

Report of the Botanical Survey of India for 1929-30.

I. Systematic.—The endeavours made to revive the field activities of the Botanical Survey, so long kept in abeyance through lack of funds and staff, have been vigorously continued during the year and the scope of field work now extends from the borders of India on the North-West and North-East to the extreme limits of Burma in the South-East and into the furthestmost points of the Peninsula itself.

The result is again a rapidly accumulating mass of collections at headquarters piling up faster than the officers can digest it but from which new and interesting finds are steadily being extracted and added to the already incorporated records.

Mr. Narayanaswami, until June still Senior Assistant on the systematic side, continued work on his materials from the South of the Peninsula. Several hundreds of records resulted but the immediate examination of much of his material has been interrupted by transfer of service. It is, however, hoped that his association with the botany of this part of India will not be lost to the Survey and that the cessation of work on these South Indian collections is only temporary. He has taken with him to his new sphere of activity a set of his own plants and as he is now within easier reach of his areas, South India survey work may yet, it is hoped, profit by his past experience in this field.

Mr. Srinivasan, now Senior Assistant, has spent only part of the year at survey work proper, as during the absence of Mr. Bal on leave his services were required in the Industrial Section of the Indian Museum. But he has continued his work on the Garo Hill plants and the following remarks from a preliminary note on the vegetation of the area is indicative of the type of work done.

“ Collections were made spreading over an altitudinal range of from about 500 to 4,000 ft. The general vegetation is a mixture of the deciduous and evergreen types. At elevations of about 3,000 ft. various deciduous species of lower elevations are associated with such trees as *Quercus*, *Castanopsis*, *Schima*, etc., of the higher altitudes.

Generally up to about 2,000 ft. *Bambusa* and *Ageratum conyzoides* form the main undergrowth, while pure formations of *Phragmites* occur in wet open situations.

Among shrubs in frequent evidence about this elevation, *i.e.*, up to about 2,500 ft. are species of *Randia*, *Canthium*, *Clerodendron*, *Daedalacanthus*, *Phlogacanthus*, *Ardisia*, *Eranthemum* and *Acanthus*. *Strag-*

gling over these and other small trees of species of *Callicarpa*, *Linocera*, *Litsea*, are to be found a large variety of creeping and climbing shrubs, such as *Eleagnus*, *Dalbergia*, *Holmskioldia*, *Dioscorea*, *Smilax*, *Stemona*, *Hedyotis*, *Combretum* and *Entada*, while various herbs spread on the floor of the jungle. Of these the most common are species of *Polygonum*, *Blumea*, *Bidens*, *Phyllopsis*, *Bonnaya*, *Lepidagathis*, *Scoparia* and *Tragia* with grasses and *Cyperaceae*. Trees in this zone are represented by species of *Albizia*, *Gmelina*, *Grewia*, *Sterculia*, *Trewia*, *Shorea*, *Dysoxylum*, *Amoora*, *Bombax*, *Alstonia*, *Acacia*, *Beilschmiedia*, *Aporosa*, *Litsea*, *Excoecaria*, *Wrightia*, *Aglaia*, *Cedrela*, *Glochidion*, *Turpinia*, *Phyllanthus* and *Vitex*, associations which show close relationship with pure Eastern Himalayan types.

At higher elevations the vegetation is closer and more luxuriant and several large trees of species of *Mesua*, *Pygeum*, *Schima*, *Gynocardia*, *Myristica*, *Quercus*, *Hydnocarpus*, *Aesculus*, etc., occur in association with *Litsea*, *Diospyros*, *Lygostrum*, *Garcinia*, *Villebrunia*, etc.

A net work of lianes in which are prominent *Entada*, *Artabotrys* and *Buettneria* spp. is often seen hanging in large loops and coils from *Nephelium* and other taller trees.

Among the genera of herbs and shrubby undergrowth commonly met with in these higher elevations are *Strobilanthes*, *Artemisia*, *Polygonum*, *Leea*, *Linocera*, *Elatostemon*, *Laportea*, *Marlea*, *Sonchus*, *Crepis*, *Adenocacme*, *Ophiorrhiza*, *Achyrospermum*, *Plectranthus*, *Gomphostemon*, *Gnaphalium* and *Chloranthus*.

Linostoma, *Deeringia*, *Beaumontia* and *Uvaria* represent climbers while epiphytes like *Agapetes*, *Coelogyne*, *Peperomia* also occur. *Raphidophora* and *Pothos* abound while *Piper* is seen clothing many tree trunks. Several mud banks on these higher elevations show associations of *Curcutigo*, *Ophiopogon* and *Hedychium*.

Of parasites *Loranthus*, though not confined to higher elevations, is much in evidence while species of *Balanophora* occur on *Buettneria*. A transition, though not very marked, from the open deciduous forms of the lower to the closer evergreen vegetation of the higher altitudes is noticeable."

Mr. Biswas, Curator of the Herbarium, was on tour in the Bombay Presidency early in the year, and towards its close started work for a survey of the South Burma Cinchona reserve area. Collections have accrued from this area for several years but it is proposed to systematise the collections and survey by having an officer on the spot for periods representing all seasons of the year. The thoroughness with which the flora of the Malay Peninsula has been explored and the rich accessions to Botanical knowledge which the explorations of Dr. Kerr and others in Siam and the work on his collections that Prof. Craib has undertaken,

make it desirable that work on the Flora of Southern Burma and particularly of this reserve area be brought into line. That it will repay the labour to be expended is certain and the proximity of Cinchona camps and the opening up of the heavy jungle that Cinchona works entail gives a chance to the collector that is absent in heavy jungle conditions, a chance that is not to be lost.

From his first short tour Mr. Biswas has returned with some 2,000 specimens and there exists now from this area an accumulating mass of material ready to yield its botanical treasure to the systematist and its oecological interests as the field observations and photographic work progress.

In all between 5,000 and 6,000 specimens were received in the herbarium during the year. Prominent amongst accessions from outside were gifts of well preserved specimens from the Swedish State Museum and from the National Museum, Washington, and a set of named grasses from Prof. Hitchcock of the Smithsonian Institute, Washington.

The chief distribution, so far as number of plants goes, was a set of 927 Eastern Himalayan, Chittagoug and Madras duplicates to the Department of Tropical Forest Botany, University of Oxford. Many specimens have been on loan. The *Juncaceae* have been to Stockholm, the *Gnataceae* to Berlin and the Southern India *Cyperaceae* to Kew in connection with the Flora of Madras. These will be followed at an early date by the *Gramineae*. To Kew also by way of loan in the first instance but possibly for permanent incorporation with the African collections there, has gone a set of South African plants collected by Dr. Roxburgh early last century. The collection is of historical interest and is more appropriately housed at Kew with other African collections than at Silpur.

Mr. Badhwar, the newly appointed Second Assistant, has been mostly engaged in gaining acquaintance with the collections at headquarters and in local collection, but in addition to working up his moss material previously gathered in the North-West, he has started the systematic collection of the grasses and is to specialise in this group. Soon after the close of the year he was deputed to examine the question of Santonin bearing *Artemisias* in the North-West and will be almost fully engaged in this work for a year at least. The problem is one of considerable economic interest at present. The young industry is developing but difficult botanical and biochemical problems have arisen to hinder its growth, and it was imperative that an officer with knowledge of the area and with technical experience should be on the spot to watch the yearly fluctuations in Santonin content and to plot the distribution and prevalence of the best yielding varieties, and generally to gain knowledge essential to the development of the industry. But in addition to this

he is actively engaged in the collection of Kurram plants so that the collections work, in which the survey proper is chiefly interested, is not likely to suffer but rather to gain by Mr. Badhwar's temporary deputation.

Mr. Badhwar has also got ready in collaboration with Prof. Dixon, specialist in the group, a paper on the " Mosses of the North-West Himalaya " in which several species new to Science or holding the interest of such plants, are dealt with for the first time.

II. Botanical Divisions.—As of late years taxonomic work has been mostly on material from the lesser known areas of North-Eastern India, Burma and the Peninsula and there has been revealed a considerably larger number of new or interesting species than is usual in a year's work. Many new species hail from Siam, the result of work by Craib, Dandy and Geddes on Dr. Kerr's and others' collections. Mr. C. E. C. Fischer has several additions from Lushai out of material collected by Mrs. Parry, while the collections of Parker and Parkinson have given him numerous new records of the South Burma Flora emphasising its affinity with the Floras of Siam, the Malay Peninsula and Indo-China.

Individual additions from other parts of India make up the unusually large number of 87 new species or records that have been noted amongst the flowering plants during the year.

Several general works of more than usual interest and importance for students of Indian Botany have appeared during the year.

In speaking of his reasons for bringing up to date botanical knowledge on the Indian Bamboos, Father Blatter refers to the vast field for research existing in the group, for the forester as well as for the pure botanist, before the many and intricate problems in connection with the bamboo forests of India are brought nearer their solution. His paper published in the Indian Forester will have a special appeal for, apart from the volumes on Orchids, no volume of the Annals of the Royal Botanic Garden has excited the demand that Gamble's monograph of the Bamboos published some 30 years ago has done. For the Indian forester few groups of plants hold the importance that the bamboo does and Father Blatter's revision is certain to appeal as much to the Forester interested in the bamboos of his area as it will appeal to and help the systematist, engaged often with scrappy material, in solving the identity of the bamboo specimens sent in for determination.

No one who has had to work on herbarium material of the genera *Mallotus* and *Macaranga* can have failed to feel how unsatisfying is such work in the absence of intimate knowledge of these genera in the field, and it is, therefore, doubly welcome to have the Malatas of Northern Bengal set in order by one whose wide interests and keen powers of observation are equalled by his opportunity for field botany.

Mr. Shebbeare and Dr. Cowan between them have set the group in order in a manner that will be as useful to the systematist in the herbarium as it is to the forest botanist interested in the identity of these plants in the field. The Malatas form, from the numerical point of view at least, a not unimportant element in the forests of Northern Bengal.

Another number of the *Pflanzenreich* being Knuth's revision of the *Oxalidaceae* has appeared during the year. The whole seven genera of the family are dealt with in the one volume and the genus *Oxalis* itself runs to 389 octavo pages comprising nearly 800 species. The work follows the plan of previous volumes and collects together for the botanist and especially the systematist the fullest material yet compiled on this interesting group of world wide plants.

Probably no work in the aid of botany that has appeared during the year will equal in importance the *Index Londonensis* to illustrations of flowering plants, ferns and fern allies. The want which the *Index Kewensis* aims to meet as regards references to plant names and descriptions, this new work, an emended and enlarged edition of Pritzels's *Iconum Botanicarum*, will fulfil as regards plant pictures. One volume is issued comprising some 84,000 references and four more are to come. It is a work that will be a standard in the libraries of all botanical and horticultural institutions and its appearance supplies a want that has long been felt by all who have to delve in the scattered literature of plant iconography. The references are of post Linnean date but owing to the high quality of the pictures in certain earlier works, these are given, and amongst others Rumphius Herbarium Amboinense and Rheedes Hortus Malabaricus will gratify all students of Indian Botany.

III. Industrial Section.—During the year under report about 600 gallery specimens have been registered in the Collection Register, of which about 500 specimens have been exhibited. Most of these specimens are of medicinal value and were collected by the Curator during his tour in Assam and East Bengal. Besides these gallery specimens, about 1,400 plant specimens have been collected by the Curator from the Naga and the Manipur Hills in Assam and from Chittagong and other parts of East Bengal, representing about 500 species: this collection is being worked out.

As usual a number of herbarium specimens exhibited in the Gallery were replaced by coloured drawings of plants, prepared during the year. The re-arrangement and overhauling of specimens continued during the year and about 4,000 labels were re-written.

A new show-case has been added to the Gallery to take in the Kashmere Silk exhibits.

A comprehensive exhibit of Cinchona and its products with photographs explaining the methods employed in the cultivation of Cinchona and details of the manufacture of Quinine and other salts, was placed on view to the Public in the Health Welfare Exhibition held in Calcutta in March 1930.

Information regarding the sources of supply of Economic plants and their products was given to numerous correspondents, both from India and abroad, and a considerable number of plants and plant products were identified on behalf of Government Departments and the general public. Information on materials of the following was supplied to various applicants in different parts of the world :—

Putranjiva Roxburghii, Wall., *Boehmeria nivea*, Hk. and Arn., *Sida acuta*, Burm., *Litsaea polyantha*, Juss., *Grewia sclerophylla*, Wall., *Mukia scabrella*, Arn., *Turraea villosa*, Benn., *Crataegus Oryacantha*, Linn., *Grevillea sp.*, *Triticum vulgare*, Vill., *Nelumbium sp.*, *Calamus sp.*, *Carica Papaya*, Linn., *Alstonia macrophylla*, Wall., *Cryptostegia grandiflora*, Br., *Atropa Belladonna*, Linn., *Adonis sp.*, *Valeriana sp.*, *Bambusa sp.*, *Ephedra sp.*, *Citrullus Colocynthis*, Schrad., *Chloroxylon Swietenia*, DC., *Mundulea suberosa*, Benth., *Cannabis sativa*, Linn., *Terminalia Chebula*, Retz., *Panicum sp.*, *Setaria sp.*, *Psychotria Ipecacuanha*, Stokes., *Mimulus moschatus*, Dougl., *Ludwigia parviflora*, Roxb., *Plantago amplexicaulis*, Cav., *Erythrina indica*, Lam., *Gossypium sp.*, *Cynodon dactylon*, Pers., *Hibiscus Mutabilis*, Linn., *Eriodendron anfractuosum*, DC., *Perilla ocimoides*, Linn., *Artocarpus integrifolia*, L., *Artocarpus incisa*, Linn., *Zizyphus Jujuba*, Lamk., *Ananas sativa*, Linn., *Semecarpus Anacardium* Linn., *Plantago sp.*

The catalogue of medicinal plants, already in manuscript, is awaiting to be printed while another list forming a Catalogue of Food, Spices and Fodder Plants is now also ready in manuscript. Materials for a catalogue of Timber plants are being drawn up and it is expected to be ready in manuscript during the ensuing year.

IV. Cinchona and Quinine.—*Bark.* No bark was imported from abroad on Government account. Bark harvest weighments during the year on the Burma plantations showed 149,749 lbs. which through dryage had become 142,263 lbs. as shown by weighment at the end of the year. There was a carry over of 33,665 lbs. from the year 1928-29 at the Burma plantation bark stores, so that the total carry over to 1930-31 amounted to 175,928 lbs. thoroughly dry bark.

No bark was despatched during 1929-30 from Burma to any of the Indian factories. Mungpoo stocks of Java and Burma barks carried from

1928-29 were 522,852 lbs. and 21,080 lbs. All the latter quantity was worked up during the year and of the former 28,127 lbs. leaving at the end of 1929-30 494,725 lbs. Java bark as a carry over to 1930-31. At Naduvattam the year started with a stock of 17,067 lbs. Java bark, none was received and all was worked. Thus the total carry over of India bark to 1930-31 was 670,653 lbs. of which 494,725 lbs. Java lay at Mungpoo and 175,928 lbs. Burma lay at Mergui. From the above-mentioned amounts of Java and Burma barks used at Mungpoo 1530-75 lbs. Sulphate and 452 lbs. Febrifuge and 559-25 lbs. Sulphate and 480 lbs. Febrifuge total 2090 lbs. Sulphate and 932 lbs. Febrifuge were extracted. The 17,067 lbs. Java bark extracted at Naduvattam produced 1,020 lbs. Quinine Sulphate and 288 lbs. Cinchona Febrifuge, so far as the Sulphate is concerned relatively a better yield than Mungpoo as their bark was richer.

Stock of Quinine.—The total Government of India stock of Quinine Sulphate purchased as such and extracted from home and foreign barks amounted to 319,625-3 lbs. at the end of the year. This amount lay 71,541-6 lbs. at the Indian Museum, 239,471-9 lbs. at Mungpoo and 8,611-8 lbs. at Naduvattam.

Stock of Cinchona Febrifuge.—The total stock of India Febrifuge at the close of the year amounted to 26,422 lbs. held 15,960 lbs. at Mungpoo and 10,462 lbs. at Naduvattam.

Sale of Quinine.—From the different stocks of India Quinine there was a total issue of 23,312 lbs. against 32,134 lbs. last year. The latter figure, however, included a special order of some 10,998 lbs. given by the Madras Cinchona Department. True comparisons are furnished by the distribution in the India area of 12,314 lbs. during the year against 12,775 lbs. in 1928-29. The shares of the provinces and the Indian States in the distribution were, Punjab 9,260 lbs., United Provinces 1,760 lbs., North-West Frontier Province 357 lbs., Baluchistan 151 lbs., Rajputana and Central India 730 lbs., Delhi Province 46 lbs., Sind 6 lbs., Bushire (Persian Gulf) 4 lbs., and Madras Cinchona Department 10,998 lbs.

Sale of Cinchona Febrifuge.—There was no taking over and, therefore, no sale by local distributing Governments of India Febrifuge and the stock of this product, therefore, continues to mount. During the year 3,770 lbs. of Cinchona febrifuge powder were distributed in the India area against 4,458 lbs. in the previous year. The distribution was done by Bengal, all from their own Stock of febrifuge.

Revenue by the sale of Quinine.—During 1929-30 the actual receipts amounted to Rs. 5,70,231 against Rs. 3,86,144 in the previous year. The receipts include Rs. 1,91,510 paid by Madras during the year, being arrear outstanding from 1928-29 accounts, and exclude Rs. 52,889 due

from that Government, being the cost of 2,998 lbs. of Quinine sulphate remaining to be paid in 1930-31. Of the receipts Rs. 79,347 were by cash sales and Rs. 4,90,884 by credit to the Government Departments including payments by Bank Drafts in the case of Government Departments in the United Provinces.

Plantations.—There is nothing fresh to add to the history of these and all the remarks made last year both for and against them still hold good. The year under review was not unfavourable for Cinchona, but again experience emphasised the inadvisability of concentrating all the Cinchona effort in the one area. The Cinchona Department has had to expend effort here that could more profitably and certainly with greater scientific advantage have been distributed over at least half a dozen widely separated areas. It is, perhaps, inevitable that caution should mark Cinchona policy while questions of public health and the bearing Quinine has on them hang between a Central and Local Governments, but the retention of effort in one area, whose value for Cinchona several years' experiment has now exactly assessed, is not necessary to this caution. The distribution of effort need not be much more expensive than its concentration and the better caution even dictates it. These reflections gain emphasis when it is realised that long and invaluable Cinchona planting experience is rapidly coming to an end with the senior men in direct charge of experiment completing service. If anything at all is true of Cinchona this is that now is the time to broaden the basis of experimental planting. The very wide interest shown by Local Governments not immediately engaged in planting and by Native States, shows how keen they all are that Cinchona should be extended. Scarcely a week passes without enquiry from one or other source for seed and for information as to methods of cultivation. Often the enquiry emanates from areas where Cinchona would stand no chance, but even where it does stand a chance against the natural conditions, ignorance of the special methods necessary to its cultivation militates against success. Of all the many millions of Cinchona seeds distributed yearly it is questionable if ten in a million ever reach a bark yielding state and those that do gain it by luck rather than by good management from the planter. But the interest is there and is widespread. In no way can the future of Cinchona in India and the Empire be better cared for than by the establishment now of small experimental areas capable of development on an economic basis when the experimental stage is passed. The cost of such experiment may well be infinitesimal compared with the ultimate money gain and the gain in health by having ample means to combat malaria may easily cease to be referable to money values. Whether or not caution is necessary it cannot be wrong to push ahead in other fields with the same experimental proof as has now been obtained in ample degree for the South Burma reserve areas.

The operations of the Department in Burma have not been confined to Cinchona. Another plant, the yielder of a drug, again one of immense importance to India's health, has been successfully exploited, and all the material is now available for the building up of an Ipecacuanha or Emetine Industry. Work in Burma in this direction is in continuation of wide experiment extending over a quarter of a century in the Bengal plantations. Partial success has alternated with failure and the fight to find successful methods has had its advances and reverses. But it emerges now from the experimental stage and a plentiful supply of this valuable drug can now at any time lie with Government.

V. Financial.—The total budget allotment for the year was Rs. 3,10,000, of which Rs. 61,400 were for the Botanical Survey proper including the Industrial Section, Indian Museum, and Rs. 2,48,600 for Cinchona. A surrender of Rs. 40,000 was made from the total allotment under orders of the Government of India in connection with the Haj Inquiry Committee. This was effected by reducing the Botanical Survey allotment by Rs. 6,300 and the Cinchona allotment by Rs. 33,700 under several items. Thus the reduced allotment for the year after surrender was Rs. 2,70,000, of which Rs. 55,100 was for the Botanical Survey proper and the Industrial Section, Indian Museum, and Rs. 2,14,900 for Cinchona. The actual expenditure was Rs. 53,396 for Botanical Survey proper and Rs. 2,06,906 for Cinchona, that is, a total of Rs. 2,60,302. The saving under Botanical Survey proper was Rs. 1,704 and under Cinchona Rs. 7,994, that is, a total of Rs. 9,698 and was distributed under several items.

VI. Staff.—Mr. C. C. Calder held charge throughout the year. Mr. S. N. Bal was Curator, Industrial Section, Indian Museum, throughout the year excepting for about 2 months from 19th October to 23rd December 1929 when he went on leave and Mr. T. D. Srinivasan, Systematic Assistant, acted for him. Mr. Srinivasan availed himself of leave from 26th June to 27th July 1929. Mr. V. Narayanaswami left the Department from 1st June 1929 to accept the post of Systematic Botanist in the Madras Agricultural Department, retaining a lien on his appointment in this Department. Owing to the vacancy caused by Mr. Narayanaswami's leaving the Department, Mr. R. L. Badhwar was appointed Systematic Assistant on probation from 5th November 1929. Mr. U. C. Pal was Assistant Curator, Industrial Section, Indian Museum, excepting for about 2 months in February and March 1930, and held charge of the Government of India Quinine Store in the Indian Museum and of distribution of Quinine. During the absence of the Assistant Curator, Mr. R. K. Das, Head Clerk, acted for him.

On the Cinchona Plantation, Mergui, Mr. P. T. Russell held charge as Superintendent throughout the year. The post of the Assistant

Superintendent, which has been kept vacant since Mr. A. Braybon left, was filled up temporarily by the appointment of Mr. L. G. Richards of the Bengal Cinchona Department from 7th December 1929 in view of Mr. Russell's proposed leave early next year. Mr. Maung Sine was Overseer in the Cinchona Plantation throughout the year.

All members of the staff, both Executive and Ministerial, of the Department worked satisfactorily.

C. C. CALDER,

Director, Botanical Survey of India.