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### II. Report on the Cultivation of Chinchona in Bengal for the Year 1867-68

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II. *Report on the Cultivation of Cinchona in Bengal for the Year 1867-68.* By THOMAS ANDERSON, M.D., Superintendent, Botanical Gardens, and in charge of Cinchona Cultivation in Bengal.

The cultivation of the cinchonas has been most successfully carried on during the year. The open air cultivation has been greatly extended, and now consists of four times the amount of plants reported last year. I shall follow the arrangement of the report of last year, and shall consider the plants in their different stages of growth.

*Stock Plants.*—These plants, which are all grown under glass panes, are in excellent condition, and notwithstanding the vast amount of cuttings they have yielded, their vigour has increased during the year.

*Seedlings.*—A quantity of excellent seedlings of *C. officinalis*, and a very few of *C. succirubra*, were reared from seed yielded by the plants planted at Rungbee in October 1864. Besides these, I received during the year several packets of seed of *C. officinalis* and of *C. succirubra* from Mr Thwaites, the director of the Botanical Gardens, Ceylon. The number of seedlings raised during the year amounted to 101,750. The number of seedlings obtained during the previous year was 38,500.

*Nursery Beds.*—Large additions were made to the nursery beds. Most of the plants in these beds remained unprotected throughout the winter.

*Permanent Plantations.*—The formation of the open air plantations, and the tending of the plants in them, are the simplest parts of the cultivation of cinchona as practised at Darjeeling. As the process of planting followed by me at Darjeeling has not yet been fully stated in any of my previous reports, the time has now arrived for narrating the various stages of the open air cultivation, from the clearance of the forest-covered land until the end of the second year of the growth of the plants. Hitherto, the land selected has consisted of ground on which Lepchas had previously carried on the cultivation of maize, millets, and rice (a peculiar variety, which is grown without being irrigated)

in the manner known as joom\* cultivation, with patches of virgin forest occurring every here and there among the partially cleared spaces.

Nepalese coolies with their kookeries (short heavy curved knives), and Lepchas with their long straight sword-like knives, are sent to fell the jungle as close to the ground as possible.

The scrub, and even young trees as thick as a man's body, fall rapidly before the knives of these clearers. Where patches of virgin forest are met with, the axe must be used, but here every tree is not felled, as the smaller ones, being notched near the ground, are borne down by the fall of the full-grown trees. In preparing ground for cinchona planting at Darjeeling, the practice has always been to clear the land entirely of all vegetation, not a tree of even the smallest size ever being spared. In these hills, forest should not be felled before the middle or the end of November; if the land is cleared earlier, the grasses and underwood spring up among the branches of the fallen trees, and thus their burning is prevented. Felling may be continued until the middle of March. After two or three months' exposure to the bright sunshine and dry air of the cold season, the felled trees are in a fit state to burn. By the end of March, therefore, fires may be lit in the afternoon, when the sun has thoroughly dried up the heavy dew, at the bottom of the slope covered with felled and dry jungle. The fire rapidly consumes the whole of the brushwood and the branches of the trees, leaving only the large branches and trunks to smoulder for weeks.

Wherever virgin forest or bamboo jungle has existed, it has been necessary, after burning the lighter vegetation, to cut up the trunks of the trees and the bamboos into short pieces, and either to pile them into heaps for burning, or to roll them into the steep ravines which are too stony for planting cinchonas. The land thus cleared by fire is ready

\* Joom cultivation is the term used to designate the rude cultivation practised by most of the hill tribes of India. It consists of felling and burning virgin forest (leaving the stumps of the trees standing), for the growth of sub-tropical grains. After two or three crops have been obtained, the ground is abandoned for a freshly cleared patch of forest. The piece abandoned soon becomes covered with a dense vegetation of shrubs, gigantic grasses, and young trees.

for laying out the ground for planting, and for marking the bridle paths required to give easy access to all parts of it. These paths are made about 4 or 5 feet wide, and are connected with the principal roads of the plantation. The sites for the plants are fixed by means of a cord about 100 feet in length, on which marks are tied at intervals of 6 feet for *C. succirubra*, and at shorter distance for *C. officinalis*. This marked cord is stretched along the ground, and at each mark on it, a stick, about  $2\frac{1}{2}$  feet in length, is thrust into the ground, thus indicating the place where a cinchona is to be planted. In order to secure uniformity in the plantation, each line is continued to the full extent of the ground to be planted before another line is commenced; the lines in properly laid out plantations will thus be parallel.

In the plantations of *C. succirubra*, the lines are fixed at 6 feet from each other, and as the plants are 6 feet apart in the lines, a uniform distance of 6 feet between the plants is maintained.

At first, *C. officinalis* was planted with an interval of 5 feet between the plants, but I have lately altered this plan for a system of close planting in lines, the lines being 4 feet apart.

After the ground has been "staked out," the next preparation for planting consists of digging the soil to the depth of a foot, removing the roots at the same time in a circle about a foot in diameter, of which the stake is the centre. The planting of the ground thus prepared is performed in dull, cloudy weather, when showers are frequent, but when the ground is not saturated by long-continued heavy rain. The thoroughly hardened plants are brought from the adjoining nursery beds in shallow boxes, which the men carry on their heads. The plants are given to the coolie engaged in planting, who, with his hands, makes a hole in the loose soil sufficiently large to admit the roots of the plant, and the soil is gently pressed around the roots to prevent the plant being beaten down by heavy rain. The plants when taken from the nursery-bed should not be less than 4 inches, and should not exceed a foot in height, but plants varying from 6 to 10 inches in height are of the best size.

After the plants have been planted for three weeks, it is necessary to cut down the weeds which had sprung up around them, as in a few weeks more the young cinchonas would soon be smothered in a jungle 5 or 6 feet high. These weeds require to be cut down once a month, from May until the end of October ; they are laid in lines following the slope of the hill, and the slightly raised ridges soon disappear as they are decomposed by the heavy rain and high temperature. During the same period of the year, it is necessary to weed every six weeks the prepared circles in which the cinchonas are growing, and at the same time to loosen the soil round the plants by lightly hoeing with a kodalie or furroah. In November, the entire surface of the plantations is thoroughly hoed, and by this means the weeds receive a great check by being exposed to the drying sunshine of the cold season after having been uprooted. After hoeing, the plantation requires no attention until the end of April, when a light covering of weeds having sprung up again, the circles round the plants should be lightly hoed and somewhat enlarged. From May again, until the end of October, the periodical cutting of the weeds must be continued, but not so frequently as in the previous season, as many of the strongest growing weeds by this time have succumbed to the hoeing in November. The growth of the plants is greatly favoured by a hoeing of the ground in November again, after the second growing season is over, and if this is done in the following year, their third growing season, the plants are tall and strong enough to outgrow the jungle, which then begins in its turn to be smothered under the dense foliage, at least of *C. succirubra*.

The Selim Tea Association purchased 10,000 plants of *C. succirubra* in July 1867, and all of these, which were planted on steep slopes of the Himalaya, immediately above the Terai, are inferior in condition and promise only to the splendid plants of cinchona in the Government plantation at Rishap, close to Rungbee.

*Chemical Analysis of the Bark.*—The bark of *C. succirubra* and *C. officinalis*, referred to in the last annual report as having been sent to London for analysis, was analysed by Mr Howard. The analysis was most satisfac-

tory, one specimen of *C. succirubra*, thirty-one months old, yielding no less than 7·30 per cent. of precipitated alkaloids, of which 3·20 was quinine, and 2·27 cinchonidine mixed with a little quinine—a larger percentage of alkaloids than has been found in any other bark of the same age. The bark of *C. officinalis*, taken from plants twenty-eight months old, gave 3·20 of alkaloids. The conclusion drawn by Mr Howard from this analysis is, “that there is no reason to think the Darjeeling barks at all inferior to those grown at Ootacamund; the difference of climate does not appear to have much effect on the alkaloids therein contained.”

*Flowering and Seeding.*—A small number (270) of plants of the varieties of *C. officinalis*, planted in October 1864, have again produced a profusion of flowers, and already many of them are covered with most promising panicles of seed vessels. A considerable amount of good seed was obtained from several of these plants in August and September 1867. Out of 389 plants of *C. succirubra*, planted in October 1864, only two plants produced flowers and seed last year, and a few seedlings were raised from their seed. These plants, which were in an unhealthy state at the time of flowering, soon after became healthy and vigorous, and this year they have not flowered. Another plant of *C. succirubra*, from whose stem a large piece of bark was taken, has put forth a few flowers from one or two of the branches. With these exceptions none of the *C. succirubra* plants have flowered at Darjeeling, although many of the oldest plants are above 12 feet in height.

*Distribution of Cinchonas.*—11,390 plants of *C. succirubra* were distributed during the year. Of these, 10,290 were sold to planters in the district of Darjeeling, 1000 plants were despatched to Chittagong for distribution among the tea planters, and 100 were sent to the deputy commissioner of Hazara in the Punjab.

*Private Cultivation of Cinchona in Darjeeling.*—100 acres were planted with *Cinchona succirubra* during the year by the Darjeeling Cinchona Association, the area being 120 acres. At Coombe Banks, the cinchona estate of Major Fitzgerald, 25 acres have been planted.

The Darjeeling Tea Company possesses some fine plants of *C. succirubra* planted in May 1864. This company is

also forming plantations of red bark on land well adapted to the cultivation of cinchona.

Mr Robson, the superintendent of the cinchona plantations of the Tuckvar Tea Company, has made large additions to the plantations of *C. officinalis* and *C. succirubra*. Some of the older plants of *C. officinalis* on this estate are now in flower.

The Selim Tea Association possesses 10,000 plants of *C. succirubra*, which were purchased from the Government plantations in July 1867.

One thousand plants of *C. succirubra* were sent to Chittagong in February 1868, and most of them arrived in good order.

*Khasia Hills*.—The establishment of a small nursery at the Khasia Hills was sanctioned by Government early in 1867. The nursery was intended only for raising plants of cinchona for distribution among the planters in Assam. One of the European gardeners from the Darjeeling plantation was sent, in February 1867, in charge of the plants from Darjeeling, with which the cultivation was to be commenced. He reached Shillong in the Khasia Hills in the end of March, and early in May the cultivation was commenced near the Dak Bungalow of Nunklow.

The plants had been increased from 650, the original number sent from Darjeeling, to 6778 on the 31st March 1868. The distribution was begun in March 1868 by the sale of 100 plants, and other applications had been registered. The species in these nurseries is *C. succirubra*, the only species that will probably succeed in Assam.

### III. Notes of a Visit to the Hot Springs of Jumnotri in 1860. Part. II. By Mr WILLIAM BELL.

The hot springs of Jumnotri are about six miles above the village of Kursalla, but as the crow flies perhaps they are not more than two, and the road leading to them is up the bed of the Jumna. For the first mile and a half it is passable, at least not much worse than many of the other public highways through the Terai Rajah's dominions; but the remaining four and a half miles have to be accomplished both on hands and feet—the exceptions to this mode of