pure ledgers.
flourishing field of hybrids that had be
ground. The original field of hybri
uprooting the trees and replanting why
trees from hybrids, which had given
These grafts at six years old were a
the open ground on old trees is not how
graft in the nurseries.

Propagation by cuttings seems to h
less satisfactory than seed and grafts.
cuttings, it might be expected that cutt
closely in alkaloid contents, that grafts
show the greatest variety in type, but M
Plantations, has shown in his interesting
of graft, cuttings, and seedling plantati
relied on to give the same yield of alka
analysing 10·33 per cent. were found to
per cent., while cuttings from a tree a
cent. to 7·94 per cent. sulphate of quini
derable variation, but they yield so muc
can be no doubt that it is more profita
cuttings, provided the soil is suitable.

Mr. Van Leersum has given particu
of first harvest, of fields of cuttings, gr
the seven years the cuttings gave 1,516
seedlings 3,209 lb. Seed ripens in Java
vessels are beginning to burst they ar
seeds fall out. Nurseries are prepared,
and Ceylon, and plants are put out in th
seed is sown, when they are from 6 to
dered necessary. The number of seedli
March 1899 was 1,580,000; consisting
Succirubras, and 25,000 hybrids, and on
numbered 2,602,300, or 1,180 per acre,

Number of plants.	Proportion to total plants.	Percentages.
	PER CENT.	
1,098,000	42·19	62·10
513,500	19·74	
4,500	·17	
494,000	18·98	37·90
444,300	17·08	
48,000	1·84	
2,602,300	..	..

seedlings have been preferred to grafts
l number of Ledgers being 67·94 per
per cent. cuttings. I was not able to
grown by private planters, but I was
ly consist of Ledgers grown from seed,
argely grown. Ground is cleared for
The forest is felled and burnt, and the
s are planted 4′×4′, hybrids 5′×4′ or
ing is done during the wet months of
ants are not shaded or protected in any
limited to keeping down the weeds.
cluding the cost of nurseries, is about
is figure does not include the cost of
bouw—(1 bouw = $1\frac{3}{4}$ acres) or about

ese labour should be plentiful is not
ae population. The area of the island
a population of about 26 millions, or
ly is about the same as in India, viz.,
nan, and 10 to $12\frac{1}{2}$ cents (2 annas to
have a great advantage over planters
t advances. The system of making
ae Dutch Government considered that
s who had received large advances,
practically in the position of slaves.
the courts of advances made to coolies,
ned. "Mandors" or maistries whose
ive from 10 guilders to 50 guilders a

lant is very liable to canker where
f moisture. Two forms of the disease
another that attacks the branches. In
rning of the diseased branches is the
has attacked the roots, the tree is
al of damage is also done by the tea
pillar (*Euproctis flexuosa*). On the
428·75 acres, no less than 100,000 lb.
re harvested in the first quarter of the

on is very similar to that followed in
ions absolutely clean. The growth of
eeding, and at the commencement of
bout 4 feet long by 1 foot broad and
and the soil is then dug to a depth of
Great importance is attached to this

—
Ledgers grown from seed .. ..
Grafts of ledger or succirubra .. .. ..
Ledger cuttings .. ..
Hybrid—(succirubra and ledger) .. .. ..
Succirubra .. ..
Officinalis .. ..
Total ..

It will be seen from the above that Ledger
and cuttings, the relative proportion to the tota
cent. seedlings, 31·78 per cent. grafts, and ·28
ascertain the proportions of the different kinds
given to understand that the plantations genera
and that neither Succirubra nor Officinalis is
planting in Java in the same way as in India.
size of the pits is usually 2 feet cube. Ledge
5′×5′, and Succirubras 6′×4′ or 6′×6′. Plan
December, January and February, the young pl
way, and during the first year cultivation is
The cost of opening and planting forest land, ir
50 guilders per acre, or 60 Indian rupees. Th
terracing which is said to be 10 guilders per
Rs. 7 per acre.

VIII. Labour.—That the supply of ay
surprising when one considers the density ter
is about 50,000 square miles, and it suppo e
520 to the square mile. The daily pay of a co
from 20 to 25 cents (4 annas to 5 annas) per
$2\frac{1}{2}$ annas per woman), but the Dutch planter
in India in being able to recruit labour with
advances to coolies was formerly in vogue, but
the practice was being abused, and that coo
which they could not liquidate for years, wer
A remedy was found in the non-recognition by
and this at once led to the system being aband
duty is to supervise the work of the coolies rec
month.

IX. Diseases and Pests.—The Ledger
the subsoil contains much clay and is retentive
are recognised, one that begins at the root and
the case of branch canker, the removal and b
course usually adopted, but when the diseas
doomed, and has to be uprooted. A good de
mosquito (*Helopeltis antonii*) and by a cate
Government estate, Tirtasari, which consists of
of wet bark or about 35,000 lb. of dry bark w
current year from diseased trees and branches.

X. Cultivation.—The system of cultiva
Indi... No attempt is made to keep the planta
weeds is checked during the rains by a rough
the dry weather, trenches are dug measuring
1 foot deep, weeds are buried in these trenches
1 foot, all weeds being turned into the soil.

intensive culture," and on the Government
set apart to show the effects of non-culti-
sive culture described above. Plots A, B, C
hybrids between Ledger and Succirubra.
the commencement, the trees were looking
ht was about 8 feet. The cultivation on
weeds and cleaning round the plants to
this plot looked unhealthy and stunted,
only, and from their general appearance, I
ve much longer. Plot C had been rough
, and there had been no burying of weeds.
being deficient in foliage, and their average
the amount of sulphate of quinine in these
showed that the highly cultivated plot A
ine per bouw, the non-cultivated plot B
tly cultivated plot C contained ·79 kilos

1897 on the three plots was as follows: A
bouw, so that the cost of a kilo of quinine
plot C 46·58 guilders, while the expendi-
entirely unproductive. The sum spent on
igging, on the Government estates during
s. 7·56 per acre; but on private estates, 20
acre per annum is considered a reasonable

ANCE.—The original ledgers on the Govern-
remained on 31st March 1899, are now 33
ees, 50 to 60 feet high, with good crowns,
5 feet from the ground. They stand on 4
average number of these trees per acre is
) years old, average about 30 feet high, but
measuring about 4 inches in diameter at 5
rivate estate belonging to Mr. Kerkhoven,
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mode of cultivation, which is known as "
estates some experimental plots have bee
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were planted in 1894 on old land with
Plot A had been well cultivated from
remarkably healthy, and their average he
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XI. GROWTH AND GENERAL APPEA
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do not represent the maximum yield.
seedlings planted in 1884 gave as
op of thinnings was taken in 1888–89,
er bouw, or 4,507 lb. per acre, and the
kilos per bouw, or about 630 lb. per
is due, in a great measure, to the fact
m the stem and root. Ledger branch
, and therefore well repays harvesting.
arvested show great variations. Some
give 53·53 per cent. stem, 17·16 per
nd a private estate "Pasir Malang"
ranch, and 29·60 per cent. root bark.
erably; at six years, the yield of stem,
at eight years, when a plantation has
nges from 2 lb. to 7 lb. The original
good example of a plot that has been
rs old, the area of the plot is 7 acres,
1899 was 1,280 or 183 per acre. In
. of bark, or 596 lb. from about 9 trees
wing the yield of this plot before 1891,
l yield was 36,314 lb. or 741 lb. per
estates is 2,205 acres. The total crop
and the average annual yield per acre
r acre. The system of harvesting by
l. I gave particular attention to this
me to depend largely on the degree of
Government estates, where, as I have
terraced, interplanting is done, when
light and space for the young
be successful, the growth and
plantations made on new soil.
terplanting, and prefer to continue
ared. The ground is then replanted
the Government estates, where inferior
the second planting has come on well,
soil. I saw no instance of a second
ing, and I am inclined to think that
have been worked out, the planters
s on virgin soil, it will be impossible
ilos of bark per bouw.

s dried in the sun and also by artificial
the bark has been partially dried in the
y flues are used. Great care is taken

XIII. Harvesting.—The bark crop is
and redundant branches, and by the uprootal
worked as "high forest" with the object of
ment when the final crop is taken. Coppicing
because the ledger tree does not reproduce
this system of working is unsuited to graft pla
duced by McIvor was tried, but was abandone
the health of the trees, and the shaving system o
for the same reason. Close planting and the
the fourth year is the system invariably follo
2,722 trees per acre. In the fourth year it is
and by the uprootal of trees that have not suffi
first crop gives about 100 lb. of bark per acre
taken which gives about 175 lb. per acre. Th
are 300 lb. and 450 lb. per acre, respectively, a
ordinary annual crop is estimated at 500 kilos
Although these figures appear to be high, they o
On the private plantation "Lodaja", ledger
much as 365 kilos per bouw, when the first c
the total yield up to 1895–96 was 3,585 kilos
subsequent annual yield was estimated at 50
acre. The high yield of the Java plantations
that bark is taken from branches, as well as fr
bark gives about 5 per cent. sulphate of quinin
The proportions of stem, branch and root bark
figures for the Government estate Tjinjiroean
cent., branch and 29·31 per cent. root bark, a
shows 39·68 per cent. stem, 30·72 per cent. b
The yield of individual trees varies very consid
branch and root is from 1 to 3 lb. per tree, and
been judiciously thinned, the yield per tree r
Ledger plantation at Tjinjiroean affords a ve
systematically thinned. The trees are 33 ye
and the number of trees standing on 31st Mar
1897, 64 trees were uprooted, and gave 4,172 lb
on each acre. I am not able to give figures sh
but during the 7 years 1891 to 1897, the to
acre per annum. The area of the Government
in 1897 was 651,744 lb. or 295½ lb. per acre;
for the period 1888 to 1897 was 286 lb. p
uprooting necessitates the replanting of old lan
subject, as the future of the industry appears
success which attends such replanting. On t
mentioned above, the land has all been carefu
the plots have been sufficiently thinned out,
plants; but although this interplanting may be
development of the plants cannot be compared
Some of the private planters disapprove of
thinning out until a plot has been entirely cl
without being allowed a period of fallow. On
varieties were uprooted, and the land replante
but the growth is not so good as on virg
planting, which could compare with a first pla
in the course of time, when original plantatio
will find that unless they make new plantatio
to keep up the present maximum yield of 500

XIV Drying and Packing.—The bark
heat. On some estates, siroccos are used whe
sun, and on other estates drying rooms heate

CNo 4905/99

Mr Standens Report

on

Cinchona Cultivation

in Java.

Revenue Dept.

Received notice only this morning 10/9/99

I

Read letter from the D. G. C. P.
No 34 of 28 July 1899
(Cin No 4905 of 99)
(Submitting report on cinchona
cultivation in Java)

Also pamphlet

CNo 4905/99

E.D. Desp 608 dy 8. IX. 99
The Govt has read
Mr Standens report with interest.
It will be communicated to
the U. P. A. S. I & also
placed on the E. T. for
general information. Copies
will be forwarded to the Govt of India & to
the Govt of Bengal. WDe
27/8/99

H.W. 1-9-99

H.H. 6.9.99

H.T 30-8-99

To the D. G. C. P.
the U P A S I
E. T.
Copy to the Govt of Bengal R&LR.O.A.
L.R.

Recd. 19-9-99.

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Government {1899} of Madras.

REVENUE.

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G.O., No. 608, 8th September 1899.

SEPTEMBER.

Cinchona cultivation in Java.

Reviewing Mr. Standen's report on—.

GOVERNMENT OF MADRAS.

REVENUE DEPARTMENT.

Read—letter from the Director, Government Cinchona Plantations, dated 28th July 1899, No. 34 :—

Abstract.—Submitting report on the cinchona cultivation in Java.

REPORT ON CINCHONA IN JAVA.

Contents.

I. History.
II. Area under cultivation.
III. Climate.
IV. Soil.
V. Elevation.
VI. Lay of land.
VII. Propagation.
VIII. Labour.
IX. Diseases and pests.
X. Cultivation.
XI. Growth and general appearance.
XII. Manuring.
XIII. Harvesting.
XIV. Drying and packing.
XV. Cost of production.
XVI. Future of Cinchona.

I. History.—The history of Cinchona in Java dates from the year 1852, when a single plant of Calisaya, which had been grown in Paris from seed collected by Weddell in South America, was received by the Curator of the Botanical Gardens at Buitenzorg. Further supplies of seed and plants were subsequently received from South America, and at the end of 1863, the cultivation had been so vigorously pushed forward, that there were more than half a million of cinchonas permanently planted out on the Government estates. Nearly the whole of these plants consisted of Pahudianas ; and as it was soon found that this species contained very little quinine, its cultivation was given up, and propagation was confined to Calisaya, Officinalis, and Succirubra. In December 1865, a small parcel of seed was purchased by the Dutch Government from Mr. J. W. B. Money, who had bought it from a Mr. Ledger, and in the following year, 12,000 plants raised from this seed were put out and were called Ledgerianas. The bark from these trees was first analysed in 1872, and was found to be exceptionally rich in quinine. No effort was spared in propagating from the richest of these trees, by means of seed, cuttings and grafts ; and the result has been that Java, at the present time, produces the richest bark in the world, and exports about 80 per cent. of the amount required by the trade.

II. Area under Cinchona.—I regret to say that I found it impossible to ascertain precisely the extent of land now under cinchona cultivation, but it is generally supposed that the total area is about 20,000 acres. The low prices for bark, which ruled a few years ago, led to the uprooting of a considerable quantity of cinchona to make room for tea, so that the area under cinchona is not so great now, as it was five years ago. On the other hand, the recent advance in the price of bark has revived interest in cinchona planting, and I heard of several new clearings being made. In addition to the Government Cinchona Plantations, which cover 2,205 acres, there are said to be 83 private plantations in Java, of which 58 are in the Preanger Residency of Western Java a district which is admirably suited for cinchona cultivation. The remaining plantations are chiefly in Central Java, while the number in the eastern part of the island is small. Ledgeriana is almost universally grown, but hybrids between Ledgeriana and Succirubra, which have been proved to contain a high percentage of quinine, are also cultivated ; and there is still a small area under Succirubra and Officinalis.

III. Climate.—The climate of the Preanger Residency of West Java is admirably suited to the growth of cinchonas. The annual rainfall averages about 130 inches, and is well distributed throughout the year. At Tjinjiroean, which is one of a group of four estates, belonging to Government, covering 1,496·25 acres, the average number of rainy days per annum is about 215 ; and even in the dry season, no single month passes without several rainy days. The prolonged droughts from which the plantations suffer in Southern India are quite unknown in Java, and it is not surprising, therefore, that the growth of the cinchonas, as well as that of vegetation generally, should be more luxuriant than it is in India. The shade temperature ranges from 50° to 78° fahrenheit, and the mean average temperature for the year is about 62°.

The rainy season lasts from October to April ; the wettest month of the year is March and the driest August.

IV. Soil.—The volcanic soil of Java bears a very high reputation for fertility, but it is a curious fact that analysis shows the soil to be by no means rich, as compared with rich European soils, and the forest soils of Southern India. Even the grass lands of the Nilgiris compare favourably with Java soils, as regards the actual quantity of plant-food available. No one, however, who has seen the luxuriant vegetation of Java can doubt that the soil is fertile to a high degree ; and this fertility must be in a great measure due to its fine physical condition, and to the favourable climatic conditions which render the constituents of the soil readily available as plant food.

The following table of analyses is given to show that in the most important constituents, viz., nitrogen, potash, phosphoric acid and lime, the soils of the Nilgiris compare very favourably with Java soils :—

—	Java soil.	Dodabetta forest soil.	Nedivattam grass land.
Water	2·14	4·14	3·45
Organic matter and combined water *	18·91	50·71	23·44
Ferric oxide	12·50	5·03	8·54
Alumina	26·20	4·72	12·35
Lime	·51	1·71	·28
Magnesia	·47	·72	·18
Potash	·22	·41	·36
Manganese oxide	·41	..	..
Soda	·33	·20	·23
Phosphoric acid	·11	·30	·17
Sulphuric acid	·23	·23	·19
Silica	..	..	..
	38·20	31·83	50·81
	100·00	100·00	100·00
* Containing nitrogen	·310	1·360	·341

From a comparison of the above it is very evident that soil analysis alone affords no explanation of the richness of the cinchona barks grown in Java. The soil on which the cinchonas thrive best is a dark chocolate colored loam, rich in humus, and with a free subsoil. Generally speaking the soil on the Government plantations answers to this description. It is of great depth, entirely free from stones, and very pervious to air and moisture ; but there are a few fields where the subsoil is of rather stiff clay. In such ground, the growth is not so luxuriant and the trees suffer from canker.

V. Elevation.—The elevation that has been found most suitable for Ledgers is from 4,000 to 5,000 feet, and the majority of the estates in the Preanger Residency are at this level. One of the Government plantations however—Kawah Tjiwidee—is about 6,000 feet above sea level, but this is found too high for Ledgers, and the estate contains only Succirubra and Officinalis. In making a comparison between the elevations at which cinchona is successfully grown in Java, with that at which it is grown in India, it must not be forgotten that the cinchona districts of Java are about 7° south of the equator, those of Southern India are about 12° north, and the plantations in Sikkim are about 27° north.

VI. Lay of Land.—The sites for the cinchona plantations have been carefully chosen, steep slopes have been avoided, and for the most part only gently undulating land has been planted. On the Government plantations the whole of the land has

been carefully terraced. The terraces are four feet in width, and are accurately traced across the slopes of the hills. The plants are put out in the centre, and the cultivation is done along the terrace, care being taken to avoid breaking down the edges. The soil is so deep and the slope of the land so gradual, that there is no danger of cutting into inferior soil in making these narrow terraces. As a result of this system of terracing, there is an entire absence of wash on the Government estates; no drains are required, and the rain water, instead of flowing over the land, carrying all the finer particles of soil to the nearest stream, penetrates freely into the soil, adding to the natural store of fertility, the ammonia, nitric acid, and salts, that it has become charged with in its course through the air. I was not able to obtain an analysis of the rain water of the cinchona districts, but judging from the number of active volcanoes in the island, I should think it must be rich inthe elements that are conducive to fertility.

VII. Propagation.—At a very early date in the history of cinchona in Java, it was recognized that the future success of the enterprise depended on the selection of seeds and cuttings from trees, which had a high alkaloidal value; but it was not until 1872, when the bark of the Ledgerianas was found to be so much richer than that of any other cinchonas, that special attention was given to the propagation of this species. The richest trees were reserved for the yield of seed and cuttings, and it was found that individuals of the second generation occasionally had a higher alkaloidal value than the parent trees. The work of selection was at first solely in the hands of Government, who were in possession of the original Ledgers, and for some years, the seed was distributed gratis; but from the year 1883 it has been sold, and the private planters have been able to grow their own stock trees, and take seed and cuttings from the richest of these. The Government, however, still continues to make a considerable revenue from the sale of seeds and grafts. In 1894 the sum realized was only 275 guilders, but in 1897 with the revival of interest in cinchona planting, the income from this source amounted to 12,065·25 guilders, as much as 260 guilders being paid for a packet of 25 grammes of some specially fine seed, and 10 guilders each for well-established grafts of Ledger on Succirubra. These high prices are a very good indication of the importance attached by planters to selection from good stock. The highest price paid for seed in 1897, viz., 260 guilders for 25 grammes, works out to 10·4 guilders per gramme, or Rs. 5,896 per lb. One gramme of Ledger seed is said to contain 3,500 seeds, 25 grammes would therefore contain 87,500 seeds. The seed from the Government estates is sold periodically by public auction at Bandoeng, the upset price is 10 guilders per packet of 25 grammes, and the bidding for the best seed is always keen. Seed is not obtainable by private treaty with the Director of the Cinchona Plantations, and as the planters are naturally unwilling to part with seed from their own trees, the only course open to planters in India, who wish to procure a supply of the best Ledger seed, is to authorize an agent to bid for them at the auctions. The trees from which the seed is taken on the Government estates are not isolated, they are in close proximity to Succirubras, and it would seem that there is great danger of hybridizing; but I was surprised to hear that cross-fertilization does not take place to any appreciable extent, and that although a few hybrids may be found among the seedlings grown from Ledger seed, the number of these is very small, and they can be readily identified and rejected while in the nursery beds. No special treatment is given to the seed bearers with a view to increasing their vigour, and up to the present time, no deterioration of the seed has been observed. Seedlings from seed taken from the original Ledgers, which are now 33 years old, are found to be quite as vigorous and healthy as those raised from seed taken from younger trees, and the subsequent growth of the plants on new land is as free and healthy as it was in the early days of the enterprise. Experience with regard to Officinalis and Succirubra is the same, there has been no deterioration of seed, either in vigour or in type.

The grafting of Ledgers on Succirubra which was first tried in 1879 has been continued to the present day with great success. Succirubra being of a more robust habit than Ledgeriana, it has been found advantageous to put out grafts of Ledger on Succirubra on land which is not considered so suitable for Ledgers. Where there is any indication of stiffness of soil and a non-porous subsoil, Ledgers will not develop

well, and are liable to suffer from canker. On such ground, as well as on old land, which has already borne a crop of cinchona, grafts are found to do well. The system of grafting is that known as "side grafting" and is generally done in the open nurseries. The Succirubra seedling is grown in the nursery bed for a year or two, until the stem is of the thickness of the little finger. A small cutting of about 3 inches in length is taken from a branch of a Ledger tree, and a sloping cut of about 1½ inches in length is made at one end. A small strip of bark, corresponding in breadth to the diameter of the cutting, is lifted from the stem of the Succirubra seedling, close to the ground, and turned back to form a flap. The scion is now inserted, the flap of bark is divided vertically into two narrow strips, and these strips are bound firmly to the scion in such a way as to exclude air from the opposed edges of scion and graft. The material used for binding is jute fibre, obtained by unravelling ordinary gunny bags. Melted wax is applied round the binding to save it from rotting, to the top of the scion, and to the angle between scion and graft. A few leaves are tied round the stem of the Succirubra plant, immediately above the scion, to protect it from sun and rain. When the scion begins to grow, which is usually in three or four weeks from the time of grafting, the Succirubra seedling is shortened, and as the scion increases in vigour the stock is further reduced. Finally when the graft is well established, the remnant of the Succirubra stem is cut away, immediately above the point of union. The Javanese are very quick at grafting, trained coolies turning out 200 to 300 grafts a day. They are paid according to the number that succeed. Before this method of payment was introduced, the number of successful grafts was about 10 per cent., whereas 95 per cent. is the proportion of successful grafts under the present system. The stocks used for grafting are almost invariably Succirubras, but scions are taken from hybrids between Ledgeriana and Succirubra, and from officinalis, as well as from pure ledgers. On the Government estates I saw a very flourishing field of hybrids that had been grafted on to hybrid stocks in the open ground. The original field of hybrids analysed only 4 per cent., and instead of uprooting the trees and replanting with other plants, grafts were made on the standing trees from hybrids, which had given 11 per cent. to 12 per cent. sulphate of quinine. These grafts at six years old were about 15 feet high and well branched. Grafting in the open ground on old trees is not however generally done, it is considered better to graft in the nurseries.

Propagation by cuttings seems to have been given up, as this method was found less satisfactory than seed and grafts. As to the respective merits of seed, grafts and cuttings, it might be expected that cuttings would resemble the parent trees most closely in alkaloid contents, that grafts would be next in value, and that seed would show the greatest variety in type, but Mr. Van Leersum, the Director of the Cinchona Plantations, has shown in his interesting pamphlet on the alkaloid contents and yield of graft, cuttings, and seedling plantations, that neither grafts nor cuttings can be relied on to give the same yield of alkaloids as the parent trees. Grafts from a tree analysing 10·33 per cent. were found to vary in yield from 3·35 per cent. to 11·45 per cent., while cuttings from a tree analysing 11·63 per cent. gave from 4·57 per cent. to 7·94 per cent. sulphate of quinine. Plants raised from seed also show considerable variation, but they yield so much more bark than grafts or cuttings that there can be no doubt that it is more profitable to grow seedlings than either grafts or cuttings, provided the soil is suitable.

Mr. Van Leersum has given particulars of the yield for seven years, from the time of first harvest, of fields of cuttings, grafts, and seedlings, and has shown that during the seven years the cuttings gave 1,516 lb. bark per acre, the grafts 2,288 lb. and the seedlings 3,209 lb. Seed ripens in Java towards the end of the year. When the seed vessels are beginning to burst they are gathered and dried in the shade until the seeds fall out. Nurseries are prepared, and worked in the same manner as in India and Ceylon, and plants are put out in the field about twelve months from the time the seed is sown, when they are from 6 to 9 inches high. Plant baskets are not considered necessary. The number of seedlings in the Government nurseries at the end of March 1899 was 1,580,000; consisting of 1,240,000 Ledgers and grafts, 315,000 Succirubras, and 25,000 hybrids, and on the same date, the plants in the open ground numbered 2,602,300, or 1,180 per acre, as shown below:—

—	Number of plants.	Proportion to total plants.	Percentages.
		PER CENT.	
Ledgers grown from seed..	1,098,000	42·19	62·10
Grafts of ledger or succirubra	513,500	19·74	
Ledger cuttings	4,500	·17	
Hybrid—(succirubra and ledger)	494,000	18·98	37·90
Succirubra	444,300	17·08	
Officinalis	48,000	1·84	
Total ..	2,602,300	..	..

It will be seen from the above that Ledger seedlings have been preferred to grafts and cuttings, the relative proportion to the total number of Ledgers being 67·94 per cent. seedlings, 31·78 per cent. grafts, and ·28 per cent. cuttings. I was not able to ascertain the proportions of the different kinds grown by private planters, but I was given to understand that the plantations generally consist of Ledgers grown from seed, and that neither Succirubra nor Officinalis is largely grown. Ground is cleared for planting in Java in the same way as in India. The forest is felled and burnt, and the size of the pits is usually 2 feet cube. Ledgers are planted 4′×4′, hybrids 5′×4′ or 5′×5′, and Succirubras 6′×4′ or 6′×6′. Planting is done during the wet months of December, January and February, the young plants are not shaded or protected in any way, and during the first year cultivation is limited to keeping down the weeds. The cost of opening and planting forest land, including the cost of nurseries, is about 50 guilders per acre, or 60 Indian rupees. This figure does not include the cost of terracing which is said to be 10 guilders per bouw—(1 bouw = $1\frac{3}{4}$ acres) or about Rs. 7 per acre.

VIII. Labour.—That the supply of Javanese labour should be plentiful is not surprising when one considers the density of the population. The area of the island is about 50,000 square miles, and it supports a population of about 26 millions, or 520 to the square mile. The daily pay of a cooly is about the same as in India, viz, from 20 to 25 cents (4 annas to 5 annas) per man, and 10 to $12\frac{1}{2}$ cents (2 annas to $2\frac{1}{2}$ annas per woman), but the Dutch planters have a great advantage over planters in India in being able to recruit labour without advances. The system of making advances to coolies was formerly in vogue, but the Dutch Government considered that the practice was being abused, and that coolies who had received large advances, which they could not liquidate for years, were practically in the position of slaves. A remedy was found in the non-recognition by the courts of advances made to coolies, and this at once led to the system being abandoned. "Mandors" or maistries whose duty is to supervise the work of the coolies receive from 10 guilders to 50 guilders a month.

IX. Diseases and Pests.—The Ledger plant is very liable to canker where the subsoil contains much clay and is retentive of moisture. Two forms of the disease are recognised, one that begins at the root and another that attacks the branches. In the case of branch canker, the removal and burning of the diseased branches is the course usually adopted, but when the disease has attacked the roots, the tree is doomed, and has to be uprooted. A good deal of damage is also done by the tea mosquito (*Helopeltis antonii*) and by a caterpillar (*Euproctis flexuosa*). On the Government estate, Tirtasari, which consists of 428·75 acres, no less than 100,000 lb. of wet bark or about 35,000 lb. of dry bark were harvested in the first quarter of the current year from diseased trees and branches.

X. Cultivation.—The system of cultivation is very similar to that followed in India. No attempt is made to keep the plantations absolutely clean. The growth of weeds is checked during the rains by a rough weeding, and at the commencement of the dry weather, trenches are dug measuring about 4 feet long by 1 foot broad and 1 foot deep, weeds are buried in these trenches, and the soil is then dug to a depth of 1 foot, all weeds being turned into the soil. Great importance is attached to this

mode of cultivation, which is known as "intensive culture," and on the Government estates some experimental plots have been set apart to show the effects of non-cultivation, rough weeding only, and the intensive culture described above. Plots A, B, C were planted in 1894 on old land with hybrids between Ledger and Succirubra. Plot A had been well cultivated from the commencement, the trees were looking remarkably healthy, and their average height was about 8 feet. The cultivation on plot B had been limited to sickling down weeds and cleaning round the plants to prevent their being choked. The trees on this plot looked unhealthy and stunted, their average height was about 2 feet only, and from their general appearance, I should think it unlikely that they will live much longer. Plot C had been rough weeded only. No digging had been done, and there had been no burying of weeds. The trees on this plot looked rather poor being deficient in foliage, and their average height was about 5 feet. An estimate of the amount of sulphate of quinine in these plots was made at the end of 1897, which showed that the highly cultivated plot A contained 1·51 kilos of sulphate of quinine per bouw, the non-cultivated plot B contained no quinine, and the indifferently cultivated plot C contained ·79 kilos per bouw.

The total expenditure to the end of 1897 on the three plots was as follows: A 58·70, B 36·80, and C 43·90 guilders per bouw, so that the cost of a kilo of quinine (2·2 lb.) on plot A was 38·87 guilders, on plot C 46·58 guilders, while the expenditure of 36·80 guilders on plot B had been entirely unproductive. The sum spent on the actual fieldwork, *i.e.*, weeding and digging, on the Government estates during 1897 was 10·60 guilders per bouw, or Rs. 7·56 per acre; but on private estates, 20 guilders per bouw or about Rs. 14 per acre per annum is considered a reasonable allowance for cultivation.

XI. Growth and general appearance.—The original ledgers on the Government estate Tjinjiroran, of which 1,280 remained on 31st March 1899, are now 33 years old. They are very fine healthy trees, 50 to 60 feet high, with good crowns, and with stem about 1 foot in diameter at 5 feet from the ground. They stand on 4 bouws or 7 acres of ground, so that the average number of these trees per acre is only 183. Ledger cuttings on Tirtasari, 20 years old, average about 30 feet high, but are of a rather spindly habit, their stems measuring about 4 inches in diameter at 5 feet from the ground. On Gamborng, a private estate belonging to Mr. Kerkhoven, 12 years old, ledgers grown from seed measure 30 feet high, with stems about 6 inches in diameter. Hybrids grafted on Succirubras on the Government estates show very fine growth; at the age of 5 years, they are from 12 to 20 feet high, with a stem diameter of $2\frac{1}{2}$ inches, 3 feet from the ground. One year old Ledgers grafted on succirubra are 3 to 4 feet high, with fine healthy crowns and branching 6 inches from the ground. Hybrids grafted on hybrid stocks show an average height of 15 feet at 6 years, and hybrids on Succirubra, 3 to 4 months old, measured 1 foot. Succirubras 20 years old are from 30 to 40 feet high, and succirubras over 30 years old are about 70 feet high with stems of $1\frac{1}{2}$ to 2 feet diameter at 5 feet from the ground. The Officinalis trees at 20 years are about 30 feet high, but their stems are not so large as those of the finest trees at Dodabetta. The most marked characteristic of the cinchonas in Java is the luxuriance of their foliage. The trees have fine healthy crowns, and show very little tendency to run to seed. In this respect, they present a striking contrast to the cinchonas grown on the Nilgiris and in the Wynaad, which ripen seed at an early age, and are generally somewhat deficient in healthy foliage.

XII. Manuring.—Little or no manuring seems to be done on private cinchona estates, but on the Government estates experiments are being made with sulphate of ammonia, castor cake, stable manure and lupins. The lupins are grown from seed in the nurseries, are planted out on the terraces and are turned into the soil before flowering. This system of green manuring has been found to add about 1 per cent. to the alkaloids. Castor cake has been applied on a small experimental plot at the rate of 5 lb. per tree, and has had a good effect on the trees, the leaves being of a darker green than those of unmanured trees, but its influence on the alkaloidal value of the bark has not yet been determined. Stable manure has been found to increase the alkaloids from 1 to 2 per cent., but the effect of the application of sulphate of ammonia has been to cause a slight diminution in the alkaloids.

XIII. Harvesting.—The bark crop is obtained by the removal of extra stems and redundant branches, and by the uprootal of crowded trees. The plantations are worked as "high forest" with the object of securing the greatest possible development when the final crop is taken. Coppicing does not appear to find favour, partly because the ledger tree does not reproduce freely from coppice and partly because this system of working is unsuited to graft plantations. The stripping process introduced by McIvor was tried, but was abandoned as it was found to seriously affect the health of the trees, and the shaving system of Moens was given up, after a fair trial, for the same reason. Close planting and the gradual thinning of the plantation from the fourth year is the system invariably followed. An estate planted 4′×4′ contains 2,722 trees per acre. In the fourth year it is found necessary to thin out by prunings and by the uprootal of trees that have not sufficient space for free development. This first crop gives about 100 lb. of bark per acre. In the fifth year, a second crop is taken which gives about 175 lb. per acre. The crops in the sixth and seventh years are 300 lb. and 450 lb. per acre, respectively, and from the eighth year upwards, the ordinary annual crop is estimated at 500 kilos per bouw, or about 630 lb. per acre. Although these figures appear to be high, they do not represent the maximum yield. On the private plantation "Lodaja", ledger seedlings planted in 1884 gave as much as 365 kilos per bouw, when the first crop of thinnings was taken in 1888–89, the total yield up to 1895–96 was 3,585 kilos per bouw, or 4,507 lb. per acre, and the subsequent annual yield was estimated at 500 kilos per bouw, or about 630 lb. per acre. The high yield of the Java plantations is due, in a great measure, to the fact that bark is taken from branches, as well as from the stem and root. Ledger branch bark gives about 5 per cent. sulphate of quinine, and therefore well repays harvesting. The proportions of stem, branch and root bark harvested show great variations. Some figures for the Government estate Tjinjiroean give 53·53 per cent. stem, 17·16 per cent., branch and 29·31 per cent. root bark, and a private estate "Pasir Malang" shows 39·68 per cent. stem, 30·72 per cent. branch, and 29·60 per cent. root bark. The yield of individual trees varies very considerably; at six years, the yield of stem, branch and root is from 1 to 3 lb. per tree, and at eight years, when a plantation has been judiciously thinned, the yield per tree ranges from 2 lb. to 7 lb. The original Ledger plantation at Tjinjiroean affords a very good example of a plot that has been systematically thinned. The trees are 33 years old, the area of the plot is 7 acres, and the number of trees standing on 31st March 1899 was 1,280 or 183 per acre. In 1897, 64 trees were uprooted, and gave 4,172 lb. of bark, or 596 lb. from about 9 trees on each acre. I am not able to give figures showing the yield of this plot before 1891, but during the 7 years 1891 to 1897, the total yield was 36,314 lb. or 741 lb. per acre per annum. The area of the Government estates is 2,205 acres. The total crop in 1897 was 651,744 lb. or 295½ lb. per acre; and the average annual yield per acre for the period 1888 to 1897 was 286 lb. per acre. The system of harvesting by uprooting necessitates the replanting of old land. I gave particular attention to this subject, as the future of the industry appears to me to depend largely on the degree of success which attends such replanting. On the Government estates, where, as I have mentioned above, the land has all been carefully terraced, interplanting is done, when the plots have been sufficiently thinned out, to allow light and space for the young plants; but although this interplanting may be said to be successful, the growth and development of the plants cannot be compared with plantations made on new soil. Some of the private planters disapprove of interplanting, and prefer to continue thinning out until a plot has been entirely cleared. The ground is then replanted without being allowed a period of fallow. On the Government estates, where inferior varieties were uprooted, and the land replanted, the second planting has come on well, but the growth is not so good as on virgin soil. I saw no instance of a second planting, which could compare with a first planting, and I am inclined to think that in the course of time, when original plantations have been worked out, the planters will find that unless they make new plantations on virgin soil, it will be impossible to keep up the present maximum yield of 500 kilos of bark per bouw.

XIV Drying and Packing.—The bark is dried in the sun and also by artificial heat. On some estates, siroccos are used when the bark has been partially dried in the sun, and on other estates drying rooms heated by flues are used. Great care is taken

with the preparation of succirubra quills. The bark is taken from the uprooted tree in strips, varying in size from 12½ centimetres × 5 centimetres to 1 metre × 15 centimetres; each strip after being partially dried in the sun is curled round a piece of bamboo, and firmly tied to it. The bamboo is removed when the bark is dry, and the quills after trimming and sorting are packed in wooden cases, containing 150 lb. This druggist's quill realizes a high price at Amsterdam, as much as 1¼ guilders per pound having been paid recently for metre quills from the Government estates. The cost of harvesting, packing and transport to the coast is 6 cents per pound for quill bark, and 4 cents for manufacturer's bark. The whole crop charges on the Government estates in 1897, for manufacturer's and druggist's bark, amounted to 9·6 pies per lb., the freight and home charges amounted to 8·7 pies per lb. or a total of As.1–6·3 pies per lb.; and on private estates, the harvesting, transport and sale charges on ledger bark are estimated at 12 cents per kilo, or about As. 1-2 pies per pound.

XV. Cost of Production.—As the Government plantations in Java are worked as a commercial undertaking, and the bark is shipped to Amsterdam for public sale, the figures given in the most recent annual report may fairly be taken as representing the average cost of bark-production throughout the island. The total expenditure on the Government plantations in 1897 was 93,198·87 guilders, or Rs. 1,16,498·98. The area of the estates is 2,205 acres, and the expenditure was therefore at the rate of Rs. 52·83 per acre. This sum was distributed as follows:—

	Per acre per annum.
	Rs.
Establishment	18·19
Nurseries and fieldwork	13·68
Buildings	2·94
Miscellaneous	3·21
Crop including transport to f.o.b.	14·81
Total ...	52·83

Apart from the crop, the ordinary upkeep of the estates cost Rs. 38·02 per acre. The crop amounted to 651,744 lb. or 295·5 lb. per acre, and as the total cost was Rs. 1,16,498·98, the cost per lb. f.o.b. was As. 2–10·3 per lb.

Freight and home charges amounted to 8·7 pies per lb., so that the total cost was As. 3–7 pies per lb. This figure may be further analysed as follows:—

	As. P.
Cost of establishment and general upkeep ...	2 0·7 per lb. of bark.
Harvesting and transport to f.o.b.	9·6
Freight and home charges	8·7
Total ...	3·7 per lb.

The most important consideration, however, is the cost per unit of sulphate of quinine. The 578,298 lb. of Ledger bark averaged 7·16 per cent. sulphate of quinine, and for the present purpose this figure may be taken as representing the average of the whole crop; for the 73,476 lb. of Succirubra quill bark cost more to harvest than the Ledger, and was not sold to manufacturers on the sulphate of quinine basis. The cost per unit therefore was 5·8 pies or rather less than ½d. The average analysis of the whole crop from Java is not much above 5½ per cent. sulphate of quinine, so that the cost of production of a unit is about ¾d. The average unit price in Amsterdam in 1897 was 4·7 cents or rather less than 1 penny, and the net profit for that year on the Government plantations was 97,213 guilders or Rs. 1,21,516·4, which is equal to a net profit per acre of Rs. 55. The planters in Java have always recognized the fact that the chief object of cinchona cultivation is to produce quinine rather than bark, and the success they have achieved is very largely due to their perseverance in selection based on analysis. It is usually assumed that the soil and climate of Java are sufficient to account for the superiority of the bark over that grown in India, but if this were

the case, the Succirubra bark of Java, which is grown to meet the demand for druggist's quills, and not as a yielder of quinine, would be richer than the succirubras grown in India. As a matter of fact, however, the composition of the barks is almost identical. An average of 42 samples of Java Succirubra shows 1·45 per cent. quinine, while the average of 50 samples of Indian Succirubra analysed by Mr. Hooper was 1·40 per cent. quinine. This comparison is interesting, for it shows that in the case of Succirubra, the one species which has not been propagated from trees with a high quinine yield, and which has been grown for its bark rather than for its quinine, the results have been very much the same as in India.

The Officinalis in Java, which was raised from seed received from the Government plantations in India, is grown to a very small extent; but with this species as with Ledgers attention has been given to propagation from the richest trees. The average of 30 analyses of this bark made by Mr. VanLeersum shows 8·25 per cent. sulphate of quinine, but as each sample measured only half a metre (19·68 inches), and was taken at a height of half a metre from the ground, where the greatest deposit of alkaloid occurs, this high figure cannot be taken as the average for Officinalis stem bark.

XVI. Future of Cinchona.—The extraordinary fluctuations in the bark market in the course of the last few months have shown that the Java planters are in a position to cause a rise or fall in prices in proportion to the amount of bark they export; but the planters have hitherto failed to take advantage of this position, and by shipping large quantities of bark whenever the market has improved, have invariably sent prices down. From time to time, efforts have been made at combination, with a view to regulating shipments, but they have not been successful, and the Bandoeng Quinine Factory has not met with the support which it deserves. Since my visit to Java, however, it appears that a combination has at last been made, and that it has been decided to establish a cinchona market in Batavia, where all the bark grown in the island is to be sold.

It is anticipated that this action on the part of the planters will give them a better control over the market, and will force up the price of bark and quinine.

The exports of bark from Java from the 1st of January to the end of June of the current year amounted to 5,090,800 lb., which is the highest total that has ever been shipped during the first half of the year. I am of opinion, however, that these large shipments cannot be kept up without discounting the yield of the plantations in the future, unless new land is opened to counterbalance the lower yield from ground which has been replanted.

In regard to cinchona cultivation in India, the principal suggestions I have to make are as follows:—

(1) Further attempts should be made to cultivate Ledgers from seed obtained from Java. They should be grown at an elevation of from 4,000 to 5,000 feet in rich well-drained soil, and the richest trees only should be propagated from.

(2) The grafting of Ledger on Succirubra at low elevations, and of Officinalis on Succirubra at higher elevations should be tried.

(3) Officinalis seed should be taken only from trees showing a high percentage of quinine.

(4) Succirubra bark should be shipped in the form of quills.

(5) High cultivation should be adopted, and where the lay of land and the nature of the soil are suitable, the ground should be terraced before planting.

In conclusion, I beg to express my thanks to the officials and planters generally for their courtesy and hospitality, and to Mr. VanLeersum, the Director of the Government Cinchona Plantations, in particular, for the valuable information he gave me on every detail of the working and management of the estates under his charge.

Ootacamund,
28*th July* 1899.

(Signed) W. M. STANDEN,
Director.

No. 608, Revenue, dated 8th September 1899.

Miscellaneous.

The Government has read Mr. Standen's report with interest. It will be communicated to the United Planters' ation, Southern India, and also placed on the Editors' Table for general inform- Copies will be forwarded to the Government of India and to the Government engal.

(True Extract.)

Ag. Secretary to Government.

To the Director, Government Cinchona Plantations.
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