CHAPTER - IV
SPECIAL STUDY OF CINCHONA CULTIVATION
The Cinchona is a tropical tree that is the primary source of anti-malarial drug - Quinine. Quinine is found in the bark of the Cinchona tree. Quinine is a chemical that cures malaria, a deadly tropical disease carried by mosquitoes. Malaria killed thousands during the Civil War and during the World War II — one half of all the troops suffered from Malaria. In India alone, in 1952, the disease affected about 75 million people. Indeed, during the period 1952-1970, the transmission of Malaria was reduced to a level at which the disease could no longer be considered as endemic. Unfortunately, Malaria re-emerged during the period of 1971-75.

4.1 History of Cinchona Bark

Cinchona was discovered during the conquest of the Incan Empire in the late 16th and early 17th century. Spanish legends indicate a soldier suffering from Malaria drank from a pool of brown water at the base of a Quinine tree. Another Spanish legend suggests that Indians noted sick animals drinking water from the brown tepid pools. The first written record of a Malaria cure with Cinchona bark dates back to 1630. Word of Cinchona reached Europe in 1632 by Jesuit Barnabe de Cobo. In 1640, Juan de Lugo first employed the tincture of the Cinchona bark for treating Malaria. Juan de Lugo (made cardinal in 1643) was entrusted by Pope Innocent X to learn more about the bark. De Lugo had the bark analysed by the pope’s physician, Gabriele Fonseca, who reported on it very favourably. In the late 1640s, directions for the use of the bark were published as the Schedula Romana. While on a visit to Paris in 1649 the cardinal even used some of his Cinchona to treat the young Louis XIV. After the king’s recovery, the French eagerly embraced the new remedy. Juan de Lugo remained a faithful advocate, zealous defender, and generous, disinterested dispenser of the bark in Italy and the rest of Europe until his death in 1660. The first prescription of Cinchona in England is attributed to Robert Brady, a Professor of Physic in
Cambridge, who in 1658 began prescribing the powder of the 'Jesuits' bark' to treat an outbreak of Malaria.

The first official recognition of Cinchona came in 1677, when it was listed in London Pharmacopoeia as "Cortex Peruamn". It became the official drug in the UK Pharmacopoeia in 1677. Fryer made mention of the drug's Indian origin in the year 1675. Knowledge of the drug was then carried very rapidly across the globe, yet nothing was known about the plant from which the medicinal bark was procured. It was M.M.La Condamine and Jussieu who procured the plant during one of their astronomical expeditions to South America. They sent samples of the plant to Carolus Linnaeus, a Swedish botanist, who, in 1742, named it as "Cinchona" and established the species C. officinalis. The first partially successful separation of the active principle from Cinchona was achieved in 1811 by a Portuguese naval surgeon named Bernadino A. Gomez. He extracted the gray bark of poor variety with dilute acid and then neutralized it with alkali and managed to obtain a few crystals, which he named Cinchonin (later, to be known as Cinchonine).

French pharmacists, Joseph Pelletier and Joseph Bienaimé Caventou, appointed a full professor of toxicology at the École de Pharmacie in Paris at age 22, isolated a medicinally worthless quinine poor powder, from the gray bark in 1817. In 1819, Friedlieb Runge isolated a base from Cinchona, which he named "China base" - which was different from Cinchonine. Later, in 1820, Pelletier and Caventou isolated from the yellow bark a sticky, pale yellow gum that could not be induced to crystallize. The gum was soluble in acid, alcohol, and ether and highly effective against malaria. The properties of the gum were seen to be identical to "China" base; but Runge's prior discovery was overlooked. The two men named the new chemical quinine after quinquina, the name given by Peruvian Indians to the bark, meaning medicine of medicines or bark of barks. Pelletier and Caventou refused any profit from their discovery. Instead of patenting the extraction process, they published all the details so that anyone could manufacture Quinine. Quinidine was discovered in 1833 and Cinchonidine not until 1847. In fact more than 30 alkaloids are known from the bark of this genus. Formerly, the bark in different forms was used as a drug, but later natural harvesting formed the base of the production of Cinchona alkaloids. This industry was carried on principally in Germany, and
the Dutch and English Cinchona Plantations in Java, Ceylon and India were
the chief sources whence the raw material was supplied. Its main active
principle, Quinine is now chemically synthesized. In 1823, Dr. John Sappington
of Philadelphia acquired several pounds of Quinine and issued "Dr.
Sappington's Fever Pills." He persuaded ministers in the Mississippi River Valley to
ring the church bells every evening to alert people to take the pills, and
through that enterprise, Sappington became a very wealthy man.

By the mid-19th century, the Dutch and English began claiming that the South
American supply of Cinchona was threatened by the non-sustainable cutting
practices of the indigenous harvesters. In 1839, William Dawson Hooker, son of
the renowned botanist William Jackson Hooker, wrote his dissertation on
Cinchona. He claimed that completely cutting the trees, rather than
harvesting pieces of bark, was a better method, because insects would attack
Cinchona plants that had simply been debarked. On completely cut plants,
new growth quickly appeared, and could be harvested again in 6 years. Years
later it was also discovered that cut and regrown Cinchona had higher levels
of the effective alkaloids in its bark, and this method of harvesting became
common on many plantations.

Attempts were continued to grow Cinchona in other parts of the world. Seeds
carried to Paris and Java by French and Dutch expeditions failed to germinate.
In 1860, an English government clerk, Clements Robert Markham, carried
seedlings to England; shortly thereafter, a distinguished botanist, Dr. Richard
Spruce, did the same. These plants supplied the London market for only six
years before being destroyed by insects.

In the meantime, to protect their monopoly, Peruvian authorities had barred
foreigners from the Cinchona forests. But in 1865 Charles Ledger, an Englishman
living in Peru, obtained sixteen pounds of seed from a loyal native servant
Manuel Incra Mamani for a fee of about 20 dollars. Mamani was jailed,
beaten, and eventually starved to death for his act. A pound of this seed was
sold to the Dutch in Java, and though apparently decayed on arrival, it
germinated readily, giving birth to an enormous Dutch Cinchona industry,
destroying the South American monopoly on Quinine and establishing a new
Dutch monopoly. By grafting what was eventually named C. ledgeriana onto
the hardier C. succirubra, the Dutch soon dominated Cinchona cultivation,
eventually producing 80 percent of the world’s Quinine on the Indonesian island of Java. The high price of Quinine was driven down and the drug was made available to large numbers of impoverished Malaria sufferers.

The widespread use of Cinchona came about because of the colonising efforts of Europeans, and the drug, in turn, aided Europe in expanding its colonisation even further. However, the world supply of cultivated Quinine trees in Asia (especially in Indonesia and Java) was captured by Japan in 1942 during World War II and Germany captured the Quinine reserves in Amsterdam, so allied forces had to use emergency measures during World War II. Before the fall of the Philippines, the U.S. managed to escape with four million seeds, which were germinated back in Maryland and then transplanted in Costa Rica and other Latin American countries. Meanwhile, a Smithsonian botanist named Raymond Fosberg was able to secure millions of pounds of Cinchona bark in 1943 and 1944 for the Allies from forests and plantations in northern South America.

Even today, Quinine remains an important and effective treatment for Malaria in most parts of the world, although resistance has been reported sporadically in 1844 and 1910.

4.2 Botany of Cinchona

The Cinchona plants are evergreen trees with bitter bark and scented flowers. They have a two-celled ovary with two short obtuse branches. The details of the characteristic features of four main cultivated species of Cinchona are:

4.2.1 Cinchona Ledgeriana Moens: It is a weak straggling tree; its maximum height is about 7-8 m. Its bark is yellow, while the bark, powder is Cinnamon brown in colour. The leaves are elliptical, smooth and thick. The flowering takes place between May and August and it bears fruit in autumn.

4.2.2 Cinchona Officinalis Hook: It is a slender tree with an erect trunk rising up to a height of 8-9 m. Its bark is yellow in colour and the leaves are broad and smooth. The flowers are red, flowering takes place between May to August, and it bears fruit in autumn.

4.2.3 Cinchona Succirubra Pav: It is a tree with erect trunk growing up to 18-20 m. height. The bark is red in colour and the leaves are large, thin and broad. The flowers are pink, flowering takes place between May to August, and it bears fruit in autumn.
4.2.4 Cinchona Calisaya Wed: It is a tree with a strong, straight and bare trunk rising up to 6-7 m. The bark is a smooth white and the bark powder is Cinnamon brown in colour. The leaves are large, smooth and thick. The flowers are pale and flesh coloured, flowering takes place between May to August, and it bears fruit in autumn.

4.3 Climate and Soil
Cinchona requires an average temperature of 20°C with a relative humidity of 85%. Annual rainfall should not be less than 1,500 cm. The best elevation is 1000-2000 m above MSL without any frost occurrence. Cinchona prefers porous, well-drained, fertile soils with thick cover of organic matter and high moisture holding capacity. The optimum pH range is 4.5-6.5.

4.4 Species of Cinchona
Cinchona is a genus of family Rubiaceae. It has 65 species of evergreen shrubs and trees indigenous to South America and occurring in the Andes, Colombia, Ecuador, Peru and Bolivia, between 10° N and 10° S latitudes ranging from 800 to 3000 m.

Out of all the species only C. succirubra, C. ledgeriana, C. officinalis and C. calisaya could be successfully brought under cultivation.

4.5 Cinchona Producing Countries in the World
The principal Cinchona producing countries are Indonesia and Zaire. The other countries where it is produced are India, Peru, Tanzania, Kenya, Rwanda, Sri Lanka, Bolivia, Peru, Colombia, Costa Rica, Ecuador and Guatemala. In India, Cinchona Cultivation is being done only in two states viz. West Bengal and Tamil Nadu (Fig. 4.1).

Following the decline in demand for quinine during 1950’s, Cinchona Plantations appeared to have been abandoned by many countries particularly Indonesia and India. But interest in the product revived during the following decade presumably due to re-appearance of malaria in many parts of the world and also owing to increase in demands from the soft-drink sector and a number of countries (including India) are reported to have rehabilitated old plantations or initiated new ones.

4.6 Cinchona Plantation in India
It is recorded that Sir Clements R. Markham brought the first consignment of Cinchona calisaya from South America to Ootacamund in 1860. It was Mr.
Cinchona Producing Areas

World distribution

![Map of Cinchona producing areas](image)

**Index**
- Major areas
- Minor areas

**CINCHONA PLANTATIONS IN INDIA**

![Map of Cinchona plantations in India](image)

**CINCHONA PLANTATIONS IN WEST BENGAL**

![Map of Cinchona plantations in West Bengal](image)

**West Bengal**

![Map of West Bengal](image)

**DARJILING**

![Cinchona leaf](image)

**FIG 4.1**
W.G. McIvor who, with broad perspective and energetic cooperation planted Cinchona for the first time in the Nilgiri Hills in 1860 on a plantation scale.

4.6.1 History of Cinchona Plantation in the Darjiling Hills

The Cinchona Cultivation in the Bengal Presidency was made under the direction of Dr. Thomas Anderson, the then Superintendent of the Royal Botanical Garden, Calcutta. Sir W.J. Hooker sent the first Cinchona seeds received by Dr. Anderson to the Botanical Garden, Calcutta in 1861. In the same year, Dr. Anderson was sent to Java by the then Supreme Government of India with the motive of acquainting himself with the Dutch mode of cultivation. Dr. Anderson brought 50 plants of C. calisaya, 284 plants of C. pahudiana and only 4 plants of C. lancifolia and handed them over to Mr. W.G. McIvor at Ootacamund wherefrom he took 193 plants of C. succirubra to cultivate in Bengal. Dr. Anderson started his experimental trials in 1862 for cultivation of Cinchona in the Darjiling Hills of Bengal. The first planting was made in June 1862 on the Senchal ridge, but this place did not prove to be suitable for the plants. The next spot to be chosen was at Lebong, at a slightly lower elevation and the stock of plants at Senchal were shifted there in 1863. By this time, an area in the Rambo Valley on the slopes of a spur from the Senchal ridge (including Mungpoo) was selected for planting and the first field planting was made there in 1864 at an elevation of about 1450 metres. Subsequently, after the death of Dr. Anderson, the plantation had been in the charge of Dr. Anderson’s successors like Mr. M.B. Clarke during 1870 and later Dr. George King.

4.6.2 Cinchona Plantation in Other Parts of India

In 1867, a Cinchona Plantation was opened at Nunklow (Assam) on the northwestern slopes of Khasia hills. The trees thrived well, but because of the scarcity and dearness of labour, the plantation was abandoned. The cultivation of Cinchona was attempted also on the Mahabaleswar hills of Bombay Presidency, but there it failed due to the excessive moisture of the climate. A Cinchona Plantation was also started by a private company in Sikkim almost simultaneously with that started by the Sikkim Government. Patches of Cinchona were also planted in several tea gardens in Sikkim, but the cultivation has not commended itself to private enterprise to the same extent in Sikkim as it has done in the south of India. The cultivation of Cinchona
also received a very patient trial for several years in the northwestern provinces of India at various altitudes but all the plants ultimately perished due to frost.

4.7 Methods of Cinchona Plantation

Cinchona plants are mainly grown from seeds, though vegetative propagation remains another good practice for multiplication of high yielding clones. Seeds of Cinchona are generally collected during November-December after complete maturity of the fruits. Fruits are collected from the selected plants having a high percentage of alkaloid content. After collection, the seeds are separated from the fruits and are stored in a dry condition.

4.7.1 Seed Sowing of Cinchona

Seedbeds are prepared with well-decomposed leaf soil under thatch shades and seeds are sown during February-March. After sowing, the seeds are covered with thin layers of fine leaf-soil, and careful and controlled watering makes them to germinate within 20-25 days.

4.7.2 Transplantation of Cinchona Seedlings

Seedlings of Cinchona at the age of 80-90 days are transplanted in another nursery bed and at about 150-160 days of age, they are carefully transplanted at 10.0 x 10.0 cm spacing. After six months or so after the final transplanting, the nursery roof is removed with the objective of hardening the seedlings. After 90-100 days, when seedling sprouts 4-6 leaves each they become ready to go to the open field.

4.7.3 Field Planting of Cinchona Seedlings

For final planting, the field has to be properly prepared. Pits are opened at a spacing of 1.2 x 1.2 m generally but at higher altitude, sometimes-closer spacing of pits (1.0 x 1.0 m) is recommended to arrest soil erosion. At planting time, 15-16 month-old seedlings are collected from the nursery site early in the morning on rainy days of early June by careful digging to keep roots with adhering soil intact. After planting, the seedling is staked properly.

4.7.4 Field Maintenance of Cinchona

Proper maintenance is essential after field planting. Systematic weeding operation is done 2-4 times in the planting season until the advent of colder months. Light forking is done followed by deep forking in the second and third year. From the third year onwards, sickling is done annually twice till the final
harvest. Hoeing operation in the fourth and eighth year is often recommended. Application of fertilizers and nutrients are also done, preferably up to third year. The Cinchona plant suffers from water stagnation and thrives best on steep lands. Adequate emphasis is given to anti-erosion measures of soil and planting of shade trees is necessary in the first year, taking utmost care for their survival. Besides protecting Cinchona plants from the direct sun, these shade trees also enrich the soil by fixing atmospheric nitrogen and checking soil erosion.

4.7.5 Harvesting of Cinchona

Cinchona harvesting is normally done after 4th, 8th, 12th, and 16th year. Amongst several factors, altitude affects the bark yield and alkaloid content largely. Harvested bark is dried in the sun (50% drying is advisable) and final drying is done in well-ventilated bark-drying shades. The barks are then stored in well-ventilated godowns. Root bark is considered superior as compared to stem bark and constitutes about 40-50% of the total bark yield per plant of Cinchona ledgeriana.

4.7.6 Vegetative Propagation of Cinchona

Cinchona is a highly cross-pollinated plant and multiplication from naturally produced seeds ultimately results in quality deterioration. Various techniques of vegetative propagation have been devised and some have been found to be very promising. Cinchona cutting respond poorly to rooting and the percentage of success from high-graded trees is very poor. This problem has been overcome by extensive research.

4.7.7 Pests and Diseases of Cinchona

Mortality in Cinchona plant due to diseases is relatively less in India. “Damping off” is very common and it is most noticeable in nursery beds. “Seedling blight” caused by Phytophthora palmivora is another serious disease of Cinchona. “Root-rot” Disease is also common in Cinchona. Many other diseases of Cinchona are also found such as “Stripe Canker”, “Girdle Canker” and “Stem Canker”. “Bleeding Disease” has been reported from West Bengal plantations, particularly in Mungpoo.
The Wonder Drug Plant Cinchona Producing Quinine
Plate 4

The Wonder Drug Root Ipecac with High Emetine Content
Plate 5
4.8 Alkaloids in Cinchona

In the first year of its growth, the Cinchona alkaloid seems to be quite evenly distributed amongst the various organs of the plant with age, there appears to be a localisation of these alkaloid bases in a few organs. The bark of arborescent plants like Cinchona is generally richer in alkaloids than the leaves or shoots and these may be attributed to their accumulation in the bark year after year. The most important alkaloid in Cinchona is Quinine. Moreover, more than thirty alkaloids have been isolated from the different species of Cinchona, of which, Quinidine, Cinchonine and Cinchonidine are important.

In individual plants, the total alkaloid content increases up to the age of 8 to 12 years. The concentration of alkaloids is low in the twigs and increases down the stem to a maximum in the root bark. The leaves are very poor in alkaloid content and seeds do not have alkaloid content at all.

4.9 Commercial Extraction of Cinchona Alkaloids

Commercial extraction of Cinchona alkaloids is done in two factories in India viz. Government Quinine Factory, West Bengal and Government Quinine Factory, Tamil Nadu.

4.9.1 Grinding of Cinchona Bark

The purpose of grinding of Cinchona bark is to ensure that the natural salts of the alkaloids remaining deep inside the bark cells may be easily and fully accessible to the chemical actions to follow. As such, the aim is to get as thin powder as possible.

4.9.2 Mixing of Ground Bark with Alkali (Slaked lime)

The ground bark is intimately mixed with slaked lime and water to form a homogenous moist mixture. It is left to stand overnight so that Calcium hydroxide can release the Cinchona bases from their natural salts in the bark. The alkali treatment breaks the salt-bonds and separates the base for easy extraction by solvent system.

4.9.3 Extraction of Alkaloids with Suitable Solvents

At Mungpoo, open mild steel vats are used for extraction of alkaloids. In each vat, bark, water, sodium hydroxide solution and oil are introduced. The whole thing is indirectly heated by steam coil passing through the vat, with constant
mechanical stirring and after the standardised period of extraction, the oil and the aqueous layers are allowed to separate. All the alkaloids present in the bark remain dissolved in the oil layer, which is collected while hot and pumped to a common pool for all vats.

4.9.4 Extraction of Alkaloids by Acid
The hot oil extract is introduced into lead-lined mild steel vats each containing water and sulphuric acid and thorough mixing is done by blowing air into the liquid. On standing, the two layers separate and the alkaloids remain in acid layer solution in the form of acid sulphate. The oil is reused after some occasional treatments. The acid-layers from all the vats are collected together in the lead-lined reservoirs.

4.9.5 Neutralisation
The acid solution of the alkaloids is neutralised while still hot, in batches, in lead-lined tilting pots by adding caustic soda solution while keeping the pH slightly on the acidic side. The neutralised solution is then poured into long, wide shallow troughs and kept there undisturbed for three days. As soon as the liquids cool, quinine sulphates by virtue of its sparing solubility in cold water, starts to crystallize.

The crude quinine sulphate is separated from the slurry by centrifuging and is sent straight to the purification unit. Simultaneously, the mother liquor, which is saturated with quinine and cinchonidine sulphates, is treated with an excess of caustic soda solution in a wooden trough, so that, all the residual alkaloids are thrown out together. This precipitated alkaloid mixture is known as “Cinchona febrifuge”.

4.9.6 Purification of Alkaloids
The fact that quinine sulphate is soluble in hot water but is insoluble in cold water is taken advantage of for resolving the impurities arising from the external sources during the period of operation. For this, the moist crude is dissolved in water by heating with steam and continuous stirring. The solution is then filtered while still in a hot condition. The filtrate is then rendered slightly acidic and left for 24 hours to allow the quinine sulphate to crystallise. The whole content is centrifuged and the solid obtained is found to be of semi-purified quality contains much less other alkaloids and colouring matters than before. The
mother liquer contains much Quinine and is collected for precipitation of alkaloids for recovery of Quinine.

4.9.7 Controlled Drying of the Moist Final Product:
The purified Quinine Sulphate obtained in the moist state contains 30 to 35% moisture. Solid Quinine Sulphate is sensitive to high temperature and presence of white light causes deterioration to its colour. The drying operation is therefore carried out by putting the material in shallow trays placed on shelves in a drying room, maintained at a temperature ranging from 45°C to 48°C and is kept in a semi dark condition with faint coloured light provision. It takes about 20 to 24 hours’ drying to bring moisture level ground down to the desired level of 4.4% to 4.6%.

Besides Quinine Sulphate, some other Quinine salts are also manufactured according to the demands at that time. The main item is Quinine Hydrochloride which is produced by dissolving Quinine Sulphate in water, adding pure Barium Chloride solution to it, filtering of the heavy precipitate of Barium Sulphate and crystallizing out the Quinine Hydrochloride from the mother liquor - all under standard conditions. The crystals are dried in subdued temperature and in the absence of white light, until they contain about 9% moisture. Standardization tests are then conducted as usual before passing the material for packing and sale.

4.9.8 Standardisation and Quality Control of Alkaloids
Strict quality measures are constantly adopted during all the stages of production. The final products are tested according to the requirements of different pharmacopoeias.

4.10 Production of Alkaloids in India
Even though the Cinchona plantations were started in the Nilgiris (Tamil Nadu) in 1860, and in the hills of Darjiling (West Bengal) in 1861, the production of alkaloids from Cinchona bark was, however, started only after 1880 in the Quinine Factory at Naduvattam (Nilgiris) with Mr. Broughton as Chemist. The Quinine Factory at Mungpoo (Darjiling) started production of alkaloids in the same year. The Naduvattam Quinine Factory started production of Quinine Sulphate in 1889 with a production capacity of 45,000 kgs per annum. The factory of Naduvattam was burnt accidentally and a new Quinine Factory was
commissioned in 1955 in the Annamalai Hills of Coimbatore district of Tamil Nadu.

The Quinine Factory at Mungpoo started manufacturing Quinine Sulphate in 1887, at commercial level in West Bengal. It was soon enlarged and took its present shape in the year 1906. The installed capacity of West Bengal Quinine Factory was for the production of 27,000 kg Quinine salts but the actual production declined to 17,500 kg during 1975-76 and to 9000 kg during 1977-78 due to nonavailability of Cinchona barks. The Tamil Nadu Quinine Factory is designed to process 20,000 kg Quinine salts but, here also, the production has come down to 9,000 kg (approx.) of Quinine salts per annum due to nonavailability of Cinchona bark. The low availability of Cinchona bark to both the factories is the effect of complete stoppage of new planting of Cinchona from 1955 to 1965 due so called eradication of malaria cases within the country. However, the position changed after 1965 due to other uses of Quinine and Indian Quinine could be exported to foreign countries. This is also because of the political turmoil in Indonesia and the international Quinine dealers, who were originally buying their requirements at lower prices from Indonesia, turned to India. In view of the good export market, the resurgence of malaria in many countries including India and its use in the manufacture of Quinine preparations for the treatment of heart ailments, Quinine production was proposed to be increased by both West Bengal and Tamil Nadu Governments by expanding the Cinchona plantation at heavy capital cost. West Bengal is at present having about 2600 hectares under Cinchona plantation and taking into account the areas harvested every year the present holding of Cinchona plantations in Tamil Nadu is about 2500 hectares.

4.11 Substitute Crops and Synthetic Antimalarial Drugs

Quinine is also obtained from two other sources like Remijia Purdieana and Remijia Pedunculata. These plants are native to northern parts of South America and were introduced to Sikkim regions of India during 1889 but could not be grown. Moreover, the cost of extraction of Quinine from these plants is comparatively high.

There are a number of synthetic substitutes for Quinine in the treatment of Malaria - for example, Primaquine, Chlroquine and Choroguanide. However,
these do not appear to have adversely affected the demand for Quinine, may be either because of their high costs or due to greater reliability of Quinine.

4.12 Use of Cinchona and its alkaloids

Of the alkaloids isolated from Cinchona so far, the most important are Quinine, Quinidine, Cinchonine and Cinchondine. Quinine is used mainly in the form of Sulphate, Bisulphate, Hydrochloride and Dihyochloride and are used in a variety of medicinal applications, principally as suppressive anti-malaria drugs. Quinine is still a drug of choice in cerebral cases of Malignant Malaria. Quinine possesses marked bacterial action and is employed in the treatment of bacterial infections. It is used in analgesic preparation for the treatment of headaches. As an anesthetic, Quinine was at one time used as a substitute for Cocaine. It is a bitter tonic and a stomach appetizer. In small doses, in solution form, it is a mild irritant and a stimulant of the gastric mucosa and other mucosa membranes. It is also used as provocative agent inpatients with suspected Malaria. It has been found useful in pneumonia, influenza, colds, whooping cough, septicaemia, typhoid and amoebic dysentery. As a contraceptive, its action is slow and unreliable in non-toxic concentrations.

The salts of Quinine are also added to sunburn lotions, moth repellants, insecticides, vulcanization accelerators in rubber industry, polarized sensors, and as pickling agents in metal industries.

Cinchona and Cinchonidine are also used as prophylactics for Malaria in combination with Quinine and other alkaloids and as febrifuge. Quinidine sulphate is used as a cardiac depressant. In addition to its being used as a drug, Quindlne is widely used as a flavouring agent in soft drinks. Quinine, Quinidine and their derivatives are utilised in insecticide compositions for the preservation of fur, feathers, wool, feits and textiles. They are also ingredients of moth-repelling preparations. Derivatives of Quinindine are used in metallurgy as ingredients of pickling baths.

Quinine Sulphate finds use in the treatment of night cramps. It is also used in eye lotions due to its astringent bacterial and anesthetic effects. Extracts of Cinchona are used in hair tonics, for stimulating hair growth and controlling illnesses of the hair.

Quinine Hydrochloride and Sulphate are listed in "Food Chemical Codes" and are used extensively alongwith Red Cinchona extracts as a bitter in tonic...
waters, alcoholic bitters and liquers, - highest average maximum use level reported for Red Cinchona extract is 0.0028% Quinine and extracts of Cinchona, mostly Red Cinchona are reported to be used in frozen dairy desserts, candy, baked goods and condiments, with use levels lower than those reported in beverages.

Thus, we find Cinchona from South America came to India, expanded in Tamil Nadu and in West Bengal, and is today being put to diverse users all over the world.

4.13 Cinchona Plantation in West Bengal

In West Bengal, we find that the successful establishment of Cinchona Plantation at Mungpoo was made in 1864. Subsequently, there was Munsong plantation in 1901. Munsong is situated to the north of Kalimpong bordering Sikkim. The third Cinchona Plantation was opened at Rango in 1938 near the Bhutan border. The fourth Cinchona Plantation was started at Latpanchar in 1943. A plantation was started on an experimental basis in Ambotia in 1977. There are four species of Cinchona under successful cultivation in Darjiling hills of West Bengal. These are C. ledgeriana, C. succirubra, C. robusta and C. hybrida. Due to high Quinine content and good quality of bark, C. ledgeriana forms more than 80% of the existing plantations of West Bengal. Commercial cultivation of Ipecac started in Rango plantation during 1940 and in Mungpoo, Munsong and Latpanchar during 1980. The cultivation of Dioscorea started during 1977. In West Bengal, the Cinchona Plantation is under the Directorate of Industries. The Directorate of Industries was setup in the year 1917. This Directorate plays the most vital role in planning, developing and promoting several industries in the state.

4.14 Activities of the Directorate

The Directorate of Cinchona has mainly been engaged in pursuing the following activities:

- **Plantation Activities**
  (Of Cinchona and other medicinal and aromatic plants)

- **Factory Production Activities**
  (Of Quinine, Emetine, Diosgenine and its Downstream Products)

- **Research and Development**

- **Administration**
4.14.1 Plantation Activities
The Directorate of Cinchona and other Medicinal Plants, West Bengal, grows on a commercial scale, Cinchona (for Quinine and Quinidine), Ipecac (for Emetine) and Dioscorea (for Diosgenin and other Steroidal precursors) – in their plantations. Besides these three major crops, pilot scale cultivation of the other medicinal and aromatic plants like Citronella, Lemongrass, Cardamom, Tung, Vinca, Rauwolfia, Solanum, Ocimum, etc. have also been undertaken. We find that the plantation activities of the Directorate are spread over four major and one minor plantation (Fig 4.2).

a. Mungpoo,
b. Munsong

c. Rongo
d. Latpanchor
e. Ambotia (Minor Plantation)

4.14.1. a Mungpoo
Mungpoo, about 33 kms from Darjiling has two factories: viz (1) the Government Quinine Factory and (2) the Government Emetine Factory. The R & D Wing with its main laboratory and nursery are also located here. Even before power supply was provided by the State Electric Board, power was made available to Mungpoo from the Directorate’s own hydel power generation unit which was sufficient to run the factories and R & D wing. Mungpoo Plantation has four Divisions – Mungpoo, Labdah, Rungbee and Ranju valley (Fig 4.3).

4.14.1. b Munsong
Munsong Plantation is at a distance of about 66 kms from Mungpoo, 25 kms North of Kalimpong on the border of Sikkim.
Munsong Plantation has five divisions – Munsong, Kashyem, Burmail, Sangseer and Rangoo

4.14.1. c Rongo
Rongo Plantation is situated 100 kms north of Siliguri on the Indian side of the River Jaldhaka bordering Bhutan. Cultivation pattern followed here is of a mixed nature comprising of different medicinal and aromatic plants. This area experiences heavy rainfall as well as devastating hailstorms sometimes.
CINCHONA PLANTATION IN MUNGPOO

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1. Taraingh Khola
2. Takup Khola

DATA SOURCE A PAPER OF GOVT. CINCHONA PLANTATION, BY N.B.THAPA, 13.2.1992

FIG: 4.3
Rongo Plantation consists of three divisions – Gairibas, Dalgaon and Ronga

4.14.1. d. Latpanchor

Latpanchor Plantation is situated 20 kms North of Kurseong and is less than one hour’s journey from Siliguri. The main produce here is Cinchona and Ipecac. This Plantation has two Divisions – Latpanchor and Sittong

4.14.1. e. Ambotia

Ambotia (Minor plantation with an area of 120 acres) is, in fact, an experimental and research based Plantation. This area is isolated from the mainstream of the Directorate. This Plantation is very near to Kurseong. Only four regular workers are engaged there.

This experimental Plantation was established in the year 1977.

Table 4.1 below tells about the different plantations in the Darjiling district of West Bengal. Mungpoo Plantation has the largest area followed by Rongo, Munsong and Latpanchor Plantations. The number of workers is also highest in Mungpoo Plantation followed by Rongo, Munsong and Latpanchor. Mungpoo was the first plantation to be developed in the year 1862 followed by Munsong in 1901, Rongo in 1938 and Latpanchor in 1943.

Table 4.1

<table>
<thead>
<tr>
<th>Plantation</th>
<th>Area (acre)</th>
<th>Altitude (feet)</th>
<th>Average rainfall (cms.)</th>
<th>Average Temperature (°C)</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mungpoo</td>
<td>10023.61</td>
<td>900-6200</td>
<td>280-300</td>
<td>31 4</td>
<td>1862</td>
</tr>
<tr>
<td>Munsong</td>
<td>9361.80</td>
<td>800-6000</td>
<td>250-300</td>
<td>30 5</td>
<td>1901</td>
</tr>
<tr>
<td>Rongo</td>
<td>4222.00</td>
<td>200-5900</td>
<td>400-500</td>
<td>30 4</td>
<td>1938</td>
</tr>
<tr>
<td>Latpanchor</td>
<td>2445.17</td>
<td>1000-6000</td>
<td>315-400</td>
<td>30 6</td>
<td>1943</td>
</tr>
<tr>
<td>Ambotia</td>
<td>155.0</td>
<td>NA</td>
<td>NA</td>
<td>NA NA</td>
<td>1977</td>
</tr>
</tbody>
</table>

Source: Directorate of Cinchona and Other Medicinal Plants, Govt. of West Bengal

Fig 4.4
## Table 4.2

Land Use Pattern of five Plantation Areas of Darjiling (2002) (in acres)

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Mungpoo</th>
<th>Munsong</th>
<th>Latpanchar</th>
<th>Rongo</th>
<th>Ambotia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinchona</td>
<td>2946.98</td>
<td>2961.12</td>
<td>1394.67</td>
<td>944.30</td>
<td>30.00</td>
<td>8277.1</td>
</tr>
<tr>
<td>Ipecac</td>
<td>17.59</td>
<td>11.65</td>
<td>13.73</td>
<td>7.50</td>
<td>-</td>
<td>50.70</td>
</tr>
<tr>
<td>Dioscorea</td>
<td>9.65</td>
<td>13.15</td>
<td>0.91</td>
<td>125.05</td>
<td>-</td>
<td>148.51</td>
</tr>
<tr>
<td>Cardamom</td>
<td>42.50</td>
<td>49.92</td>
<td>11.33</td>
<td>35.40</td>
<td>-</td>
<td>139.23</td>
</tr>
<tr>
<td>Nursery</td>
<td>30.91</td>
<td>33.15</td>
<td>7.52</td>
<td>10.40</td>
<td>-</td>
<td>81.87</td>
</tr>
<tr>
<td>Bamboo</td>
<td>177.65</td>
<td>93.46</td>
<td>64.51</td>
<td>156.95</td>
<td>-</td>
<td>492.51</td>
</tr>
<tr>
<td>Research complex and Nursery</td>
<td>20.73</td>
<td>-</td>
<td>0.25</td>
<td>12.00</td>
<td>-</td>
<td>32.98</td>
</tr>
<tr>
<td>Thatch</td>
<td>230.12</td>
<td>88.40</td>
<td>24.64</td>
<td>4.00</td>
<td>-</td>
<td>351.16</td>
</tr>
<tr>
<td>Afforestation</td>
<td>1226.49</td>
<td>532.38</td>
<td>194.92</td>
<td>139.31</td>
<td>-</td>
<td>2093.12</td>
</tr>
<tr>
<td>Bungalow and Quarters</td>
<td>42.43</td>
<td>18.75</td>
<td>45.35</td>
<td>88.00</td>
<td>-</td>
<td>194.43</td>
</tr>
<tr>
<td>Majdoor and Staff Settlement</td>
<td>1353.60</td>
<td>758.06</td>
<td>221.35</td>
<td>983.33</td>
<td>-</td>
<td>3316.30</td>
</tr>
<tr>
<td>Health and Welfare Activities</td>
<td>20.15</td>
<td>7.22</td>
<td>5.72</td>
<td>36.00</td>
<td>-</td>
<td>69.19</td>
</tr>
<tr>
<td>Factory and Water Reservoir</td>
<td>4.10</td>
<td>4.70</td>
<td>-</td>
<td>5.40</td>
<td>-</td>
<td>14.20</td>
</tr>
<tr>
<td>Fallow Land</td>
<td>119.40</td>
<td>170.14</td>
<td>4.13</td>
<td>238.49</td>
<td>-</td>
<td>532.18</td>
</tr>
<tr>
<td>Forest Area</td>
<td>2288.54</td>
<td>1298.79</td>
<td>189.14</td>
<td>815.61</td>
<td>-</td>
<td>4592.21</td>
</tr>
<tr>
<td>Uncultivable Area</td>
<td>293.24</td>
<td>3015.03</td>
<td>205.15</td>
<td>505.68</td>
<td>123.00</td>
<td>4142.01</td>
</tr>
<tr>
<td>Roads &amp; Paths</td>
<td>213.77</td>
<td>269.63</td>
<td>46.35</td>
<td>49.00</td>
<td>02.00</td>
<td>235.75</td>
</tr>
<tr>
<td>Bustee(Under the Directorate)</td>
<td>158.07</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>158.07</td>
<td></td>
</tr>
<tr>
<td>Coffee</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.50</td>
<td>-</td>
<td>3.50</td>
</tr>
<tr>
<td>Black Pepper</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.50</td>
<td>-</td>
<td>0.50</td>
</tr>
<tr>
<td>Rubber</td>
<td>15.62</td>
<td>25.00</td>
<td>10.00</td>
<td>50.00</td>
<td>-</td>
<td>100.62</td>
</tr>
<tr>
<td>Areca Nut</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.58</td>
<td>-</td>
<td>2.58</td>
</tr>
<tr>
<td>Mulberry</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.00</td>
<td>-</td>
<td>5.00</td>
</tr>
<tr>
<td>Taxus Baccata</td>
<td>8.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.00</td>
</tr>
<tr>
<td>Landslide and Damaged Area</td>
<td>12.98</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12.98</td>
</tr>
<tr>
<td>Steep Land</td>
<td>783.57</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>783.57</td>
<td></td>
</tr>
<tr>
<td>Turmeric</td>
<td>7.52</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.52</td>
</tr>
<tr>
<td>Floriculture</td>
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<td>-</td>
<td>-</td>
<td>2.50</td>
<td>-</td>
<td>2.50</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.50</td>
<td>-</td>
<td>0.50</td>
</tr>
</tbody>
</table>

CINCHONA CULTIVATION VIS-À-VIS PROPAGATION OF MALARIA - A GEO-ENVIRONMENTAL APPRAISAL IN THE SETTING OF THE RYANG BASIN
Table 4.2 reveals that the area under Cinchona Cultivation is the maximum in every plantation. Ipecac cultivation is highest in Mungpoo whereas Dioscorea is highest in Rongo plantation. Forest area is highest in Mungpoo and here considerable afforestation programme has been taken up. In all the plantations, we find Cinchona, Ipecac and Dioscorea as well as some alternative and subsidiary crops like Tung, Coffee, Black Pepper, Rubber, Turmeric, Eucalyptus and Cardamom are grown. Seeds of Tung trees yield Tung oil, which is used in the manufacture of paints and varnishes, printing ink etc. Coffee fruits are dried and de-shelled to produce clean coffee. The cardamom pods are marketed after drying.

4.14.2 Factory Productions Activities

Presently the Directorate runs the following four factories:

- Government Quinine Factory, Mungpoo (Established in 1864)
- Government Emetine Factory, Mungpoo (Established in 1884)
- Government Diosgenin Factory, Gairibas (Established in 1985)
- Downstream Factory, Gairibas (Established in 1990-91)

4.14.2.a Government Quinine Factory, Mungpoo

The Government Factory, established in 1864, is located at Mungpoo of Darjiling district. This factory is more than a century old. This factory has not been upgraded. The factory has stopped functioning, as the products are not being sold. This is largely due to the high production cost. The production cost
for a kg of Quinine is Rs 12,000. The market value, however, is about Rs3, 000. The overhead expenses (social responsibility towards workers and over-employment) are just too high.

4.14.2. b Government Emetine Factory, Mungpoo

Government Emetine Factory established in 1984-85 is located at Mungpoo at a cost of around 40 lakhs. The production in this factory has stopped for several years due to lack of sale prospects of the product. The basic raw material for Emetine is Ipecac roots. Ipecac utilized for production is produced in the Directorate’s owns plantation but the cost of raw material is very high. The only positive aspect, however is that Ipecac is still sold from the stock produced earlier.

4.14.2 .c Government Diosgenin Factory, Gairibas

Government Diosgenin Factory was built by CSIR (Council of Scientific & Industrial Research) on turnkey basis, with the entire fund provided from Central Assistance until commissioning stage. The total project cost was to the tune of Rs.44 lakhs. Production capacity of this unit is about 1500 to 2000 kgs annually. Almost half the requirement of raw material (Dioscorea tubers) is met from the Directorate’s own Plantation, at a very high cost though. The quality of its product also needs improvement.

4.14.2.d Downstream Factory, Gairibas

To improve the viability prospects for the Diosgenin Factory, this Downstream Factory was built to complement the Diosgenin Factory for conversion of Diosgenin into steroid drugs and their intermediates.

The total cost of the project is Rs. 40 lakhs and RRL (Regional Research Laboratory under CSIR); Jammu has been entrusted with the work on turnkey basis. The factory is now ready for commissioning and trial production has already been taken up.

4.14.3 Research and Development

The Research section at Mungpoo started in 1977 with sub-units at Rongo and Latepanchour plantations. The research studies aim to improve the quality and quantity of raw materials of different medicinal and aromatic plants by exploring different areas of applied research. The main thrust areas of research are the following:

CINCHONA CULTIVATION VIS-À-VIS PROPAGATION OF MALARIA - A GEO-ENVIRONMENTAL APPRAISAL IN THE SETTING OF THE RYANG BASIN
Government Quinine Factory, Mungpoo

Plate 6

Research Laboratory, Mungpoo

Plate 7
• Production, selection and isolation of high-grade medicinal & aromatic plants and maintenance of their genetic purity.
• Improvement in agro-technological practices to replace the age-old cultivation practices of different crops.
• Adoption of intensive farming to obtain high quality raw materials with minimum land coverage.
• Control of diseases and pest.
• Creation of germ-plasma centers and conservation of natural wealth.
• Quick propagation of medicinal and aromatic plants by vegetative means particularly through tissue culture.
• Rural economical upliftment through cultivation of medicinal and aromatic plants.

It is to be noted that the Research and Development Wing of the Directorate had a team of scientists in the past. They had earned many laurels in their respective fields. New methods of production evolved by the domestic R & D, had shown bright results at the laboratory level but these achievements, could not be translated into results on a commercial scale in two main areas- of cost efficiency and quality improvement. R & D, to speak the truth has failed to serve its purpose as may be expected from such an agency.

4.14.3.a Research Work Done on Cinchona in India

It has been observed that though the commercial cultivation of Cinchona and production of its alkaloids started in India quite long ago, but extensive research work for improvement of the crop as well as of its products, was not done in India for a long time.

In 1941, the history of the establishment of Bengal Cinchona Plantation was published in a Calcutta journal.

Mohan Rao and R.Veeraraghaban, in 1954, described the method of vegetative propagation of the crop and were successful in multiplication of the plant through different vegetative methods. S.Mukherjee and S.K.Chatterjee, in 1960, developed the method of vegetative propagation of Cinchona ledgeriana.

In 1965, S.K. Chatterjee analysed the physiology of rooting of cuttings of C. ledgeriana with the application of same growth hormones. K.P. Biswas, in 1966, described the morphological character of different Cinchona plants, C. Quasin
In 1968 chemically examined the heartwood of C. ledgeriana, and S.K. Jain in the same year scientifically described the plant in detail. S.K. Chatterjee and I.K. Lana, in 1977, extensively detailed the cultivation technology of C. ledgeriana grown in West-Bengal. R.P. Nandi, in 1980, analysed the internal and external factors for improved cultivation of C. ledgeriana to augment production of alkaloid. Experimental data revealed that Cinchona plants growing at high altitude, North and West facing slopes were more congenial to alkaloid formation. R.P. Rao, in 1982, tried to convert Quinine into Quinidine. R.P. Nandi and S.K. Chatterjee, in their studies, analysed the effect of inorganic fertilizers on the growth and alkaloid formation in C. Ledgeriana. According to them, alkaloid biogenesis was found to be directly correlated with extensive growth. R.P. Nandi, in 1987, described the effect of hardening of seedlings of Cinchona ledgeriana on growth performance, biomass production and alkaloid formation. In 1988, he also highlighted the future aspects of Cinchona by analyzing the detailed history of the crop. Along with S.K. Chatterjee, in 1990, he studied the improvement of conventional cultural practices of Cinchona grown in West Bengal. R.P. Nandi in 1991 had also described in details the role of shade trees on growth and alkaloid formation in C. ledgeriana. The shade trees not only conserve soil and provide nutrients by fixing atmospheric nitrogen to the soil but also protect the Cinchona plants from extreme cold or heat according to altitude. The average Quinine content of C. ledgeriana trees of West Bengal in between 3.5 to 4.5% and this can be augmented to approximately 5.0 to 6.0 percentages with well-organised research and development programmes. Most of the research studies have concentrated on the hybridisation of high quality clones, application of mineral nutrients, hormonal regulations, environmental modifications, changing of soil characters and introduction of improved cultural operations and agro technology. Little known medicinal flora of Darjiling hills have been subjected to exploration studies. The plants, which are generally used by the hill people for treatments against different ailments, are being collected, identified, preserved and chemically examined. The medicinally important plants, which are under threat
of extinction, have been put to assimilation trials in different experimental nurseries of varying altitudes according to their habit and habitat.

4.14.4 Administration
The Director of Cinchona and Other Medicinal Plants, West Bengal, having to head the Directorate is liable to receive all the bouquets and brickbats on its behalf. He is in charge of overall administration of the organisation. Since the date of superannuating of the last Director (more than ten years back on 1st February 1991), no full appointment to the post has been understandably made.

The responsibility was shouldered was by the Deputy Director (Plantations), in addition to his normal duties, till his superannuation in November 1997, then the baton was passed to The Joint Director Of Cinchona and Other Medicinal Plants, the person next in command, in addition to his normal duties. At present, the District Magistrate of Darjiling has been entrusted with the responsibility of holding the charge of the Directorate of Cinchona and Other Medicinal Plants, West Bengal.

4.15 Organisational Set-up
The Director is the administrative as well as technical head of the Directorate and directly guides the research and developmental activities of the organization. Quinine Factory is under the charge of the Quinologist, the Emetine Factory is under the charge of the Chief Chemist, while the Diosgenin Factory is under the charge of a Manager (Plantation) along with the Divisional Officers who are looking after each division. Research Division comes under the charge of the Horticulturist and Analytical Chemist. The Directorates’ establishment at kolkata is the main selling center of its products, which is under the control of the Manager. The Central Administrative Wing of Kolkata is looked after by the Director at the Head Quarters (Mungpoo). He is assisted by a Manager.

4.16 Personnel
The deployment pattern of the Directorate shows that the Headquarter of the Directorate at Mungpoo has the highest number of Group “A” officers (Table 4.3). The Government Cinchona Plantation, Mungpoo has the highest number of daily workers i.e. 1751. Followed by Government Ipecac Plantation, Rongo with 1656 daily rated workers. Under the Directorate, there are 47 group
"A" employees, 76 Group "B" employees, 328 Group "C" workers, Group "D", 573 employees are on contract basis and 5350 are daily rated workers. The total number of workers according to 2002 data is 6520.

Table 4.3

Deployment Pattern of the Directorate
(Number and categories of Workers, Staff and Officers)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Establishment</th>
<th>Gr &quot;A&quot;</th>
<th>Gr &quot;B&quot;</th>
<th>Gr &quot;C&quot;</th>
<th>Gr &quot;D&quot;</th>
<th>Cont</th>
<th>Daily rated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Headquarter of the DCOMP, Mungpoo</td>
<td>16</td>
<td>9</td>
<td>23</td>
<td>53</td>
<td>3</td>
<td>43</td>
<td>147</td>
</tr>
<tr>
<td>2</td>
<td>Kolkata Office of the Directorate</td>
<td>2</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>Govt. Quinine Depot, Kolkata</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Govt. Quinine Factory, Mungpoo</td>
<td>5</td>
<td>5</td>
<td>57</td>
<td>103</td>
<td>0</td>
<td>5</td>
<td>175</td>
</tr>
<tr>
<td>5</td>
<td>Govt. Emetine Factory, Mungpoo</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>27</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>Govt. Diosgenin &amp; Downstream</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>6</td>
<td>0</td>
<td>7</td>
<td>34</td>
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<td>7</td>
<td>Govt. Cinchona Plantation, Mungpoo</td>
<td>4</td>
<td>9</td>
<td>66</td>
<td>156</td>
<td>31</td>
<td>1751</td>
<td>2017</td>
</tr>
<tr>
<td>8</td>
<td>Govt. Cinchona Plantation, Mungpoo</td>
<td>5</td>
<td>11</td>
<td>63</td>
<td>99</td>
<td>25</td>
<td>1188</td>
<td>1391</td>
</tr>
<tr>
<td>9</td>
<td>Govt. Cinchona Plantation, Latpanchor</td>
<td>4</td>
<td>8</td>
<td>33</td>
<td>50</td>
<td>9</td>
<td>700</td>
<td>804</td>
</tr>
<tr>
<td>10</td>
<td>Govt. Ipecac Plantation, Rongo</td>
<td>5</td>
<td>10</td>
<td>43</td>
<td>79</td>
<td>51</td>
<td>1656</td>
<td>1844</td>
</tr>
</tbody>
</table>

| Total   | 47     | 76     | 328    | 573    | 146  | 5350 | 6520 |

| % Of Total Workers | 0.72    | 1.17    | 5.03   | 8.79   | 2.24 | 82.06 | 100  |

4.17 Directorate's Kolkata Establishment.

As mentioned before, the Directorate's administrative centre is at Kolkata. The main activities of Kolkata unit are to follow up administrative matters relating to different plantations and factories with the government and other agencies. Co-ordination of plantation and factory activities including monitoring of different State Plans and Central Assistance Projects are conducted from the Kolkata office. The Directorate's centralised sales office is at Kolkata from where all the products are sold- including exports. The sales office keeps active
CHAPTER IV SPECIAL STUDY OF CINCHONA CULTIVATION

contact with different Pharmaceutical and Phytochemical Organisation of India and abroad under the direct supervision of the Directorate.

4.18 Conclusion

With the resurgence of Malaria and the new use of Quinidine in coronary ailments and psychic treatments; and possible use of Cinchonidine in the oral contraceptives, the cultivation of this crop confers an inestimable blessing on the population of the entire Indian Union. However, there is still much to learn before the art of cultivation of this Peruvian bark tree is fully grasped. The question of the best methods of harvesting, have the reason why other species do not thrive and such other issues need closer investigation. In fact, Cinchona industry in West-Bengal needs thorough rejuvenation through quality improvement of plantations and by increasing the efficiency of alkaloid extraction processes.

References


• **The Statesman,** 2005: 20th April, Kolkata: "Cinchona say still rankles".

• **The Telegraph,** 2004: 29th July, Kolkata: "Extra efforts for revival".

• **The Telegraph,** 2005: 4th January: "Search for Cinchona buyer".

• **The Telegraph,** 2006: 11th April: "No funds for research, estates sell nothing".