Original Articles.

Cultivation of Chaulmoogra Oils for the Treatment of Leprosy.

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THE Secretary of State for the Colonies in a Circular despatch, dated April 25th, 1925, drew the attention of Government to the probable increase in the demand for the various species of the chaulmoogra nut in the treatment of leprosy and stated that the Colonial Advisory Medical and Sanitary Committee suggested that specimens of *Taraktogenos Kurzii* and *Hydnocarpus wightiana* might be grown in some parts of the British Empire.

The following summary was drawn up for the information of Government in 1926:—

Taraktogenos Kurzii, King, is recorded (1) as a synonym for *Hydnocarpus heterophyllus*, Kurz (not Blume), and is a large tree 40—50 feet high found in Eastern Bengal and Assam, and yields the Chaulmoogra seeds of commerce. These are brought to Calcutta at the end of the rainy season in November and December, chiefly from Chittagong. They are collected from the forests and consist of mature seed with a brown kernel rich in oil and immature seed with a black kernel containing a smaller proportion of oil of a dirty colour. The trade is mainly in the hands of the Bengali traders, but occasionally sales by public auction occur in Calcutta. Chaulmoogra seeds have also been used for centuries in Burma and seeds of *Taraktogenos Kurzii* and of closely related species are sold in the bazaars of that country under the name of "Kalaw."

The satisfactory results obtained in the treatment of leprosy in the Hawaiian Islands (2, 3, 4), aroused a good deal of public interest and in 1919 the Department of Agriculture of the United States of America deputed an officer (Mr. J. F. Rock) to make a full investigation in the East of the Chaulmoogra trees and their

related species. The report of this investigation which was made in Siam, Burma, Malaya, Bengal, and South India was published in 1922 (5) and concludes as follows:—

"The facts brought to light in this recent survey show that the dealers in chaulmoogra oil (that derived from *Taraktogenos kurzii*) have never seen the tree in its wild state. Even the native Bengal dealers in Chittagong had not been in the forests of the Chittagong Hill tracts. All depend on jungle people for collecting the seeds, which are known by different native names in the various regions in which they grow. Smith, Stanistreet & Co., of Calcutta, claimed to have a tree growing in their compound, but on examination it was found not even to belong to the family *Flacourticeae*, to which Taraktogenos belongs. The collecting of the seeds is, then, in the hands of jungle people, who are more or less indolent. Moreover, the conditions under which these seeds are collected are such, as has already been explained, that at least 50 per cent. of the crop is lost every year. The Burmese name kalaw is applied to more than one species, and these species resemble each other so closely that the jungle people make no distinction between them. Seeds of these trees are sent to markets and bazaars under the collective name of kalaw, where they are bought up by dealers who manufacture chaulmoogra oil from them.

"Another point of interest and one of which very little is known is that *Taraktogenos kurzii* and kindred species do not bear a regular yearly crop but fruit sporadically and sometimes are without fruit for two years or more. The natives stated that fruit is collected by them every three years. The causes of the irregular fruiting habit of chaulmoogra trees are not known, but the fact that the trees are polygamous may have something to do with this. The flowers are undoubtedly dependent on insects for pollination, and while it is said of the species of *Hydnocarpus* that male flowers with rudimentary ovaries and female flowers with regular stamens but without pollen occur at the same time with strictly male and female flowers, it must be stated that on the trees of *Hydnocarpus anthelmintica* (in Bangkok) and of *H. curtisii* (in Penang) examined by the writer, only male flowers were found, and in the first species male flowers with a well-developed hirsute style. It may also be that this group of trees does not flower every year and that they are biennial fruiters. It is well worth while to study these questions, as very little is known of the flowering habits of these trees; in fact, the female flowers of *Taraktogenos kurzii* have never been found.

"The remoteness from civilized centres of the forests where these trees occur, the danger and difficulty encountered in collecting the seeds (which may not be found every year), and also the conditions under which seeds are at present collected would point to the necessity of starting plantations of *Taraktogenos kurzii*, which is known to yield the true chaulmoogra oil, and also of such species of Taraktogenos, Hydnocarpus, and Asteriastigma as yield oils of similar composition. This would assume a steady supply and uniform crop and avoid the possibility of having several species confused, as undoubtedly is the case at present in certain localities. It has been stated by an eminent authority that owing to the very encouraging work carried on in Hawaii and the great success achieved in the treatment of leprosy with chaulmoogra oil derivatives, the lowest yearly demand will be for 1,000,000 litres of oil. The present output, the conditions under which the seeds are collected, and the uncertain fruiting periods of these species makes it certain that the demand will far exceed the output. With this in view, the expedition was undertaken by the writer, of whose work this is a preliminary report, for the purpose of securing viable seeds of as many species as possible, and these seeds are now growing in several places.

"The following suggestions are offered regarding the requirements for establishing plantations of *Taraktogenos kurzii*. The soil should be of a sandy nature, preferably quartz sand. Perfect drainage is necessary, and undulating or hilly land is preferable. The region should have a distinct rainy season with a pronounced dry season in the winter months, but still with considerable humidity. The winter temperature should not fall below 40°F. The foregoing represent approximately the climatic and soil conditions of this species in its native habitat. Other species such as *Hydnocarpus anthelmintica*, require slightly different conditions; but all species of Hydnocarpus and Taraktogenos require well drained sandy or loamy silt soils and grow best along creek beds or on the banks of streams. All require climates necessary for an evergreen rain forest, such as is found in Burma and elsewhere in India."

With the object of supplying Chaulmoogra oil for the treatment of leprosy in the Territory of Hawaii the Board of Agriculture and Forestry established (6) a plantation of 28 acres with the following trees:—

Hydnocarpus anthelminticus (the chaulmoogra tree of Siam) 2070 plants.

Taraktogenos Kurzii (the chaulmoogra or Kalaw tree of Upper Burma) 850 plants.

Hydnocarpus castanea (the Kalaw tree of Lower Burma) 80 plants.

These plants were raised from seed collected by Mr. Rock and it is stated that the most valuable tree is *Taraktogenos Kurzii* although the oil of the other two species seems to give equally good results. This plantation was spaced out 20 feet by 20 feet.

Avenues of *Hydnocarpus anthelminticus* exist in Indo-China (7) but the growth is reported to have been slow. It is thought that this has been due to their full exposure to sun as this tree occurs in the forests of Indo-China especially around Cambodia and requires light shade during its early period of growth. *Hydnocarpus anthelminticus* is reported (8) to have grown in Hawaii to a height of 12 feet in two years and it is expected that seed will be secured when the trees are about 10 years of age. Efforts to grow this species are also being made in Martinique and in New Caledonia. (9).

Three plants of *Taraktogenos Kurzii* received in Dominica, West Indies, in 1920 have grown well and are expected to produce fruit in 7-8 years and seedlings of *Taraktogenos Kurzii*, *Hydnocarpus anthelminticus* and *Hydnocarpus castanea* received in 1922 from the Rock collection are all growing well. (10).

Hydnocarpus Wightiana is indigenous to the Western Peninsula of India and the oil from its seeds has been used in the Bombay Presidency with satisfactory results. This oil resembles chaulmoogra oil in physical properties and in chemical composition.

The Position in Ceylon.

In 1921, when public attention was first drawn to the uses of chaulmoogra oil in the treatment of leprosy seed of *Taraktogenos Kurzii* was secured from the Divisional Forest Officer in Sylhet. Germination of the seed was poor, but 20 plants were raised and 14 of these were planted in Peradeniya and six at Heneratgoda. The growth at the latter garden has been the more satisfactory and the plants appear to do the best when they are sheltered from the wind. A further consignment of seed was secured in 1922, but it failed to germinate.

The genus Hydnocarpus is represented in Ceylon by *Hydnocarpus venenata* S. Makulu, T. Makal, which is common up to about 2,000 feet and the oil of which is employed in skin complaints. *H. alpina* is common in the low country particularly in the dry districts and *H. octandra* a somewhat rare plant in the moist low country particularly the Pasdun Korale.

In the Royal Botanic Gardens at Peradeniya the genus is represented by *H. venenata* and *H. octandra* two of the Ceylon species and by *H. heterophylla* Blume. These are all large and fruit-bearing specimens and are between 30 and 50 years of age. This last tree was labelled at Peradeniya *H. Wightiana* but when in Calcutta last year I found that it differed from the specimens growing in those gardens and upon my return to Ceylon I had full herbarium material sent to Calcutta. The tree labelled in the Royal Botanic Gardens, Peradeniya, *Wightiana* has been identified as *alpina* and our tree labelled *octandra* as *heterophylla* Blume. This latter is identical with *Taraktogenos Blumii* a native of Sumatra of which there is another large tree in the Arboretum. The Systematic Botanist is not however satisfied with the Calcutta determination of *alpina* as the fruits are larger than those usually secured from the wild Ceylon plant.

Further supplies of seed of *Taraktogenos Kurzii* were received from Burma and 100 plants have been raised and will be ready for planting out in a couple of months and over 40 lb. of *H. Wightiana* seed have been secured from South India and from the Royal Botanic Gardens, Calcutta. *Taraktogenos Kurzii* grows in Burma on soil which consists largely of quartz sand and is associated with species of *Dipterocarpus*, *Garcinia* and *Terminalia* and the *Hydnocarpus*, *Shorea*, *Caryota*, *Lagerstroemia* and *Bauhinia*. The preparation of the oil is simple. The seeds when they arrive from the forests are washed and then dried in the sun for one or two days. They are then shelled, sorted and placed between corrugated rollers worked by a hand crane where they are crushed. They are then placed to a thickness of about an inch in jute bags and placed in layers

in a hydraulic press. The cold drawn oil is collected in cans and filtered through ordinary blotting paper. The resulting cake contains 6% of nitrogen and is sold for manure.

Proposals for Ceylon.

I would therefore recommend that the Taraktogenos plants be planted out at Heneratgoda and that bulk of the Hydnocarpus plants be planted at Peradeniya and a small number at Heneratgoda.

There is in the Heneratgoda Gardens 4 acres of Mukalana forest which has been allowed to remain uncleared. This area could be utilized for the trial of the plants which will be available shortly. Part could be cleared in August for planting in October with Taraktogenos and the remaining portion cleared next February-March for planting Hydnocarpus with the South West Monsoon. On the Experiment Station, Peradeniya, 10 acres could be cleared next February-March for planting Hydnocarpus if the germination of the recently imported seed is satisfactory.

No data is available as to the commercial prospects before the cultivation of these plants. It is stated that the world's demand may be nearly 250,000 gallons of oil. The yield of oil is about 30—33% of the weight of the seed. The present purified Taraktogenos oil is Rs. 15/- per gallon, but Hydnocarpus oil is cheaper. Prices for the seed in Calcutta appear to vary from Rs. 5-15 per maund of 82 2/7 lb. No data is available as to the yields from cultivated trees, but it is certain that if the world's demand is to be met it must be from cultivated trees as the wild sources of supply are in difficult and isolated country infested with wild animals. From such areas increasing supplies are not expected to be realized.

Further Investigations.

Further investigations should be made by the Government Analyst and the Medical Department of the oils of the Ceylon species of Hydnocarpus viz., *H. venenata*, *H. alpina*, and *H. octandra*.

The oil of *H. venenata* is known to the villagers to be useful in certain skin complains. The oil of *H. venenata* was shown by Bill (11) to contain both chaulmoogra and hydnocarpic acids and de Wolff and Koldewijn (12) determined the physical constituents of the oil from *H. alpina* Wight and found them to agree closely with those of chaulmoogra oil. It is quite possible that the oil from the Ceylon species may be useful in the treatment of leprosy and this question should be carefully investigated.

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Further Report Regarding Investigations Made in Connexion with Plants Producing Chaulmoogra Oils for the Treatment of Leprosy.

A report dated June 29, 1926, suggested the establishment of plantations of *Taraktogenos Kurzii* and *Hydnocarpus Wightiana* at Heneratgoda and of *Hydnocarpus Wightiana* at Peradeniya, and that further investigations should be made of the oils of the Ceylon species of Hydnocarpus—*H. venenata*, *H. alpina* and *H. octandra*. These proposals received the sanction of Government and the necessary funds for the experiments were voted by the Legislative Council.

In the West India Committee Circular for September 9th, 1926, Dr. Leonard Rogers, Honorary Medical Secretary of the British Empire Leprosy Association reported that the oil of *Hydnocarpus Wightiana* was more valuable than the oil of *Taraktogenos Kurzii* in the treatment of leprosy, because the Hydnocarpic acid appeared to be more active than the chaulmoogric acid. It was therefore decided to concentrate more upon plantations of *Hydnocarpus Wightiana* than upon *Taraktogenos Kurzii* and to make trials of both at Peradeniya and Heneratgoda.