

Botanical Survey of India

An Account of its

**ESTABLISHMENT,
DEVELOPMENT**

&

ACTIVITIES

R. K. BASAK

BOTANICAL SURVEY OF INDIA

DEPARTMENT OF ENVIRONMENT

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Establishment, Development
&
Activities

R. K. BASAK

BOTANICAL SURVEY OF INDIA
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FOREWORD

The Botanical Survey of India was initially established in the year 1890. It functioned actively for several years, with centres in different parts of the country ; but after publication of a few regional floras, its activities were greatly reduced. By the year 1910 most of the activities closed down and only a small unit survived at Calcutta, sometimes almost in name.

After independence, reorganisation of the Department was considered necessary and it was only by about 1955 that the foundations of the reorganized B.S.I. could be laid. Few years ago, it was felt that the reorganized Survey had completed 25 years and it will be useful to bring out a brief account of the history, reorganisation and the activities of the Department in a handy volume.

Establishment of nine regional offices or stations, several of them already with good herbarium, library, museum and botanic garden, exploration of many unexplored and under-explored areas, discovery of hundreds of new taxa and records, studies on ethnobotany, publication of eleven fascicles of the new *Flora of India*, initiation of District Floras, State Flora Analysis and numerous other scientific and semitechnical publications and involvement in numerous research and development programmes of national and international relevance have received acclaim in India and abroad.

The present work compiled by Shri R. K. Basak, Regional Botanist, Headquarters of the Botanical Survey of India brings together relevant historical information as also the current activities of the Department.

In addition to the scientific units working in the Indian Botanic Garden complex at Howrah and the Industrial Section of the B. S. I. (situated in the premises of the Indian Museum at Calcutta), the account of all the existing regional offices is included. The various units forming the infrastructure for scientific researches such as the Library and Documentation Section, and Publication Section, have also been briefly described.

The present publication is important for two main reasons. It is not merely a chronological record of events, but also gives a synoptic account of the scientific programmes and achievements and relevance of the scientific programmes in national development. It also gives an exhaustive bibliography of publications of the scientists of the Survey. This bibliography contains approximately 2,340 references, which in itself is a valuable contribution to the taxonomic and floristic literature of our country.

It is hoped that this status report will apprise the reader about the activities of the Survey and also inform him some aspects of the role which the plant resources play, and can play, in greater measure, in future, in national development and conservation of environment.

P.O. Botanic Garden
Howrah-711103
July, 1982

S. K. JAIN
Director
Botanical Survey of India

CONTENTS

1. Introduction	...	1
2. Early history of the Botanical Survey of India	...	1
3. The reorganisation of the Botanical Survey of India	...	3
4. Organisational set up of the Botanical Survey of India	...	7
5. Headquarters Organisation	...	8
5.1. Ecology Section	...	8
5.2. Plant Chemistry Section	...	10
5.3. Pharmacognosy Section	...	12
5.4. Cryptogamic Section	...	13
5.5. Flora Wing	...	16
6. The Central National Herbarium	...	16
7. The Indian Botanic Garden	...	24
8. The Central Botanical Laboratory	...	26
8.1. Economic Botany Section	...	26
8.2. Cytology & Cytogenetics Section	...	28
8.3. Plant Physiology & Biochemistry Section	...	30
9. The Industrial Section, Indian Museum	...	32
10. The Eastern Regional Circle, Shillong	...	34
11. The Northern Regional Circle, Dehra Dun	...	38
12. The Southern Regional Circle, Coimbatore	...	41
13. The Western Regional Circle, Pune	...	44
14. The Central Regional Circle, Allahabad	...	48
15. The Andaman & Nicobar Circle, Port Blair	...	49
16. The Arid Zone Circle, Jodhpur	...	50
17. The Sikkim Himalayan Circle, Gangtok	...	51

18.	The Arunachal Field Station, New Itanagar	...	51
19.	The Publication Unit	...	51
20.	The Library & Documentation Section	...	53
	20.1. Library Unit	...	53
	20.2. Documentation Unit	...	54
21.	The Artist & Photography Section	...	54
22.	The Technical Section		54
23.	References	...	55

BOTANICAL SURVEY OF INDIA

(an account of its establishment, development & activities)

1. Introduction

The Indian region has a large variety of flora. It has the tropical, subtropical, temperate, subalpine, alpine, desert and cold desert vegetation. It has been considered also as one of the seven centres of origin of cultivated plants. Over a quarter million species of vascular plants are reported to occur in the world and certainly many remain to be discovered. About 15000 species of vascular plants are estimated to occur in India. From early historic times, the plant wealth of India attracted the attention of foreigners for its utility and economic importance in commerce and industry. Plants are important sources of food, shelter, clothing, drugs and beverages. They also enrich the atmosphere with oxygen we breathe in and provide the aesthetic component of our environment.

The Government of India reorganised the Botanical Survey of India in 1954 to survey the vast botanical resources of India and to bring out an up-dated inventory of the floristic wealth of the country. The exploration of the plant wealth, detailed study of plant resources, keeping of the documented plant collections, evaluation of the ecological impact of changes in the landscape due to development, creating awareness about role of plants in our life and conservation of the flora, are all the tasks of the Botanical Survey of India.

2. Early history of the Botanical Survey of India

The Botanical Survey of India was established on 13th February, 1890, in the Royal Botanic Garden, at Howrah (Calcutta). Howrah and Calcutta are twin cities on the west and the east bank of the river Hooghly. The Garden is actually situated in the town of Sibpur in Howrah district.

As a sequel to the publication of Flora of British India by J.D. Hooker and his collaborators, the establishment of the

Survey intensified the botanical exploration of the country, particularly of the Himalaya and other under-explored/unexplored areas and also co-ordinated the botanical work of the regional centres at Saharanpur, Bombay and Madras. T. Cooke, the Principal of the Science College, Pune was made Director for the Western Region, Bombay ; J.F. Duthie took charge of North Western Region with the Garden at Saharanpur as the Headquarters ; M.A. Lawson, the Government Botanist at Madras was appointed as the Head of Botanical Survey in the South. George King, the Superintendent of the Botanic Garden at Calcutta became the ex-officio Honorary Director. At the time when the Survey was organised, it had no staff of its own. Officers of the State Governments with the help of their one or two assistants, conducted the survey work as an additional duty without any emoluments. It is evident from the publications of the Survey of that period that each of the Directors did splendid work in his area. The activity of the regional centres of the Survey dwindled due to lack of funds and manpower and came almost to a stop in the early years of the 20th century. By 1910, there remained only the Eastern Circle at Calcutta with the Superintendent of the Garden continuing until 1939 as the Director. With the retirement of C.C. Calder, the last Director in 1939, the post of the Director was kept in abeyance and the personnel of the Survey consisted of the Curator, Industrial Section, Indian Museum and a Systematic Assistant in the herbarium attached to the Royal Botanic Garden, Calcutta.

An economic botany herbarium of authentic plant materials, known as the 'Herbarium of the Reporter on Economic Products' was founded at the Indian Museum, Calcutta and was based on the collections made by G. Watt and many others (Sen Gupta, 1959 a). The Board of Scientific Advice in 1908 decided that the office of the Reporter of the Economic Products to the Govt. of India and the Industrial Section, Indian Museum, Calcutta should properly be the utilisation wing of the Botanical Survey of India and they were attached to the Botanical Survey from January, 1911.

3. Reorganisation of the Botanical Survey of India

On October 14, 1952, E.K. Janaki Ammal was appointed officer on Special Duty to draw a plan for the reorganisation of the Botanical Survey of India. The plan proposed by her was accepted by the Government of India and orders for the reorganisation of the Survey were passed on March 29, 1954. It was decided to set up the following organisational structures (Janaki Ammal, 1954 c) :

- A. Headquarters establishment under a Chief Botanist at Calcutta for directing the activities of the various units of the Survey and for implementing the scientific policies (in August 1963, the post of '*Chief Botanist*' was re-designated as '*Director*').
- B. Four regional circles based on phytogeographical considerations with their headquarters at Shillong, Pune, Dehra Dun and Coimbatore, to survey the regions under their jurisdiction and to utilise facilities provided by the state governments and universities.
- C. A Central Botanical Laboratory under a Director (later designated as Joint Director) in Uttar Pradesh to study plants in relation to their botany and utility to the nation.
- D. A National Herbarium to house representative flora and type specimens.
- E. Maintenance of a Botanical Museum at Calcutta.

The expansion of the Survey was planned in a phased programme. H. Santapau took over the office of the Chief Botanist on 1st December, 1954. The Central Botanical Laboratory, started earlier at Calcutta on 13th April, 1954 with E.K. Janaki Ammal as Director, was temporarily located at Lucknow up to December, 1957 and then at Allahabad up to October, 1962. H. Santapau did not continue as Chief Botanist for long and J.C. Sen Gupta assumed charge on 1st October, 1955. A rapid expansion of the department took place by establishment of several regional offices. The Southern

Circle set up at Coimbatore on 10th October, 1955 was the first regional office, followed by the establishment of Eastern Circle at Shillong on 10th December, 1955 and Western Circle at Pune on 17th December, 1955. The organisational work for the Northern Circle was started at Calcutta on 21st March, 1956 and the Circle started functioning at Dehra Dun from 1st August, 1956.

The general scheme of the revived survey provided for each region its own herbarium and an experimental garden where interesting plants could be grown and studied. Through the co-operation of the respective State Governments, the Botanical Survey of India took over the Assam Forest Department Herbarium at Shillong in 1956, the Cooke's and Talbot's Herbaria in Agricultural College, Pune in 1956 and the Madras Herbarium at Coimbatore in 1957. The Herbarium Wing of the Indian Botanic Garden at Calcutta was transferred to the Survey in 1957 to constitute the Central National Herbarium (CAL) of the country. The collections made since 1955, have practically doubled the number of specimens in the regional herbaria at Pune, Coimbatore and Shillong and richly added to the Central National Herbarium.

Consequent to the decision to transfer the Central Botanical Laboratory from Allahabad to Calcutta in October, 1962, the fifth regional centre named as the 'Central Circle' was started at Allahabad in July, 1962. On 1st January, 1963, the Indian Botanic Garden, and the library attached to it were transferred by the Government of West Bengal to the Government of India and were placed under the control of the Botanical Survey of India (Santapau, 1964 a, b, 1965 a). The sixth and the seventh regional centres, viz., the Andaman and Nicobar Circle at Port Blair and the Arid Zone Circle at Jodhpur were started in 1972. A field station at Itanagar in Arunachal Pradesh started working from 1977. Another circle, the Sikkim Himalaya Circle was set up at Gangtok in December, 1979.

H. Santapau reassumed charge as Chief Botanist in June, 1961 and continued up to June, 1968. He (1962) presented an

account of the development of plant taxonomy and floristics in India after 1947. The past role and future lines of action of plant taxonomy in India with special reference to Botanical Survey of India were discussed by Subramanyam & Nayar (1971).

Since its reorganisation, the Botanical Survey of India have made plant collections through numerous botanical tours and collected more than 300,000 field numbers of plants till to-date. The seven Regional Herbaria at Dehra Dun (BSD), Jodhpur (BSJ), Pune (BSI), Coimbatore (MH), Allahabad (BSA), Shillong (ASSAM) and Port Blair (PBL) and the Central National Herbarium at Calcutta (CAL) serve as repositories of plant collections, old and recent, and hold between them about 2,000,000 specimens. Nearly 250 new taxa have been described and several new reports of distribution covering more than 500 species have been recorded for India (Nayar & Ramamurthy, 1973 ; Nayar & Karthikeyan, 1981 & others). These additions, published along with several other comprehensive floristic accounts in various journals, both in India and abroad are noteworthy contributions by the scientists of the department and are useful material in the preparation of Flora of India.

After a resume of the growth, development and current structure of the Botanical Survey of India, the Scientific Programme Implementation and Evaluation Committee (March, 1976) redefined the aims and objectives of the department as follows. The Botanical Survey of India must

(1) aim at taxonomic studies and entire scientific staff must be utilised for the planning and execution of the Flora of India project. Everything else must be taken up as a complement of the Flora work ;

(2) encourage research and monographic studies on individual taxa of Indian plants by scientists working both inside and outside the organisation, with collections available at hand. An ethnobotanical study of flora of tribal areas should also receive adequate emphasis. However, all these work must be pivotted on the Flora of India Project ;

(3) function as custodian of botanical collections of India, pay attention to proper preservation of the type specimens of Indian taxa in particular ;

(4) encourage exchange of herbarium and museum specimens with other sister institutions in India and abroad ;

(5) create interest among botanists and public in general on floristic patterns in India and on the utility of the plant life and conservation of the indigenous flora through transparencies and films ;

(6) have an inventory of the germplasm resources of our rich vegetable wealth ;

(7) hold regular symposia and seminars at Regional Centres and at Headquarters at intervals for exchange and better understanding of different approaches ;

(8) develop the botanical section of the Indian Museum for study and display of economic plants for the benefit of students, teachers and public and to assist various government and private organisations through advice and identification of material.

An analysis of the exploration work done so far shows that the northern and western regions of Jammu and Kashmir, northern Himachal Pradesh and Himalayan districts of Uttar Pradesh have remained under-explored or unexplored owing to reasons like snow-clad inaccessible lofty ranges and border security. About one third of the total area under the three southern states has been explored recently, in addition to the explorations conducted prior to 1956. Western Ghat areas of Kerala, Telangana region of Andhra Pradesh and a few coastal districts of Tamil Nadu are yet to be thoroughly botanised. Some districts in Maharashtra and part of Karnataka require more systematic survey. The data also reveal that most of Arunachal Pradesh, Nagaland and Mizoram are in the category of under-explored regions. Earlier explorations in the Assam region have been amply rewarded with large number of novelties, especially in the Orchidaceae and Araceae. Most of the districts of Uttar Pradesh in the Ganga Plain are under cultiva-

tion. However, some districts at the foot of the Himalaya bordering Nepal and a few others will obviously reveal interesting material. The areas of Dehra Dun, Pithoragarh and Pilibhit are now well explored. Adequate attention has been focused on the Arid Zone flora of western Rajasthan. The flora and vegetation of parts of West Bengal, Andaman & Nicobar Islands are well explored; Sikkim and some districts of Bihar and Orissa have under-explored to unexplored corners. Several publications dealing with the flora and vegetation of the explored regions have been brought out by the scientists of the Botanical Survey of India and a few others.

All these data on the status of Survey reveal the large extent of work that remains still to be done in this vast country. The survey is organising its efforts to explore the under-explored or unexplored areas.

4. Organisational set up of the Botanical Survey of India

In the present set up, the administration of the Survey rests with the Director as the Head of the Department of the Botanical Survey of India. For scientific and executive functions of the Survey, the Director is assisted by two Joint Directors at the Headquarters and eight Deputy Directors, three posted at the Headquarters, Central National Herbarium, Indian Botanic Garden and the others in-charge of five of the nine Regional Stations. The Industrial Section, Indian Museum works under a Curator and the Andaman & Nicobar Circle and Arid Zone Circle, each works under a Regional Botanist. The Field Station at Itanagar and the Sikkim Himalaya Circle at Gangtok are at present under the charge of Systematic Botanists. The Botanical Survey of India has now under it the following establishments : (1) Headquarters, Howrah (2) Central National Herbarium, Howrah (3) Indian Botanic Garden, Howrah (4) Central Botanical Laboratory, Howrah (5) Industrial Section, Indian Museum, Calcutta (6) Eight Regional Circles at Dehra Dun, Coimbatore, Pune, Shillong, Allahabad, Jodhpur, Port Blair and Gangtok and (7) Field Station at Itanagar, Arunachal Pradesh. Total staff strength of Botanical

Survey of India is about 1,500 as on 31st December, 1980 amongst whom about 240 constitute the scientific/technical staff with B.Sc. or higher degrees in Botany.

Although each unit of the Survey is at present provided with technical, scientific, ministerial and other supporting staff members, considering the immediate national need for a 'Flora of India' and the availability of experts in the field of revisionary and floristic studies, more facilities are required for implementation of the scientific work.

5. Headquarters Organisation

The Headquarters Organisation is the central co-ordinating office of the Survey with the Director as its Head. In addition to the administrative wing, the research units of the Headquarters are : 1. Ecology Section 2. Chemistry Section 3. Pharmacognosy Section 4. Cryptogamic Section and 5. Flora Wing. The annual programme of work and botanical explorations are planned by the Headquarters office in consultation with the Regional Circle offices and other units of research.

The Survey maintains close collaboration with universities, research organisations such as Council of Scientific and Industrial Research, Indian Council of Agricultural Research, Forest Research Institute, Indian Standards Institution, Agriculture and Forest Departments of the States and with several herbaria and Botanical Gardens of the world. One Regional Botanist of the Survey works at Royal Botanic Gardens, Kew, U.K. to help Indian workers on plant taxonomy and systematic botany. Under the Colombo Plan, Indo-Soviet and Indo-French Cultural Exchange Programmes some scientists of the Survey were deputed to U.K., Soviet Union and France for higher training in different disciplines of botany.

5.1. Ecology Section

The Ecology section started functioning from the middle of 1960 with T.A. Rao as Ecologist. Work was initiated on

the climatic types and forest ecosystems in India (Ann. Rep. 1960-61). Later, studies were undertaken on the dry sal forests of south west Bengal, on the Salt Lake near Calcutta and on the sand dune of Rameshwaram. The programme of work on the vegetation types of India relating to the humid tropics regions and to coastal ecology were initiated in the year 1961.

An analysis of the vegetation of north and south Kanara and Coorg districts was made to provide description of the vegetation, floristics, physiognomy pattern and productivity. Data on soil structure, phytosociology, density and frequency of various plant communities were also tabulated on the basis of quadrat analysis (Arora, 1960 a, b, c, d, e, f, g, 1961, 1963 a, b, 1964 a, b, c, d, 1965 a, b, 1966 a, b, c, 1967). These data have been incorporated in the revised forest types of India by Champion and Seth (1968).

The work done on the structure, composition, development, classification of the entire coastal belts of India was published through several papers to evaluate the productivity on the coastal areas. Studies on the phytogeography, relationship between the vegetation and its habitat, phenotypic variability and other base-line ecosystem characteristics were carried out through about 50 exploration trips. About 50 publications have dealt with the enumeration of plants, floristics and the various other aspects of coastal ecology (Aggarwal & Mukherjee, 1963 ; Arora & Aggarwal, 1965 ; Rao 1964 b, 1970, 1971 ; Rao & Aggarwal, 1964, 1966, 1971 ; Rao, Aggarwal & Mukherjee, 1963 a, b, 1966 ; Rao & Banerjee, 1967 ; Rao, Banerjee & Mukherjee, 1967, 1969, 1974 ; Rao & Das, 1973, 1974 ; Rao & Korlahalli, 1967, 1969 ; Banerjee 1969 ; Banerjee & Das, 1972 ; Rao & Mukherjee, 1965, 1967, 1972, 1975 ; Rao, Mukherjee & Banerjee 1970, 1973 ; Rao & Safui, 1963 ; Rao & Shanware, 1966, 1967, 1968 ; Rao, Shanware & Tribedi, 1969 ; Rao & Sastry, 1970, 1972, 1974 a, b ; Rao *et al.*, 1972, 1974, 1975 ; Shanware, 1967 ; Sastry & Rao, 1973 ; Abraham 1964, 1966 ; Abraham & Subramanyam, 1965 ; Abraham, Mitra & Subramanyam, 1974 ; Korlahalli, 1967 ; Mukherjee

1968 ; Mukherjee & Banerjee, 1968 ; Ghosh, 1964, 1966 a, b, 1969 and others).

Ecological studies on the Indian estuarine vegetation along with the Hooghly, Burabalanga, Mahanadi estuarine complex and Coringa estuary were undertaken to show that there has been a reduction in the number of species in estuarine flora and corresponding wide distribution of some characteristic genera and species (Ann. Rep. 1967-68).

In addition to the aforesaid ecological work, eco-anatomic studies on some maritime strand plants and on anatomical taxonomy also formed a programme of work of the ecology unit. Rao and his associates furnished much information on the foliar sclereides and on other various aspects of ecological anatomy (Rao, 1957 a, b, 1958, 1960d, 1961 a, 1963, 1964c, 1965 a b, 1968 a, b, 1974 ; Abraham, 1965, Rao & Bhupal, 1971, 1972 a, b, 1973, 1974 a, b ; Banerjee & Rao, 1975 ; Rao & Banerjee, 1977 , 1979 ; Rao & Das, 1968, 1971 ; Rao & Das, 1976 a, b, 1978 a, b, 1979 a, b, 1980, 1981 a, b ; Rao & Manna, 1975 ; Rao & Bhattacharyya, 1975, 1977, 1978 a, b ; Rao *et al.*, 1978 and others).

Studies on the Rhizosphere microflora in relation to humid tropics index species and on the variation characteristics of *Rhizobium* isolated from legumes and their cross-inoculation relationship were carried out under the programme of work 'Rhizosphere and nitrogen fixation by Microbes' (Sen & Sau, 1978).

From the aforesaid studies, data on coastal plants, on vegetation patterns of other parts of India and on soils have been collected. Ecological data on some selected families are also being compiled. Presently, emphasis is being laid on ecological studies on endemic, rare and endangered plants of the Indian flora and biosphere reserves (Jain, 1981 d ; Jain & Sastry, 1980 a, b, 1981).

5.2. Plant Chemistry Section

This unit began its activity in 1960. Initially, some important well-known plants containing tannins, saponins, etc. were

selected for chemical analysis. Some of these plants are, *Cleistanthus collinus* (Roxb.) Benth. ex Hook.f. (Maiti & Das, 1965), *Andrographis echioides* Nees (Maiti, 1964) and *Leea sambuciana* Willd. Phytochemical survey of plants found around Calcutta (Maiti, 1968) were also started for screening active constituents, and eighteen new sources of alkaloids, saponins and triterpenoids were found. The bark of *Canthium diococcum* (Gaertn.) Merr., *Canarium bengalense* Roxb. (Maiti & Beri, 1963), *Hesperthusia crenulata* (Roxb.) Roem. (Maiti, et al., 1963), *Pithecellobium bigeminum* Mart., *Samanea saman* (Jacq.) Merr., (Maiti, 1963 a, b), leaves of *Daphne* L. (Das & Mukherjee, 1965) and other members of Thymelaeaceae (Maiti et al., 1963 ; Maiti & Roy, 1967), leaves of *Cardiospermum halicacabum* L. (Das, 1966), leaves of *Rhododendron* L. (Maiti, 1961 b), *Wrightia* R. Br. (Maiti & Beri, 1962) and fruits of *Barringtonia* J. R. & G. Forst (Maiti, 1961 c) were examined.

From the year 1963 onwards, the chemical screening of the family Solanaceae for steroidal alkaloids, especially solasodine were carried out in detail with United States Aid, PL 480 Project. Phytochemical screening of Indian representatives of the genus *Solanum* L. for hecogenin was made (Maiti, 1965). Species like *Solanum khasianum* Clarke (Maiti & Mookerjea, 1964, 1968 ; Maiti & Mathew, 1967 ; Maiti et al., 1964, 1965, 1969), *S. seaforthianum* (Mookerjea et al., 1972), *S. auriculata* Ait., *S. robustum* H. Wendl., *S. verbascifolium* L., *S. torvum* Sw., *S. elaeagnifolium* Cav. and *S. vagum* Heyne were found to be promising as the source material for steroidal drugs (Mookerjea & Mathew, 1969). Bhattacharjee and Das (1969 a, b) and Dan et al., (1978) reported the results of their phytochemical screening of several plants. Das (1967) reported a bromolactone of oleonolic acid.

The Chemical unit has also undertaken some chemotaxonomic problems. Triterpene and sterol extracted from the leaves of *Hoya parasitica* Wall. (Asclepiadaceae), triterpene compounds and tritininic acid (2%) isolated from the leaves of *Delima sarmentosa* L. and *Dillenia indica* L.

(Dilleniaceae) may be of diagnostic value at the family level (Dan & Dan, 1980). Chemical investigations on the cardio-glycosides in Asclepiadaceae and on the bark of *Daphne oleoides* Schr., on leaves of *Lasiosiphon eriocephalus* Dcne. and on fruits of *Gardenia campanulata* Roxb. were taken up to determine and isolate various compounds. Phytochemical survey on the plants of some selected families for the Flora of India Project is also being conducted.

5.3. Pharmacognosy Section

The Pharmacognosy section started functioning since 1960. Studies were undertaken on the stem barks of *Soymida febrifuga* A. Juss. (Chaudhuri, 1961 a), *Annona reticulata* L. (Chaudhuri, 1963 b), comparative studies on stem barks of *Sesbania* Adans. (Chaudhuri, 1966), bark of *Spondias pinnata* Kurz, *Bombax ceiba* L. (Chaudhuri, 1971), *Thevetia peruviana* (Pers.) Schum., *Psidium guajava* L. (Chaudhuri, 1968 a), *Streblus asper* Lour. (Chaudhuri, 1968 b), *Michelia champaca* L. (Chaudhuri, 1964 a), *Ficus religiosa* L. (Chaudhuri & Kayal, 1976), *Anthocephalus indicus* A. Rich. (Chaudhuri, 1975) and on root and stem bark of *Punica granatum* L. (Chaudhuri, 1963 c). Thus, 27 out of 40 species yielding bark drugs have been investigated to-date for preparation of a monograph.

In addition to the aforesaid work, a comparative study on pharmacognostic, anatomical characters, stone cells, calcium oxalate crystals and details of starch grains present in various species of *Cinnamomum* Schaeffer (Chaudhuri & Kayal, 1971), leaves of *Calotropis gigantea* (L.) R. Br. (Chaudhuri, 1961 b), *Cassia sophera* L. (Chaudhuri, 1964 b), *Cassia fistula* L. (Chaudhuri & Kayal, 1969), root, leaves and young stem of *Catharanthus roseus* (L.) Don (Chaudhuri, 1963 a) and of *Vetiveria zizanioides* (L.) Nash (Kammathy, 1968 a) were taken up. Detailed pharmacognostic studies on Indian members of the genus *Solanum* L. were also carried out (Kammathy *et al.*, 1971). The functions of this unit are to study suitability of plant materials for commercial exploitation in drug industry and study of adulterants (Chaudhuri, 1969 ; Chaudhuri & Tribedi, 1976).

An authentic crude drug museum for study and for identifying samples of crude drugs from custom authorities, private institutions and research bodies has been organised.

5.4. Cryptogamic Section

The Cryptogamic unit in Headquarters Organisation of the Botanical Survey of India was established in the year 1964. However, since 1958 several research papers were published in this branch by scientists attached to Regional Circles and Headquarters Organisation.

Earlier, G. Panigrahi published on Pteridophytes of India from Shillong (Panigrahi 1958, 1960 a, b, 1962 b, 1968, 1969). Later, Panigrahi and Patnaik (Panigrahi and Patnaik 1961 a, b, 1962, 1963 a, b, 1964 a, b, 1965, 1968 ; Patnaik 1963 ; Patnaik & Panigrahi, 1963) studied problems of cytology and taxonomy of the family Polypodiaceae from Eastern India. Panigrahi and Dixit (1966 a, b, 1967 a, b, 1968 a, b, 1969 a, b, c, d, 1970, 1971 & 1972) from Allahabad published taxonomic notes and revised Indian representatives of six families e.g., Selaginellaceae, Gleicheniaceae, Schizeaceae, Ophioglossaceae, Osmundaceae, Marattiaceae. Panigrahi (1975 b, c, d, h, j, k, 1976 a, d) reported several new combinations on *Thelypteris* Schmidel, *Diplazium* Sw., *Asplenium* L. & *Trichomanes* L. and described a new species, published nomenclatural notes and revised the genus *Pityrogramma* Link in Asia. Panigrahi & Basu (1980) described a new species of *Dryopteris* Adans. and reinterpreted three species of the genus. Subramanyam *et al.* (1960, 1961), Bhargavan (1973, 1974) and Thothathri *et al.* (1969, 1970, 1977) published accounts of ferns from South India and Andaman and Nicobar Islands. Ghatak (1963, 1964 a, b) described two new species of *Adiantum* L. and discussed some problems of identifications of ferns (Ghatak, 1961, 1967). Raju (1964 a) enumerated pteridophytes of Godavari Region in Andhra Pradesh.

Studies were undertaken on members of the genera *Pteridium* Gled. ex Scop. (Nair, 1972 b), *Pityrogramma* Link (Nair &

Ghosh, 1972) and *Antrophyum* Kaulf. (Dixit & Nair, 1974). The venation pattern in ferns was studied by Nair & Das (1973, 1977). Revisionary work on families Vittariaceae (Dixit, 1979, 1981 a, b) and Adiantaceae is in progress. Some new species, distributional records of species of ferns and several papers on nomenclature have been published (Nair, 1969 b, 1974 a; Nair & Ghosh, 1976 b, c; Nair & Nag, 1976, 1978; Dixit & Nair, 1975, 1977; Nair, 1974 b; Nair & Ghosh, 1975, 1978; Nair & Ghosh, 1973, 1975, 1976 d, e, f, g, 1977, 1978 a, b; Dixit & Ghosh, 1980; Dixit *et al.*, 1976; Safui & Ghosh, 1975; Sastry and Chowdhury, 1969; Nair, 1968 a, 1969 a; Nair & Bennet, 1969; Nair & Ghosh, 1974, 1976 a). The generic revisions on *Selaginella* P. Beauv. and *Coniogramme* Fée (Dixit and Das, 1975, 1977, 1979) have been completed. Some other notable publications are Dixit (1975, 1977), Dixit & Bhatt (1974) and Dixit & Nair (1973).

The Cryptogamic unit of the Headquarters Organisation and Regional circles have conducted several collection trips in the fern rich areas of the country and have collected more than 15,000 specimens to-date deposited at various herbaria of the Survey.

The pteridophytic herbarium at Calcutta (CAL) has been reorganised from its arrangement after Hooker and Baker's system (1865-68) to new generic sequence proposed by Crabbe, Jermy and Mickel (1975). It represents about 1800 species under 185 genera from all over the world. Of the 800 taxa of pteridophytes reported from within the Indian region, c. 100 taxa represent fern-allies. Nearly 6000 specimens of ferns and allies have been added to this herbarium (CAL) since 1961.

The work on moss flora of N.W. Himalaya was carried out mainly by J. N. Vohra and B.M. Wadhwa. Areas of Kashmir and Western Himalaya (Vohra, 1969 a, c, 1970 a), of Nilkantha and Chaukhamba expedition—1959 (Vohra and Wadhwa, 1964 a) and of Indian Cho-Oyu Expedition, 1958 (Wadhwa & Vohra 1965 b) present interesting Bryophytes for study. Several new species were added to moss flora of India by Vohra (1966 c,

1969 b, 1974) and by Vohra and Wadhwa (1964 b). They reported the genus *Alonia* (C. Muell.) Kindb. from India, revised the genus *Rhacomitrium* Bird. in western Himalaya (Wadhwa & Vohra 1963 a, 1965 c) and recorded some new distributions from western Himalaya (Vohra, 1966 a, b, 1968 ; Vohra & Wadhwa, 1963, 1966 ; Wadhwa & Vohra, 1965 a, 1966) in addition to certain miscellaneous notes on mosses (Wadhwa & Vohra, 1963 b, Vohra 1970 b). The moss flora of Western Ghats was studied (Raghavan & Wadhwa, 1968 b, 1970 b ; Wadhwa, 1969, 1971) in the Western Circle. Srinivasan (1968) presented an ecological and distributional resume of liverworts and mosses of India.

So far 26 papers enumerating the moss flora, 5 new discoveries and about 16 new records have been published. A monograph on Hypnobryales of the Himalaya with about a dozen of new taxa has recently been prepared by Vohra. J. Lal (1977, 1979 a, b) is working on Hepataceae of the Eastern Himalaya with special reference to the genus *Mastigolejeunea*.

Many areas, such as the North Eastern Region, the Sub-Himalayan Tract and the Eastern and Western Ghat areas await detailed collection and study. Botanical Survey of India is organising a moss herbarium with the aim of preparing a moss flora of India. About 3000 specimens of mosses and 1000 liverworts have been added to the herbarium (CAL) since 1961.

The Lichen flora of India is also being studied by the Cryptogamic section. The scanty literature on this taxonomically difficult group and the problem of authentic specimens for identification greatly handicap detailed study. The lichen collections of R.S. Rao from Cho-Oyu, East Nepal and of Rao and Panigrahi from Arunachal Pradesh were studied by Awasthi (1960, 1961) and placed under 104 species. Interesting results have been noted in this subject including some new species and several new records (Dharne & Roy Chowdhury, 1967, 1968 ; Roy Chowdhury, 1971 a, b, c, 1972 a, b, 1973 a, b,

1975, 1979 ; Singh, 1977 a, b, 1978 a, 1979 b). The lichen genera *Echinoplaca* Fee, *Asterothyrium* Muell.-Arg. and *Phaerographis* were studied by Singh (1978 b, 1979 a) and Singh & Awasthi (1979). A new genus *Awasthiella* was described by Singh (1980 a).

About 3000 specimens have been added so far to the Lichen Herbarium (CAL) from Manipur, Darjeeling, Sunderbans and other parts of West Bengal.

5.5. Flora Wing

In order to accelerate the work of the Flora of India Project, a research wing called the 'Flora Wing' has been functioning in the Headquarters Organisation since November, 1978 with provision of one Regional Botanist and four Systematic Botanists. The scientists attached to the Flora Wing are engaged solely in the taxonomic revisions. Revisionary studies on various other families under the Flora of India programme are also in progress.

Seven fascicles of Flora of India dealing with families Coriariaceae and Paeoniaceae (Rau, 1978), Dilleniaceae (Majumdar, 1979 a), Poaceae : tribe Garnotiae (Ved Prakash & Jain, 1979), Simaroubaceae and Balanitaceae (Basak, 1980), Orchidaceae : genus *Coelogyne* (Das & Jain, 1980), Pittosporaceae (Nayar & Giri, 1980) and Liliaceae : tribe Scilleae (Deb & Das Gupta, 1981) have been issued up to December, 1981.

6. The Central National Herbarium

The transfer of the Herbarium of the Indian Botanic Garden at Sibpur, Howrah near Calcutta (CAL) to the Botanical Survey of India was effected on 1st April, 1957. It was declared as the Central National Herbarium to serve as a repository of all the available type specimens from India and abroad and to preserve representative collections from various regional circles in addition to its rich earlier deposits. It continued to function in the old herbarium building up to the year 1971 and thereafter, it was shifted to the adjacent newly constructed building. Several research units of the Head-

quarters Organisation are now housed in the Herbarium building at Howrah. Initiated in 1793, the Central National Herbarium of today houses more than one and half million of specimens which supply the basic material for revision of the Flora of India.

The chequered history of the Calcutta Herbarium indicates several phases of its development in the past. Recently, all specimens deposited therein were regrouped following the standard pattern prevailing at the Kew Herbarium under 12 main geographical areas with 24 floristic regions of the world (Panigrahi, 1977 b). Indian specimens were further rearranged state-wise within Indian region. The sequential alignments of the families and genera within Bentham and Hooker's (1862-1883) system have been adopted after taking into account of the recent modifications and split up of certain families and genera. The thousands of types, numerous photographs of Indian type specimens from Kew and microfiches of 26 herbaria of the world, now available at Calcutta Herbarium, will aid revisionary research on Indian plants. A Representative Herbarium has been set up to facilitate students, visitors and non-professional taxonomists in their identification of plants. About 4000 drawings/illustrations have also been arranged in the Calcutta Herbarium. Of late, nearly 25,000 duplicate collections obtained from Regional herbaria have been incorporated into the Central National Herbarium.

A total number of 14285 Wallichian sheets were recorded in the Herbarium (Annual Report 1961-62, p. 26). This number increased considerably with the addition of some gift Wallichian sheets from the Swiss Government (Sen Gupta, 1959 a ; Mukerjee, 1959 a). About 12000 Wallichian sheets are segregated from the General Herbarium to constitute a separate wing 'the Wallichian Herbarium (CAL-WALL), after the pattern of K-WALL (Panigrahi, 1975 b ; Sikdar *et al.*, 1980 ; Ghosh *et al.*, 1980).

This rearrangement of the Calcutta Herbarium will facilitate identification work. It may be added here that the Central

National Herbarium is not merely a repository of the flora of the Indian subcontinent but its holdings also have a significant sample of the world flora.

At the initial stage of the reorganisation from 1957 onwards, the Central National Herbarium carried out its work of maintenance, identification, loan, exchange, supply of information on distribution, economic uses, correct names of plants and such other works. With the gradual additions of scientific personnel, the activities were directed towards enumeration of flowering plants, floristic studies and revisionary work. At present the staff of the Central National Herbarium carry out taxonomic researches in addition to the routine work of house-keeping and technical information services to various institutions and research workers in India and abroad (Mukerjee, 1959 a ; Panigrahi, 1977 b).

Apart from the general developmental activity a series of research work on different branches of systematic botany were carried out in the Central National Herbarium as detailed below.

Enumerations : Enumeration of flowering plants of India under various families with synonyms (Mukerjee, 1959 b, 1960 a, c, 1961 a, b, 1963), the genus *Bruguiera* Lam. in Sunderbans, neglected drugs of Himalaya, orchids and ferns of North Bengal (Mukerjee, 1960 b, 1962, 1972 b, c), bibliography on Tripura and plants of Manipur (Deb, 1961 b, c, 1963 a), economic plants of Tripura (Deb, 1968, 1975 c, d, 1976 a, 1978 a, b, c, 1981 a b, c, d), aquatic plants of India (Deb, 1976 b), plants of the Sagar islands and medicinal plants used in Homœopathy (Guha Bakshi & Sen, 1969 ; Guha Bakshi & Roy Chowdhury, 1972), bibliography on the flora and vegetation of Bengal and carnivorous plants of West Bengal (Basak, 1973, 1975 a), Materials for the flora of Bhutan [Rec. Bot. Surv. India 20 (2) : 1973] and ferns and plants of Garo hills in Assam (Ghosh & Biswas, 1977 ; Ghosh *et al.*, 1978) and on *Primulas* of Assam region (Ghosh, 1980) are noteworthy.

Revisions : Revisionary studies and notes on various

genera and families also form interesting contributions. Revision of genera like *Polygala* L., *Alangium* Lam. and *Allophyllus* L. (Mukerjee, 1958, 1968, 1972 a), of *Viscum* L. (Rao, 1957), of some genera of Guttiferae like *Calophyllum* L., *Mesua* L., *Garcinia* L., of *Wightia* Wall. of Scrophulariaceae and of *Erythrina* L. (Maheshwari, 1960 a, 1963 b, 1964 a, 1961 a, b), of some members of Fabaceae like *Derris* Lour., *Pongamia* Vent. and *Bauhinia* L. (Thothathri, 1961 b, c, 1965 a, 1970 c, 1976 b), of *Zornia* Gmel. (Chakrabarti & Jain, 1973), of *Rubia* L. (Deb & Malick, 1966, 1968), of *Urginea* Steinh. (Deb & Das Gupta, 1974), of *Cynodon* Rich. ex Pers., *Oropetium* Trin., *Manisuris* L., *Arthraxon* Beauv., *Anthoxanthum* L. and *Enteropogon* Nees (Jain, 1967 g,h, 1970 a, 1972 b ; Jain & Pal, 1975 ; Nair, Jain & Nayar, 1977), of some species of *Blastus* Lour., *Catanthera* F. Muell., *Anplectrella* Furtado, *Fisocreochoiton* Quis. & Merr., *Creochoiton* Bl., *Perilimnastes* Ridley, *Pomatostoma* Stapf, *Plethiandra* Hook. f., *Phaulanthus* Ridley, *Pternandra* Jack and *Phyllagathis* Bl. (Nayar, 1968 f, 1969 c, e, 1970 a, 1973 a, 1974 b, c, e, 1975 a, b, 1976), of *Doryxylon* Zoll., *Agrostistachys* Dalz., *Chrozophora* Neck. (Balakrishnan, 1967 a, 1970 b, 1973), of *Siphonodon* Griff. and Hippocrateaceae (Raju, 1965 a, b), of some genera of Boraginaceae like *Trigonotis* R. Br., *Microula* Benth., *Trichodesma* R. Br. and of Ventilaginae (Banerjee, 1966 a ; Banerjee & Banerjee, 1973 ; Banerjee & Pramanik, 1975 ; Banerjee & Mukherjee, 1970 b), of *Dentella* J.R. & G. Forst. (Subramanyam & Sharma, 1968), of *Panax* L. (Banerjee, 1968 b), of *Sadiria* Mez., *Hymenandra* A. DC. and *Antistrophe* A. DC. (Nayar & Giri, 1974, 1975 a, 1976), of *Zanthoxylum* L. (Babu, 1974), of Araliaceae (Banerjee, 1972), of *Drymaria* Willd. ex Roem. et Sch. (Majumdar, 1968 c, Malick & Majumdar 1974), of *Scilla* L. and *Dipcadi* Medik. (Deb & Das Gupta, 1975 b, 1978 a), of *Pseudostellaria* Pax (Majumdar, 1969), of *Toona* M. Roem., *Adenostemma* J. R. & G. Forst. and *Dalhousiea* Grah. (Panigrahi, 1974 a, 1975 g, 1976 b), of *Panicum* L. (Majumdar, 1973) of *Melanocenchris* Nees (Nair & Nayar, 1974), of Annonaceae (Das, 1963), of Caryophyllaceae (Majumdar, 1972, 1973) and of *Bruguiera* Lam.

(Mitra & Banerjee, 1979) have been published. The monograph on *Aquatic Angiosperms* and a review (Subramanyam, 1962 c, d) and *A Dictionary of the Flowering Plants in India* (Santapau & Henry, 1973) are notable contributions.

Grass systematics : The work on grass systematics in the Central National Herbarium was started about the year 1965 by Jain and his associates. In addition to the revisionary studies on the family Poaceae, descriptions of new taxa, several distributional reports in India, particularly in Eastern India, some critical notes and bibliographies on the family are significant contributions (Jain, 1961 a, c, 1966 a, b, c, d, e, f, h, 1967 i, 1968 a, b, 1969 a, 1970 c, 1971 a, b, c, d ; Raizada & Jain, 1966 ; Jain & Banerjee, 1967 ; Jain & Das, 1973 ; Jain & Deshpande, 1968 ; Jain & Hemadri, 1968, 1971 ; Jain, Hemadri & Deshpande, 1972 ; Jain & Pal, 1968, 1969, 1973 ; Jain, Banerjee & Pal, 1975 ; Banerjee, 1968, 1971 ; Saha *et al.*, 1971 ; Jain, Das & Banerjee, 1972 ; Banerjee & Pal, 1970, 1974 ; Bhattacharya, 1976, 1977 ; Bhattacharya, 1978 ; Bhattacharya & Jain, 1979, 1980 ; Ved Prakash, 1979 ; Ved Prakash & Jain, 1979 a, b ; Ved Prakash & Kulkarni, 1979 ; Ved Prakash *et al.*, 1978, 1979 ; Pal, 1969, 1971 ; Pal & Banerjee, 1970 ; Sur, 1975, a, b, 1976 ; Sur & Das, 1976 ; Mehrotra, 1979 ; Mitra & Jain, 1980 and others).

Floristic studies : Floristic studies on Panchmari plateau (Rao & Narayanaswami, 1960), Madhya Pradesh (Maheshwari, 1960 b, d, e, f, 1961 g, 1962 a, 1963 a), vegetation of Jalpaiguri (Mukerjee, 1965), Andaman & Nicobar islands (Thothathri, 1960 b, c, 1962 a, 1974, 1975 a, 1977 ; Thothathri *et al.*, 1973), protection and cultivation of indigenous medicinal plants of North Bengal (Mukerjee, 1966 a), Champaran district in Bihar (Thothathri, 1965 c ; Thothathri *et al.*, 1966 ; Banerjee & Banerjee, 1968, 1969 a), Kanyakumarika (Nayar, 1959), Tirap flora (Deb & Dutta, 1971, 1972, 1973 & 1974), Orissa and Andhra Pradesh (Raju, 1964 b, 1966 b, d, 1968), Birbhum (Basak, 1968 b, 1975 b, 1979 a), Thar and Rann of Kutch and Murshidabad (Guha Bakshi, 1969 b, Guha Bakshi & Naskar,

1969 ; Guha Bakshi *et al.*, 1973), Purulia district (Malick, 1966), Bhutan flora (Deb *et al.*, 1968), flora of Tripura (Deb, 1975 b, 1981 e), herbaceous flora of Dehra Dun (Babu, 1977), the distribution of Saxifragaceae (Guha Bakshi *et al.*, 1971), review on Lower Ganga Plain of West Bengal (Basak & Guha Bakshi, 1977), Flora of Howrah district (Bennet, 1979) and a few others present accounts of respective regions.

New taxa, new records and nomenclatural notes : Descriptions of new taxa, notes on interesting plants and their distributional reports and notes on nomenclature were published by various authors. Some of these are :

(a) *New taxa*—Several new taxa (Balakrishnan, 1966 a, b ; Banerjee, 1966 a, 1968 a ; Banerjee & Banerjee, 1975 ; Banerjee, 1966 b ; Bennet, 1969 c ; Biswas, 1971 a ; Biswas & Babu, 1971 ; Babu & Chandra 1971 ; Chandra, 1978 ; Das, 1962 ; Das, 1968, 1969 ; Deb, 1964 a, b, 1966 a, 1967, 1971 ; Deb & Das Gupta, 1975 a, 1978 c ; Deb & Deka, 1965 ; Deb & Datta, 1964, 1965 a, b, 1969 ; Mukerjee, 1959 c ; Majumdar & Vartak, 1971 ; Majumdar, 1967, 1968 b, 1980 ; Malick & Sen Gupta, 1969 ; Majumdar & Babu, 1969 ; McNeill & Majumdar, 1980 ; Maulik, 1971 b ; Mitra & Bennet, 1966 ; Nair, 1978 ; Nayar, 1967, 1968 a, b, c, e, g, h, i, 1969 a, b, d, f, g, h, j, k, 1970 b, c, 1973 b, 1974 d, f, g, 1975 b, 1980 ; Nayar & Babu, 1970 ; Nayar & Das, 1969 ; Nayar & Giri, 1974, 1975 a, b, c ; Nayar & Banerjee, 1970 ; Nayar & Malick, 1969, 1978 ; Sreemadhavan, 1964, 1966 b, 1967 b ; Sen, 1976, 1977 ; Sen Gupta, 1961 ; Thothathri, 1963 c, 1964 a, 1965 b, 1966 a, 1968, 1969, 1970 b, 1971 a, 1972 a, b, 1975 b, c, d, 1976 a, c ; Thothathri & Das, 1967 ; Thothathri & Pramanik, 1979) were described during the recent years.

(b) *New reports and interesting plants*—Accounts in this line were also published regularly (Arora & Sen Gupta, 1964 ; Arora & Banerjee, 1966 ; Banerjee, 1966 b ; Banerjee & Banerjee, 1966, 1967 a, b, 1969 b ; Banerjee & Majumdar, 1969 ; Basak, 1968 a ; Bennet, 1965 a, b, c, d, e, 1966, 1967, 1969 d, 1971 b ; Biswas, 1971 ; Biswas, 1971 b, 1973 ;

Biswas and Prasad, 1970 ; Chakrabarti, 1972 ; Chandra 1975 ; Chandra & Ghosh, 1979 ; Chandra & Bhattacharjee, 1966 ; Das & Majumdar, 1961 ; Das & Mukherjee, 1969 ; Das & Pramanik, 1971 ; Das & Banerjee, 1974 ; Deb, 1961 a, 1965 a, c, d ; Dutta & Babu, 1968 ; Ghosh *et al.*, 1971, 1977, 1978 ; Guha Bakshi, 1969 a ; Majumdar, 1968 a ; Malick, 1974 ; Malick & Prasad, 1968 ; Nayar, 1974 a ; Mitra & Roy, 1971 ; Santapau & Korlahalli, 1966 ; Raju, 1966 c ; Sen Gupta, 1963, 1964 ; Sikdar, 1976 ; Sikdar & Maiti, 1979 ; Sreemadhavan, 1967 a ; Thothathri, 1961 d, 1966 b ; Thothathri & Banerjee, 1977 ; Thothathri & Prasad, 1970 ; Thothathri *et al.*, 1972, 1973, 1975 ; Vuppuluri Sharma, 1969 a, b ; Yonzone *et al.*, 1970).

(c) *Other taxonomic notes*—Workers in the Central National Herbarium published several interesting notes in addition to their other series of publications (Banerjee, 1967 ; Banerjee & Babu, 1971 ; Banerjee, 1962, 1967, 1969 ; Babu & Henry, 1970 ; Babu & Majumdar, 1975 ; Babu & Nayar, 1969 ; Banerjee & Mukherjee, 1968, 1970 a ; Basak, 1976, 1979 b, 1981 ; Bhattacharya 1977 ; Bhattacharya & Maiti, 1978 ; Biswas, 1968 ; Deb, 1965 b, 1966 b, c, 1975 a ; Deb & Dutta, 1967 ; Deb & Katak, 1963 ; Deb & Lahiri, 1975 ; Balakrishnan, 1961 a, 1966 c, 1968 a, 1970 a ; Jain, 1970 c ; Ghosh & Maiti, 1978 ; Maiti & Guha Bakshi, 1981 ; Mitra, 1967, 1969, 1971 ; Mitra & Jain, 1979 ; Mitra & Subramanyam, 1969 ; Maheshwari, 1960 c, 1961 c, d, e, 1964 c, 1975 a, b ; Majumdar, 1963, 1965, 1970, 1974, 1977, 1978, 1979 b ; Majumdar & Banerjee, 1976 a, b ; Nayar, 1966 a, 1968 d, j, k, 1969 e, 1972 a, b, 1977, 1979 a ; Nayar & Babu, 1969 ; Nayar & Giri, 1978 ; Nayar & Ramamurthy, 1975 ; Panigrahi, 1973, 1974 b, c, d, 1975 a, e, f, i, l, m ; Pramanik, 1972 ; Raju 1965 c, 1966 a, 1969 ; Raju & Nayar, 1980 ; Sen Gupta, 1969, 1973 ; Thothathri, 1961 a, 1963 a, b, 1964 b, 1970 a ; Babu & Thothathri, 1971 ; Santapau & Janardhanan, 1968 ; Santapau, 1961 a ; Santapau & Wagh, 1963 and others).

Computer Unit : The unit started functioning from

September 1976. Three Projects were conceived : Work on the project 'Computer-aided Type Specimen Register for India' was undertaken by R. K. Basak, Alpana Guha & G. Panigrahi. Data from about 1200 Type specimens were transferred to the format of 'Input Form', specially designed for Computer Data Bank Unit. The status of about 500 type materials in the herbarium CAL have been determined with reference to their protologue. The works on two other projects, (1) listing of about 700 genera indigenous to India and plotting their distribution in 49 geographical areas to work out the chorology of Indian Flora and (2) building up a data bank to include information recorded on herbarium labels present in national and regional herbaria in respect of endemic species of Indian flora with a view to computerise the data, are in progress and completed for the family Urticaceae Juss. *sensu lato*. The computer-aided chorology of Indian Grasses presents an analysis of distributional data on 934 species of Indian Grasses leading to location of seven endemic centres in Indian region (Clayton & Panigrahi, 1974). Recently, M. Sanjappa has undergone training on computer methodology.

Palynology Unit : This unit started functioning in the year 1961. Pollen morphological studies on the family Simaroubaceae and Solanaceae were undertaken by Basak (1963, 1967 a, b). An account of the pollen grains of the insectivorous plants *Nepenthes* L. was presented by Basak & Subramanyam (1966). A comprehensive account of the pollen morphology of the order Malvales and of the genus *Aeschynomene* L. and *Solanum* L. and post glacial vegetational history of Kashmir were also published (Sharma, 1968, 1969 a, b, c, d). Mitra (1968, 1970 a, 1975) described the pollen grains of the family Bignoniaceae and Capparaceae. Palynological studies on the families, Burseraceae, Ochnaceae, Resedaceae and on the genus *Desmodium* Desv. have also been completed (Mandal *et al.*, 1974 ; Mitra & Mitra, 1976 ; Mitra *et al.*, 1977, 1979). The work on some members of the family Fabaceae is in progress.

7. The Indian Botanic Garden

Robert Kyd founded the Botanic Garden at Sibpur, near Calcutta in 1787. The Garden occupied a distinct role in the introduction, naturalisation and development of tea, jute, cinchona, teak, mahogany in India. Interesting species of avenue, fruit and flower trees were extensively reproduced in the Botanic Garden and thus contributed to the development of horticulture in India. The Garden is the oldest botanic garden in the South East Asia and has an area of 110 hectares and has been divided into several phytogeographical zones. Nearly 12000 living specimens of trees, shrubs and climbers, representing various parts of the world are grown here.

The history of the gradual development of the Calcutta Garden from a horticultural nursery to a botanic garden can be followed from the reports by Roxburgh (1814), Voigt (1845), Gage (1911-12), Sen (1962, 1965 a), Santapau (1965) and others (Burkill, 1965, Deb, 1977, Basak, 1973). The Garden at Calcutta plays an important role both for the utility and pleasure and has earned high repute in taxonomic research.

On 1st January, 1963, the Indian Botanic Garden was placed under the control of the Botanical Survey of India (Santapau, 1964 a, b). The Garden continues to remain as a centre of research in systematic botany, horticulture and floriculture. The activities in the Garden have been manifold :

- (1) Maintenance of the unique and diversified collections of living plants in the Garden, built up in the past 200 years and their display. The establishment of a Students' Garden (Taxonomic Garden) illustrating various families and useful medicinal plants for recognising the source of various drugs.
- (2) The supply of seeds and important plants to other gardens in India and outside on exchange basis and cultivation of plants of horticultural interest and to encourage the introduction of some useful and economic exotic plants in this country. All these works are

supervised by the Plant Introduction and Experimental Garden section.

- (3) Maintenance of flower garden and nurseries.
- (4) Further development of several Palm Houses, Orchidarium and Rock Houses.
- (5) Work in the improvement scheme of waterlilies, lotus, rose and grapes.
- (6) Development of wood, pollen and carpological section.
- (7) Studies on palms of the Indian Botanic Garden.
- (8) Building up the germplasm collection of *Citrus* L., *Vitis* L., *Nymphaea* L., *Jasminum* L., *Bougainvillea* Comm. ex Juss., palms and ferns.
- (9) Dissemination of information to plant-based industries and research departments of the States and Centre.

In addition to its advisory services in horticulture, the Garden regularly takes part in Flower Shows and receives many distinguished visitors and scientists. It offers a source of recreation to the public in general.

The post of Superintendent of the Garden was designated as Deputy Director, Botanical Survey of India in 1963. The list of non-herbaceous phanerogams of the Indian Botanic Garden is the latest available list of plants now found in the Garden (Sen & Naskar, 1965). The publications on variegated leaves in *Samanea saman* (Jacq.) Merr. (Sen and Basu, 1963), vegetation of Upper Damodar area and Sikkim (Mitra, 1972, 1974), aquatic and semi-aquatic vegetation and climbers of the Indian Botanic Garden and on Solanaceae (Mitra *et al.*, 1971 ; Ghosh, *et al.*, 1975 ; Deb, 1978 d, 1979, 1980) parasites and their hosts, orchids and epiphytes and plants producing edible fruits in the Indian Botanic Garden (Ghosh, 1968 a, b, c, 1969, 1971 a, b, c, 1973, 1974 ; Mukherjee & Ghosh, 1968), horticultural notes (Basu, 1965, 1966, 1967 a, b, 1969 a ; Bhattacharya *et al.*, 1976, 1978, Bose, 1975, a, b, 1976 ; Bose & Chakravarty, 1976 ; Mitra *et al.*, 1972, 1975, 1976 ; Sen, 1965 b), palms of the Indian Botanic Garden (Basu, 1969 b, 1973, 1975 a, b, 1976,

1978 ; Basu & Basu, 1975, 1978 ; Basu & Davis, 1979 ; Davis & Basu, 1969, 1971 ; Mukherjee & Dutta, 1967 ; Basu & Mukhopadhyay, 1972) contain useful informations.

The Indian Botanic Garden maintains a small herbarium for the identification of plants grown and/or found in the Garden. The laboratory in the Garden undertakes studies on botanical and horticultural problems.

8. The Central Botanical Laboratory

The Central Botanical Laboratory of the Botanical Survey of India was shifted back to Calcutta from Allahabad in 1962 and is presently housed in the Central National Herbarium Building inside the Indian Botanic Garden, Howrah.

8.1. Economic Botany Section

Since its initiation, the Central Botanical Laboratory took active interest in economic plants and ethnobotanical studies involving the analysis of plants collected or grown by aborigines to indicate their ancestral primitive types, to improve the cultivated forms, introduction of economic plants and to know about their special uses among the tribal people. Initially studies on the genus *Dioscorea* L. (Yam) from south India and on some other medicinal and economic plants were taken up (Janaki Ammal, 1959 a ; Jain & Saran, 1961). Search for data on new uses of economic plants are being made by direct field studies among the tribal people and by search of folk uses through the retrieval of the records from the herbarium sheets. Since, June 1960, a great impetus in this branch of botany becomes evident in the Botanical Survey of India. The *Maria* and *Muria* Gond tribal areas in Bastar (Jain, 1963 b, e, f, g, h, i, j, 1964 a, b, c, d, 1965 a, c, 1966 a, d, 1967 d ; 1981 b, Jain & Tarafdar, 1963, 1964) and the *Baigas* and *Gond* tribal areas in the Balaghat (Jain, 1965 ; Jain, Hanfi & Tarafdar, 1973) and the *Santhal* and *Bhumij* areas in the Purulia district of West Bengal (Banerjee, 1974 ; De, 1965, 1969 ; Jain & De, 1964, 1966 ; Jain & Tarafdar, 1970) were explored by Jain and his associates (1961-1965) for ethno-

botanical studies. Interesting data on medicinal and food plants, tubers, timbers etc. used by the tribals were collected. More than 25 research papers were published on these aspects. The studies have led to the reports of several unknown or little known edible, medicinal and other useful plants.

From the year 1971 onwards, the tribal areas of Waltair and districts of Warangal, Kurnool, Cuddapah and Chittoor of Andhra Pradesh, Koraput and Phulbari districts of Orissa, Singhbhum, Ranchi and Hazaribagh districts of Bihar and Midnapur district of West Bengal were also taken up for a series of ethnobotanical studies. Nearly 15 papers were published on the uses of the plants of these areas by Jain and his collaborators (Jain, 1972 a ; Jain & Banerjee, 1974 ; Jain, Banerjee & Pal, 1975 ; Pal, 1972, 1973 ; Pal & Banerjee, 1971, 1977 ; Chaudhuri & Pal, 1975 a, b, 1978 ; Chaudhuri *et al.*, 1975 ; Tarafdar & Chaudhuri, 1981 ; Pal & Srivastava, 1976 and others). Emphasis is now being laid on the use of plants by tribals and their possible introduction into current usage. Chemical analysis of *Antidesma diandra* Roth and *Vangueria pubescens* Kurz shows that they are rich in calcium, protein and vitamin B-2, and explains the frequent use of these plants over ages by the tribals. Notes on some green medicines for poor men were published by Chaudhuri (1974) and Chaudhuri & Pal (1976). The scope of Ethnobotany and an account of medicinal plants of India were also presented by Jain (1967 c, 1968 c, 1981 a, b) and Patil (1968 b) and some have been translated into *Hindi* (Jain, 1963 g, 1967 b, e, f). The story of Indian tea was retold by Santapau (1966).

In addition to the usual technical, advisory and collaborative services, the members of the Economic Botany section collected ethnobotanical, economic and medicinal data on some families to feed the Flora of India Project.

In the Integrated Rural Development Project, field studies have been initiated in Midnapur and Bankura districts of West Bengal for a census of plants that can help in generating employment opportunities for rural upliftment and develop-

ment. All available data on the flora, potentialities of the districts for growing edible plants, fuel trees, wood for industrial use, plants useful for green manuring and for checking soil erosion and on the exploitation of plant resources for setting small scale cottage industries have been collected. The exhibition based on the focal theme 'Survey, Conservation and utilisation of Plant Resources' of our country was organised at Bhubaneswar in January 1977 and the problems of rare and endangered plants have evoked great interest (Jain, 1976, 1978 a, 1979 b).

Plant materials and plant products of both economic and ethnobotanical interests, collected during the studies among the tribals and Adibasis, such as tubers, barks, roots, fruits, leaves etc. are identified and maintained properly in the ethnobotanical museum and herbarium of voucher specimens in the section. Information on the economic aspects of plants are gathered from field studies, data recorded in herbarium sheets and old records.

8.2. Cytology & Cytogenetics Section

The Cytology and Cytogenetics section of the Central Botanical Laboratory started its research activities on *Cinchona* and other allied medicinal plants. The Cytology section dealt with following cytological and genetical problems :

1. Cytotaxonomic studies on *Dioscorea* of India collected from cultivated and wild sources from various parts of the country (Raghavan, 1958 b, 1959, 1960). A good collection of *Dioscorea* and other tuberous plants were brought under cultivation at Allahabad.
2. Cytological studies on medicinal plants occurring in the Ganga Plain and on some plants from south India (Arora, 1960, 1961 ; Raghavan & Arora, 1958 ; Gajapathy, 1961).
3. Chromosome survey of the Flora of India (Janaki Ammal, 1954 c) was taken up by examining geographical races of the same species collected for different parts

- of India (Janaki Ammal, 1954 b, 1958, 1959 b) in order to ascertain the progressive development of a taxon and causes underlying speciation of the Indian flora.
4. Chromosome numbers of spontaneous grasses, some members of the family Cyperaceae and minor economic plants of India (Mitra, 1964, 1966 a, b ; Datta & Mitra, 1968).
 5. Chromosome numbers, effect of gamma rays on germination and polyploidy complex studies (Patil, 1958, 1967, 1968 a, b ; Patil & Ghosh, 1963).
 6. Cytological observations on some common weeds and other plants of West Bengal (Datta, 1965, 1966 a, b, 1967, 1968 a, b ; Datta & Chatterjee, 1969 ; Chatterjee, 1969 ; Mallick & Ghosh, 1968 ; Mallick, 1968, 1969 ; Sarkar *et al.*, 1972, 1973 a, b, c, 1973, 1974, 1974, 1975, 1976, 1976 a, 1977, 1977, 1978, 1978 b, 1980).
 7. Karyotype studies in Euphorbiaceae (Datta, unpub.), Araceae and Solanaceae (Mitra, 1965, 1967) to determine the role of polyploidy in these families.

Most of the aforesaid works were initiated by Janaki Ammal and later, were supervised R. P. Patil between the years 1955 and 1970. Since 1972 the important projects in hand are as follows :

Project No. 1 : Chromosome survey of some selected families for the Flora of India Project, to help taxonomic decisions. Chromosome numbers of nearly 700 species were determined and about 75 new chromosome reports since 1972 have been added to the available information. Plants of families like Poaceae, Cyperaceae, Araceae, Acanthaceae and others were collected from different parts of India for cytological analysis. The chromosome study on Cyperaceae shows the tribe Scirpeae to be primitive giving rise to tribes Cypereae and Rhynchosporeae (Sarkar & Das, 1980). The chromosome analysis of some members of the family Euphorbiaceae reveals the role of

polyploidy and aneuploidy in the evolution within the family. Several members of Araceae belonging to diverse habitat and geographical distributions have been studied to show cytoecological relationship. Subramanyam and Kamble (1966, 1967, 1968 a, b, 1971) published some reports on chromosomes of *Canscora* Lam. and *Utricularia* L.

In order to study somatic chromosomes from the growing shoot apex, a new technique has been developed and applied on about 50 taxa of Arecaceae, Poaceae, Cyperaceae, Araceae, Orchidaceae and Cannaceae (Sarkar *et al.*, 1976 b). This handy technique is applicable to dicotyledonous members as well (Sarkar *et al.*, 1978 a).

Project No. II: Polyploidy was induced in some bulbous and tuberous plants of economic importance like *Iphigenia* Kunth, *Dioscorea* L. and others for increased colchicine and Diosgenin content respectively.

The colchicine obtained from Indian *Iphigenia stellata* Blatter (Liliaceae) showed almost same efficacy as polyploidising agent (in 0.01-0.5%) as the standard colchicine available in the market. The Indian plant containing 1.2-1.9% of colchicine, may form the source material for colchicine industry in India (Mallick & Sarkar, 1976 a, b; Sarkar & Mallick, 1977; Ansari & Rao, 1973; Sarkar & Datta, 1979).

A cytotaxonomic herbarium having about 1000 voucher specimens has been built up. So far, the chromosome numbers of 1100 biotypes belonging to 750 taxa have been reported.

8.3 Plant Physiology & Biochemistry Section

The Plant Physiology and Biochemistry unit started functioning at Allahabad in October, 1960 with J. K. Chaudhury as Plant Physiologist. In continuation to his earlier works on essential oil bearing plants (Chaudhury, 1962 a, b, 1963 c), he undertook studies on germination, growth and development of medicinal plants, on respiration and photo-periodism of perennials and on effects of hormones and chemicals on germination, growth and development. The early bearing of Guava by

photoperiodic induction and viability and germination of seeds of two species of *Rauvolfia* L. were reported by Chaudhury (1963 a, b).

Later, the studies on growth and development of some economic plants with reference to their maximum alkaloid yields and isolation were carried on *Solanum khasianum* Clarke (*S. viarum* Dunal), *S. surattense* Burm. f. and *Rauvolfia serpentina* Benth. ex Kurz (Saini, 1966 ; Saini & Biswas, 1967 ; Saini *et al.*, 1965 ; Saini & Safui, 1968 ; Saini & Mukherjee, 1970 ; Mukherjee *et al.*, 1978). Biochemical affinities of some species of *Ficus* were studied by Saini & Mukherjee (1969).

Studies on the presence of growth substances in fruits and leaves of *Ficus benghalensis* L. and causes of low viability of seeds and effects of plant growth substances on the growth and alkaloid content of root of *Rauvolfia serpentina* were initiated (Basu & Chakraverty, 1972). Studies on dormancy, viability and germination behaviour of the seeds of numerous species are in progress.

Chromatography and co-chromatography of the extracts of mango stones, stored between two and twenty weeks, indicated the presence of several inhibitors and a coumarin derivative (Ann. Rep. 1971-72). The effect of Phloridzin (Datta *et al.*, 1973) and of gibberellic acid on growth development, flowering and fruiting behaviour and glycoalkaloid content of *Solanum khasianum* (Chakraverty & Basu, 1973) and of *Catharanthus roseus* (L.) G. Don (Chakraverty & Chakraverty, 1973) were studied. It has been noted that the gibberellic acid treatment causes almost spineless plants facilitating cultivation practices and commercial exploitation of *Solanum khasianum*.

Deflorations, carried out both mechanically and by chemicals regulating flowering of *Rauvolfia serpentina*, *Catharanthus roseus*, increased raw and/or dry weights and also total alkaloid contents (Basu & Chakraverty, 1977, 1978 a). This technique may be useful for the production of more raw material and active principles of therapeutic value. A chemical mutant, characterised by minute leaves and typical non-flowering habit

has been obtained by GA-3 treatment. Recent physiological approaches on the production of phytochemical drugs were summarised by Chakraverty (1970-71). The assay and application techniques of cytokinins were discussed by Chakraverty and Basu (1975).

Plant growth and inhibiting substances were studied in respect of several economic and medicinal plants (Saini & Datta, 1969 ; Datta, 1972). Datta *et al.*, (1973) studied alkaloid contents of *Solanum khasianum* and extracted pure solasodine. The need for survey utilization and conservation of *Solanum myriacanthum* Dunal (syn. *S. khasianum*) was stressed by Chakraverty (1977). The alkaloids and physio-chemical aspects of some medicinal plants were studied by Biswas, (1969, 1970 a, b, 1971 a, b, 1972, 1973 a, b). Chakraverty and his associates later compiled useful information on some fibre plants and on active principles of some medicinal plants (Chakraverty, 1972, 1973, 1974 b ; Chakraverty & Ray Chaudhuri, 1974 ; Chakraverty & Basu, 1974 ; Basu & Chakraverty, 1976 1978 ; Ray Chaudhuri & Chakraverty, 1977).

Plants of Sagar Islands were described and their economic aspects with reference to integrated rural development were discussed by Mahapatra (1978) and Mahapatra & Chakraverty (1977).

9. The Industrial Section, Indian Museum

The Industrial section of the Indian Museum became a part of the Botanical Survey of India since January, 1911. The permanent exhibition of important commercial vegetable products of India with about 15,000 exhibits, continues to be of great value to the Survey and attracts thousands of visitors. The exhibits include such plant products as crude drugs, foods, fodders, dyes, tans, gums, resins, timbers, fibres, narcotics, oils etc. depicting the vegetable resources of the country and their modes of processing.

The Industrial section concerns itself mainly with the collection, preservation, proper maintenance and display of all plant products to illustrate the vegetable wealth and resources

of India in relation to agriculture, forestry, medicine, commerce and industry.

A library containing valuable botanical works and the economic botany herbarium are attached. The herbarium contains about 50,000 specimens. Srinivasan (1959 a) gave a detailed history of the development and progress of the Industrial Section, Indian Museum. The important activities of the Industrial Section, Indian Museum are as follows :

1. Development, exhibition and maintenance of collections of vegetable origin, illustrating the development of agriculture and plant based industry and commerce in India.
2. Visual education through demonstrations and lectures.
3. Popularisation of botanical science through museum services.
4. Collection and dissemination of information concerning vegetable resources of India and supply of information of technical and commercial nature.
5. Botanical exploration and survey for exhibits for Industrial Section, Indian Museum.
6. Collection and supply of authentic samples for research work and for public enterprises.
7. Identification of specimens.
8. Research on problems relating to economic botany.
9. Chemical investigation on plants.

K. S. Srinivasan, Curator, for long time was interested in the study of the algal flora of the Indian coast and conducted several collection trips to Tuticorin, Laccadive & Minicoy islands and Chilka lake. He brought out a number of papers on algal flora (Srinivasan, 1960 b, c, d, e, f, g, h, 1961 b, 1962 a, b, c, 1964, 1965 a, c, 1966 b), on *Marchantia* (Srinivasan, 1965 b, 1966 a) and *Phycologia Indica* (Vols. 1 & 2 :

1969, 1973). He also contributed on the protection of wild plant life, vegetation of the Bomdi-La area, NEFA, vegetation of Church island, William Carey, medicinal plant resources, Indian Acanthaceae, Verbenaceae and Labiatae and on Tamarinds (Srinivasan, 1959 b, c, 1960 a, 1961 a, c ; Srinivasan & Sen Gupta, 1966 ; Srinivasan & Bose, 1961, 1963, 1965 ; Srinivasan & Agarwal, 1963, 1968 ; Srinivasan & Subba Rao, 1961). Bose (1961, 1968) and Krishna (1969, 1970) brought out some interesting notes. Subba Rao (1959 a, b, 1960) published on vegetable sources of cortisone, on oil of *Acacia decurrens* Willd. and on *Rauvolfia canescens* L. (*R. tetraphylla* L.). Notes on roots of Indian plants used as medicine, on *Mangifera indica* L. and on some other economic plants (Agarwal, 1970 b, 1971, 1973, 1974, 1978 ; Agarwal & Malhotra, 1970 ; Agarwal & Krishna, 1972) on *Psoralea corylifolia* (Basu, 1956), on some unreported medicinal plants of India (Agarwal & Saha, 1968), distribution and uses of the genus *Typha* L. in India (Saha, 1968) and contribution on botany of Salt-Lakes, West Bengal (Das Gupta, 1973) are some other interesting publications. Krishna & Das (1976) reported five orchids from North Bengal. The monograph on wood-yielding plants of India by Agarwal (1970 a) deserves a mention. The catalogues of medicinal, food, spice, fodder and fibre plants exhibits in the Industrial Section, Indian Museum contain valuable information.

D. B. Deb served as Curator from 1969 to 1977. He maintained his earlier interests in taxonomy of Rubiaceae (Deb & Dutta, 1976), Solanaceae and Liliaceae. The report of the presence of silver in an edible algae of Manipur (*Lemanea australis* Aitk.) is interesting (Deb *et al.*, 1974).

10. The Eastern Regional Circle, Shillong

The Eastern Regional Circle comprising of Orissa, Bihar, West Bengal, Assam, Manipur and the then North East Frontier Agency and Sikkim Himalaya started functioning at Calcutta from 1.2.1956, and was transferred to Shillong on 1.4.1956. Later, the States of Orissa, Bihar, West Bengal and

Sikkim were put under the Central National Herbarium, while other areas continue to be under the Eastern Circle, under the revised names as Assam, Meghalaya, Mizoram, Nagaland, Tripura and Manipur.

The areas included in this region are full of impenetrable virgin forests on large mountainous tracts. The variations in soil, climate and altitude, present mostly a rich evergreen vegetation (Rao & Panigrahi, 1959). The object of the study in this region are

1. To collect materials for a revised Flora of India and develop the regional herbarium.
2. To study the potential plant resources available in the area with particular reference to medicinal, timber yielding and other plants of economic aspects.
3. To collect, cultivate and propagate the rich orchid flora of Assam region in the National Orchidarium.

The forest herbarium of Government of Assam at Shillong started by G. Mann in 1873 and having collections of about 80,000 specimens, was handed over to the Botanical Survey of India on 9.8.1956. It contains many valuable collections of G. Mann, U.N. Kanjilal, P.C. Kanjilal, A. Das, C. Purkayastha, N.L. Bor, R.N. De, M.L. Saikia and their associates. Several type materials of taxa described from the Assam region are deposited in this herbarium. The herbarium now has about 1,15,000 dried specimens.

The exploration and collection trips have added several thousands specimens to the herbarium so far. Almost every visit has resulted in new discoveries of plants. The environmental and climatic conditions of the Eastern Circle region provide ideal natural conditions for the development and growth of orchids. The National Orchidarium at Shillong and Experimental Garden at Barapani near Shillong, thus provide ample facilities for a thorough systematic revision of Orchidaceae of this region. About 5,000 orchid speci-

mens belonging to 350 species are under cultivation in the Orchidarium.

After the reorganisation of the Botanical Survey of India, the floristic and systematic studies on the plants of the eastern India were conducted by R.S. Rao, A.S. Rao, G. Panigrahi, D.B. Deb, J. Joseph, N.P. Balakrishnan, A.R.K. Sastry, D.M. Verma and others.

Significant works on floristics and vegetation, and enumeration of plants in the eastern region are on the vegetation types in eastern India (Rao & Panigrahi, 1961), on Rampa and Gudam Agency Tracts, Eastern Ghats (Rao, 1958 c, 1964 c), on survey of medicinal plants of eastern India (Rao, 1961 a), on the Himalayan flora (Rao, 1962), on Cho-Oyu expedition (Rao, 1963 a), on the vegetation of Tripura (Rao & Murthy, 1962), on *Aerides* Lour. (Rao, 1963 b), on Sikkim flora (Rao, 1963 c), on flora of Siang Frontier Division (Rao & Joseph, 1965), on Hydrocharitaceae (Naik, 1964), on *Hedychium* Koenig (Naik & Panigrahi, 1961), on Rubiaceae of Assam (Kar & Panigrahi, 1963), on Ranunculaceae of Assam and North East Frontier Agency area (Kataki & Panigrahi, 1964), on flora of Tirap Frontier (Panigrahi & Joseph, 1966), on Compositae of Frontier Agency (Panigrahi & Kar, 1966 b), on flora of Subansiri Division (Panigrahi & Naik, 1961), on Monocot flora of Assam and NEFA (Panigrahi, 1965 b, 1966 b), on Gandhamadan Parvat in Orissa and on Rajmahal hills in Bihar (Panigrahi, 1963, 1966 a; Panigrahi *et al.*, 1964) on vegetation and phytogeography of Assam-Burma (Rao, 1970, 1974), on North Lakhimpur subdivision (Rao & Verma, 1969 e), on *Gonatanthus* Klotz. in Khasi & Jaintia Hills (Rao & Verma, 1968), on the analysis of Monocot flora of Assam (Rao & Verma, 1969 a, d, 1970, 1972, 1973, 1974, 1976), on Kamrup district (Rao & Rabha, 1966), on Manas Wildlife Sanctuary in Assam (Jain & Hajra, 1975) and on Commelinaceae (Panigrahi & Kammathy, 1963 a, b, 1964; Rao, 1964 a, e, 1966 a, b, 1971; Rao & Kammathy, 1962, 1966; Kammathy & Rao, 1961 a, b, 1964; Joseph & Rao, 1968; Rao

et al., 1968, 1970). The material from the eastern India form the basis of several publications of Deb (1957 a, b, c, 1958, 1960 & *l.c.*). The status of floristic studies on Meghalaya was discussed by Bhaumik & Rao (1977).

Many distributional records, notes and new species of the family Orchidaceae have been published from eastern India (Joseph, 1970, Joseph & Chowdhury, 1966 ; Balakrishnan & Chowdhury, 1966 a, 1967 b ; Joseph & Deka, 1972 ; Joseph & Yoganarasimhan, 1966, 1967 ; Katakai, 1962, 1963, 1964 ; Katakai & Panigrahi, 1963 ; Jain & Hajra, 1976 ; Jain & Katakai, 1977 ; Deori, 1975 a, b, 1978 ; Deori & Hajra, 1975 ; Deori & Das, 1976 a ; Deori & Malhotra, 1973, 1975, 1977 a, b ; Malhotra & Deori, 1973 ; Halim & Katakai, 1964 ; Panigrahi, 1962 a, 1965 a ; Rao & Balakrishnan, 1968 ; Rao, 1969 b, 1979 ; Rao & Joseph, 1968, 1969 ; Rao & Hajra, 1974 b, 1976 a, 1977 ; Rao & Deori, 1973, 1980 ; Krishna & Sastry, 1972 ; Balakrishnan & Krishna, 1970 ; Katakai & Krishna, 1970 ; Arora & Jain, 1977 ; Arora *et al.*, 1977 ; Hynniewta, 1978, 1979 a, b ; Hynniewta & Malhotra, 1978).

Several reports on the distribution, new taxa and taxonomic notes on other plants from the north eastern region also appeared in recent years. Many new taxa (Balakrishnan, 1974 a, 1975 ; Balakrishnan & Chowdhury, 1966 b ; Jain & Malhotra, 1977 ; Joseph, 1972 ; Panigrahi, 1967 ; Panigrahi & Katakai, 1967 a, b ; Panigrahi & Naik, 1964 ; Rao & Hajra, 1974 c ; Rao & Joseph, 1967 b ; Rao & Verma, 1969 a, b, c, 1971 ; Rao & Joseph, 1970 ; Subba Rao, 1963, 1964 a ; Subba Rao & Halim, 1963 ; Subba Rao & Kumari, 1968 a ; Sastry, 1967 a, c, 1969 ; Sastry & Chowdhury, 1969 ; Sastry & Verma, 1968 ; Sastry *et al.*, 1968), some new records (Balakrishnan & Hajra, 1964 ; Balakrishnan & Chowdhury, 1967 a ; Borthakur & Hajra, 1976 ; Hajra, 1978 ; Joseph & Deka, 1960 ; Deori & Bhaumik, 1976 ; Deori & Das, 1976 b ; Rao & Balakrishnan, 1972 ; Rao & Joseph, 1967 a ; Rao & Deka, 1970 ; Rao & Hajra, 1970, 1973 a, b, 1974 a, 1975 ; Panigrahi & Kammathy, 1960 ; Panigrahi & Katakai, 1966 ;

Panigrahi & Naik, 1966 ; Panigrahi & Kar, 1966 ; Subba Rao & Kumari, 1963, 1964, 1966 ; Sastry, 1968 a ; Sastry & Deka, 1967 ; Sastry & Joseph, 1967) and a few nomenclatural notes (Balakrishnan, 1974 a ; Malhotra & Hajra, 1975 ; Sastry & Katakai, 1966 ; Subba Rao, 1964 b) are noteworthy.

S. K. Jain while posted at Shillong (1973-1977) published a book on plant collection and preservation techniques with special reference to Indian plants (Jain & Rao, 1976). Shukla (1978) and Neogi & Jain (1978) worked on grasses of eastern India. Jain and Das studied on the genus *Coelogyne* Lindl. (Das, 1975 ; Das & Jain, 1976 a, b, 1977, 1978, 1980 ; Jain & Das, 1978). Borthakur (1976) reported on the less known uses of some plants among the tribes of Mikir Hills. Borthakur (1981 a, b), Dam & Hajra (1981), Hajra (1981), Hajra & Baishya (1981), Joseph & Kharkongor (1981), Kharkongor & Joseph (1981) and Rao & Shanpru (1981) published certain ethnobotanical observations.

The Eastern Circle still contains many unexplored areas with dense vegetation. The scientists posted there, are actively surveying and reporting interesting findings. The studies have been undertaken so far chiefly on mountainous plateau of Meghalaya, particularly in Garo Hills district and western parts of Khasi Hills, and the hilly tracts of Nagaland and Mizoram. The areas of Mikir Hills, Kohima and Kaziranga National Park have been visited botanically.

The National Orchidarium at Shillong attracts thousands of visitors annually.

11. The Northern Regional Circle, Dehra Dun

The Northern Regional Circle includes the States of Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh, northern hilly parts of Uttar Pradesh (24 districts) and Delhi. The flora is extremely varied and rich owing to the varied climate of tropical, temperate and frigid nature, various types of soil conditions and elevation, ranging from a few hundred to 7,000 metres or more, beyond the limit of all vegetation.

With the establishment of the Botanical Survey of India Circle at Dehra Dun, explorations in different remote corners have resulted in the huge collections of plant materials. Out of these, the present herbarium of the Botanical Survey of India Dehra Dun (BSD) was organised (Rau, 1959). It has at present a collection of about 60,000 specimens. Amongst recent explorers, M.A. Rau, T.A. Rao, N.C. Nair, U.C. Bhattacharyya, B.M. Wadhwa and J.N. Vohra collected and added much to our knowledge of the flora of the region.

In recent times, Rau contributed significantly on the botany of this region. He brought out articles on plants of Lahul and on Banda district, U.P. (Rau, 1960, 1961 a, b), on plants of North Garhwal and Kumaon (Rau, 1961 c, d), on Himalayan conifers (Rau, 1962), on vegetation around Jamunotri (Rau, 1963 d), on Valley of Flowers and Hem Kund (Rau, 1964 b), on some plants of Western Himalaya (Rau, 1967, 1972), on the ecology and phytogeography of the Himalaya (Rau, 1974), on some plant records (Rau & Rao, 1959, 1960 a, b, 1961 ; Rau & Bhattacharyya, 1966 ; Rau & Arora, 1973) and published books on *Illustrations of West Himalayan Flowering Plants* (1963), *High altitude Flowering Plants of West Himalaya* (1975) and a *Check-list to the 'Flora of Upper Gangetic Plain'* (1968). *Alectra parasitica* A. Rich. var. *chitrakutensis* M.A. Rau, (1961 a), a rare parasitic shrub of this region, is reported to be useful in treatment of leprosy. Rau also contributed several papers on the embryology of angiosperms.

T.A. Rao collected exhaustively in Milan Glaciers (1959), Jammu & Kashmir (1960 b, 1961 b), Pindari Glacier and Kumaon Hill (1960 a) and in Eastern Kumaon (1960 c, 1961 c, 1964 a). Nair also made collections in the area and published on new species of *Sesamum* L., *Gentiana* L. and *Aristolochia* L. (Nair, 1963 a, 1964 c, 1968 b), on a new variety of *Vernonia* Schreb. (Nair, 1963 b), on new records (Nair, 1964 d, 1966 a, b, 1967 a ; Nair & Pant, 1966), on botany of Lahul (Nair, 1964 a, b), *Gnaphalium* L. (Nair, 1966 c), vegetation of Lohargul (Nair & Malhotra, 1961) and on Punjab Plains (Nair &

Nair, 1963, 1964 b, c, 1966). The *Flora of Bashahr Himalayas* and the *Flora of Punjab Plains* by N.C. Nair (1977, 1978) are outcomes of comprehensive survey in the respective areas.

Bhattacharyya, recorded his observations on Mirzapur district, U.P. (1963 a, 1964 a), Hamirpur district, U.P., some new records (Bhattacharyya, 1963 b, 1964 b, 1969 ; Bhattacharyya & Uniyal, 1973), new species of *Euphorbia* L., *Argyrobolium* Eckl. & Zeyh. and new variety of *Saxifraga* L. (Bhattacharyya, 1967, 1972 ; Bhattacharyya & Biswanathan, 1973). Bhattacharyya, Wadhwa and Viswanathan have at difficult times carried out explorations in the cold desert areas of Ladakh in Jammu & Kashmir.

Naithani (1969) collected plants with Kedarnath Parbat Expedition in 1967 and also brought out a note on plant records (1972). Some new records of orchids and a new species from Western Himalaya were added by Arora (1969 a, b, c, 1972 a, b, 1978, 1980). The vegetation of Mothronwala swamp forest, near Dehra Dun and of Corbett National Park, U.P. were studied by Dakshini (1960) and Pant (1976) respectively. Flora of Bulandshahr district and weed flora of Dehra Dun and few distributional notes were presented by Singh (1963, 1964, 1967, 1969 a, b).

Babu published the *Herbaceous flora of Dehra Dun* (1977). While working in the Central National Herbarium, Howrah, Babu and his collaborators published several interesting notes and reports on Indian phanerogams (Babu, 1966, 1968 a, b, 1969 a, b, c, d, e, 1970 a, b ; Babu & Biswas, 1969 ; Babu & Dutta, 1968 ; Babu & Raju, 1969 & *l.c.*).

Studies on the Limestone vegetation of Sahasradhara, near Dehra Dun was conducted by Malhotra (1971 a, b, c, 1972, 1973 a, b, 1974). The occurrence of certain taxa in Western Himalaya were reported by Murti (1976 b), Malhotra (1969), Pant (1972), Janardhanan (1973 a, b), Janardhanan & Prasad (1974) and Arora & Prasad (1978). A.S. Rao made collections in the Kumaon and Garhwal areas, particularly in Pauri

district and Dachigam Game Sanctuary. He also made a review of the present condition of the orchid flora of India (1979).

About 150 research papers, pertaining to floristics, several new species and distributional records from the North West Himalaya and the Indo-Ganga Plain have so far been published. The Circle has been giving special attention to plant collections in the Himalaya, particularly in the higher altitude like Nanda Devi. The Circle is currently preparing the floras of the districts of Chamoli, Kumaon, Pithoragarh, Pilibhit (U.P.), Hoshiarpur (Punjab), Corbett National Park, Dachigam Game Sanctuary, Valley of Flowers and State Flora analysis of Himachal Pradesh and Jammu & Kashmir. Schemes have also been approved for floristic survey of two National Parks and nine more districts in the Circle. The High Altitude Experimental Garden at Pauri district, Uttar Pradesh is intended for the introduction of Himalayan orchids and drug plants from various areas of the North Western Himalaya, while the area at Khirsu with *Quercus-Rhododendron* forest is being preserved as a Nature Reserve.

12. The Southern Regional Circle, Coimbatore

The Southern Regional Circle comprising of Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Hyderabad and Rewa district started functioning on October 10, 1955 at Coimbatore. Later on, the Circle encompassed the States of Tamil Nadu, Kerala and Andhra Pradesh. With the evergreen humid tropic belt, hill stations and two Ghats areas, the Southern Regional Circle presents a variety of flora.

Several areas of the old Hyderabad State in Andhra Pradesh, parts of Tamil Nadu and Kerala remain yet to be botanically explored. The Madras State Herbarium, located in the Agricultural College and Research Institute, Coimbatore was handed over to the Botanical Survey of India on 31st December, 1957. It is one of the oldest herbaria of the country. The collections of H. Cleghorn, Dr. Drew, and W. Elliot form the

nucleus of the Herbarium and those of J.P. Rottler, B. Heyne, B. Schmid and R. Wight add prestige to the Herbarium. They were followed by later collectors like, R.H. Beddome, G. Bidie, M.A. Lawson, J.S. Gamble, A.G. Bourne, K. Rangachari, C.A. Barber, V. Narayanswami, C. Tadulingam and others. At present, there are about 1,90,000 specimens and over 1,500 types. An account of the growth and development of the Herbarium of the Southern Regional Circle was given by Subramanyam (1959 a) and Henry (1977). Over 300 research papers dealing with about 70 new taxa and 350 additional records for the area have appeared.

K. Subramanyam, K. M. Sebastine and their associates explored the flora of Boluvampatti forest, Coimbatore (Subramanyam, 1959 b), Madurai, Bastar, Madhya Pradesh and Jayvadi Hills, North Arcot (Subramanyam & Henry, 1959, 1966, 1967, 1970). Publications were brought out on rare and endangered species of India and phytogeography of Western Ghats (Subramanyam & Sreemadhavan, 1969 a, b ; Henry & Swaminathan 1979, 1980, 1981 c ; Henry *et al.*, 1979 ; Chandrabose *et al.*, 1979 ; Vivekananthan, 1980 ; Nair & Bhargavan, 1981 b ; Nair & Mohanan, 1981 ; Subramanyam & Nayar, 1974), economic plants on hills of Coimbatore and Nilgiri district, plants of Madras Presidency and Eastern Ghats (Sebastine, 1959, 1960, 1962, 1963 ; Sebastine & Ramamurthy, 1966 a), forests of Tanjore district (Sebastine & Ellis, 1967), north east Madhya Pradesh (Sebastine & Balakrishnan, 1963 a, b, c), Singampatti forest, Pachamalais and Warangal district, Andhra Pradesh (Sebastine & Henry, 1960 a, 1961, 1966), Prambikulam and Aliyar (Sebastine & Ramamurthy, 1966 b), Devicolam (Sebastine & Vivekananthan, 1967), Balapalle Range and Nallamalais, Andhra Pradesh (Ellis, 1966 a, 1968), Kozhikode district, Kerala (Ellis *et al.*, 1967), Tirunelveli district (Ramamurthy, 1963), Karimnagar district, Andhra Pradesh (Subba Rao & Kumari, 1967 a), Nagarjunakonda Valley (Thothathri, 1964 d), Bori forest, Hoshangabad district and Khari forest, Mandla district in Madhya Pradesh (Joseph, 1963 b ; Joseph & Vajravelu, 1967), Kottayam district, Kerala and

grasses of south India (Shetty & Vivekananthan, 1971 ; Shetty *et al.*, 1973), Bandipur Reserve Forest (Naithani, 1966), Mahendragiri region, Nilgiris and Mudumalai Sanctuary (Sharma *et al.*, 1973, 1977, 1978), Dharmapuri district, Palghat district and Anamalai Hills (Vajravelu & Rathakrishnan, 1967 ; Vajravelu *et al.*, 1968 ; Vajravelu & Joseph, 1971). The notes on various aspects of *Utricularia* L. (Subramanyam, 1969 ; Subramanyam & Abraham, 1967 ; Subramanyam & Balakrishnan, 1960 ; Subramanyam & Narayana, 1969 a), *Nechamandra* Planch. (Subramanyam & Balakrishnan, 1961), embryology (Subramanyam, 1961, 1962 a, b, 1963), *Limnocharis* H.B.K. (Kammathy & Subramanyam, 1967), role of herbaria (Subramanyam & Sreemadhavan, 1970), conspectus of the families Podostemaceae and Tristichaceae (Subramanyam & Sreemadhavan, 1969 c), chromosome reports (Ellis, 1962 ; Shetty, 1961, 1967 ; Shetty & Subramanyam, 1962, 1964, 1967), *Panicum* L. and on members of the family Poaceae of Madras Presidency (Karthikeyan, 1971 a, b, 1972) were published.

Publications also include discovery of new taxa (Balakrishnan, 1961 b ; Balakrishnan & Subramanyam, 1960 a, b, 1963 ; Chandrabose, 1967, 1978 ; Chandrabose & Shetty, 1973 ; Chandrabose & Srinivasan, 1975 ; Ellis, 1964, 1966 b, c ; Ellis & Chandrasekaran, 1970 ; Chandrabose *et al.*, 1981 ; Ellis & Saroja, 1961 ; Ellis & Swaminathan, 1969 a ; Henry, 1964 a, b, 1965 c, 1967 a ; Henry & Balakrishnan, 1961 ; Henry & Chandrabose, 1973, 1975 ; Henry & Subramanyam, 1970, 1972, 1976 ; Henry & Swaminathan, 1978 ; Joseph, 1963 a ; Joseph & Chandrasekaran, 1973 ; Joseph & Vajravelu, 1971, 1974, 1975 ; Kumari & Subba Rao, 1976 ; Ramamurthy, 1971 ; Ramamurthy & Joseph, 1964 ; Ramamurthy & Sebastine, 1964, 1966 ; Sebastine & Henry, 1960 b ; Sebastine & Ramamurthy, 1961, 1964 ; Sharma *et al.*, 1974, 1974 ; Shetty & Vivekananthan, 1968, 1969, 1970, 1973, 1975 ; Subba Rao & Kumari, 1968 b, 1969, 1975 a, b, 1976 ; Subramanyam & Nayar, 1964, 1969), distributional records (Balakrishnan, 1964 ; Henry, 1965 a, b ; Chandrabose, 1973 ; Chandrabose *et al.* 1979 ; Chandrabose & Srinivasan, 1976 ; Ellis &

Swaminathan, 1969 b, 1975 a, b ; Henry *et al.* 1980 ; Joseph & Ramamurthy, 1961 ; Kammathy, 1963, 1968 b ; Kumari, 1968, 1972 ; Kumari & Subba Rao, 1973 ; Subba Rao & Kumari, 1967 b, 1968 c, 1970, 1971 a, b, 1972, a, b ; Subba Rao, *et al.*, 1973 ; Rao, 1969 ; Nair & Pandey, 1972 ; Shetty & Karthikeyan, 1976 ; Shetty & Vivekananthan, 1972 ; Srinivasan, 1973 ; Vajravelu & Srinivasan, 1973) and several notes (Chandrabose, 1972 ; Ellis, 1967 ; Henry, 1967 b ; Subramanyam & Henry, 1969 ; Sreemadhavan, 1969 ; Sreemadhavan *et al.*, 1968).

The National Orchidarium and Experimental Garden at Yercaud founded in the year 1963 is situated in the mixed sub-tropical and semi-evergreen forests of Shevaroy hills and provides scope for studies on orchid systematics, hybridisation and culture through introduction and acclimatisation (Rao, 1966, 1978 a, b ; Banerjee & Rao, 1978 ; Sharma & Rathakrishnan, 1971, 1978 ; Rathakrishnan, 1971, 1972). It has a collection of over 200 species of orchids. The injurious effects of sulphur dioxide on plants were recorded by Banerjee & Chaphekar (1978 a, b, 1980 a, b).

The State Flora analysis of Tamil Nadu and floras of Idukki, Dharmapuri, South Arcot, Nilgiris and Kanyakumarika are now under preparation. Studies on the ferns of Kerala, orchids of south India and on Indian Arundinellae (Poaceae), Burseraceae, Aizoaceae, Celastraceae, Asteraceae and Combretaceae have been taken up. Recently, the districts of Visakhapatnam, Coimbatore, Ramanathapuram, Trivandrum, Cannanore, Quilon and Palghat are being explored botanically for the preparation of district floras. A report on the flora of Silent Valley with special reference to its rare and threatened plants has been prepared.

13. The Western Regional Circle, Pune

The Western Regional Circle established at Pune in 1956, presently covers the States of Karnataka, Maharashtra, Goa and Laccadive & Minicoy islands. The herbarium of the Economic

Botanist (Bombay) at Pune was transferred to the Botanical Survey of India in 1956. Besides old collections of R. Graham, J. Gibson, J.E. Stocks, J.S. Law, N.A. Dalzell, D. Ritchie and others, there are several collections of the twentieth century by T. Cooke, G.M. Woodrow, G.A. Gammie, W.A. Talbot, E. Blatter, C. McCann, Indrajai Thakar, H. Santapau and others from this region. The gift from T. Cooke, out of his personal duplicate set of collections, formed the nucleus of the Pune Herbarium. It was enriched further by several enthusiastic collectors and by exchange or purchase. Since 1956, the herbarium is being maintained on modern lines (Puri, 1959). It now contains nearly 1,25,000 specimens.

During the early phase, extensive explorations were undertaken and later, some selected regions were taken up for intensive studies. G.S. Puri, S.K. Jain, R.S. Rao and A.S. Rao took the lead in botanizing the areas of Western Circle and also reported on medicinal plants, grasslands, soil conservation and land use planning and desert control.

The flora of Rajasthan, West of Aravallis (Puri *et al.*, 1964) is a significant contribution to the flora of Arid Zone. Puri and his collaborators published on medicinal ferns of western India (Puri & Arora, 1957), evergreen forests of Mahabaleshwar (Puri & Mahajan, 1960), dry deciduous forest of Pune (Puri & Patil, 1960), botany of Kerala (Puri *et al.*, 1959) and on various aspects of ecology and economic botany (Puri & Jain, 1958 a, b, c, 1959 a, b, c, 1960 a, b, c, d, e, f, g, 1961 a, b, c, 1962 a, b, c ; Puri *et al.*, 1960 a, b ; Jain & Puri, 1962).

S.K. Jain in addition to his work on the plants of western India presented accounts of vegetation of various other regions. The areas of Konkan, Sawaimadhapur, Yedshi forest at Ramling in Maharashtra, Mt. Abu and Dangs district in Gujrat were botanised by Jain (1959, 1960 c, 1961 b, 1962, 1963 d, k). The review on the floral composition of Rajasthan (Jain, 1970 b), Mt. Abu (Jain, 1966 g, 1967 a), Kutch (Jain, 1968 d ; Jain & Deshpande, 1960 ; Jain & Kanodia, 1960),

Thana district (Jain & Karmakar, 1960), Shahabad in Rajasthan (Jain & Kotwal, 1960 a, b), vegetation of Khandesh (Jain & Deshpande, 1964) and notes on western Indian plants (Jain, 1956 b, 1958, 1960 a, b, e, 1963 a, b, c, 1969 a) were also brought out. The members of Poaceae in Karnataka State were enumerated by Singh *et al.* (1976).

Studies on the distribution of trees in western and eastern India (Rao *et al.*, 1961) and on floristic patterns along the the Western Ghats of India (Rao, 1978), *Parthenium* L. (Rao, 1956), *Hyphaene indica* Becc. (Rao, 1963 d), flora of Kutch (Rao, 1970 a), flora of Biligirirangan Hills, Mysore (Kammathy *et al.*, 1967), flora of Pravarsangam area (Subramanian & Rao, 1961), plant records (Rao & Ahuja, 1968), identity and nomenclature of Indian plants (Rao, 1964 b ; Rao & Hemadri, 1970 a, b ; Rao & Ahuja, 1969), *Iphigenia* Kunth (Rao, 1972 b), *Hedyotis* L. in Maharashtra (Rao & Hemadri, 1973 a), new species of *Manisuris* L., *Blumea* DC. and *Pimpinella* L. (Rao & Hemadri, 1968 a, 1973 b, 1976), vegetation of Jodhpur (Rao & Kanodia, 1962, 1963), grasses of Mt. Abu (Kanodia & Rao, 1965), Devarayadurga forest of Mysore (Rao & Sastry, 1964) are notable contributions. The work on the family Commelinaceae by Rao and his collaborators has already been mentioned under the resume of Eastern Circle. Rao has completed his floristic study on Goa, Daman, Diu and Nagarhaveli (in ed.). The progress of angiospermic taxonomy in India was reviewed by Rao & Wadhwa (1971) and Rao (1973). Nomenclature and distribution of some plants of Maharashtra were discussed, and flora of Indore district, Madhya Pradesh was studied by A.S. Rao (Rao, 1963 a, b, c, 1964 ; Rao & Sastry, 1964).

Raghavan started with the chromosome survey (Raghavan, 1958, b, 1960 ; Raghavan & Arora, 1958, 1960 ; Raghavan & Rao, 1961 a, 1965 a) and published a few notes and new records (Raghavan, 1958 a, 1959, 1964 a, b, 1969, 1976 ; Raghavan & Wadhwa, 1970 a ; Jain & Raghavan, 1967 ; Raghavan *et al.*, 1973, 1980) and on new species of *Tarenna* Gaertn. (Raghavan,

1968), *Capparis* L. (Raghavan, 1972 ; Raghavan & Rao, 1965 b ; Rao & Raghavan, 1964 a, b, 1965), *Tephrosia* L. (Raghavan & Wadhwa, 1968 a), mosses (Raghavan & Wadhwa, 1968 b, 1970 b), nomenclature of *Vigna grandis* (Raghavan & Wadhwa, 1972) and a check list of plants of Gujrat (Raghavan *et al.*, 1981). Wadhwa issued lists of plants from Laccadive group of islands (1961) and of moss flora of Western Peninsula (Wadhwa, 1969, 1971). Notes on the nomenclature and botany of western India were published by several workers (Singh, 1972, 1978, 1979 b ; Singh & Nishal, 1969, 1971 ; Singh & Deshpande, 1973, 1978, 1979 ; Deshpande, 1961 ; Ansari, 1971 ; Ansari & Rao, 1973 ; Hemadri, 1968 a ; Billore, 1969 ; Billore & Singh, 1972 ; Kulkarni & Singh, 1973, 1979 ; Kulkarni & Wadhwa, 1973 ; Malhotra & Moorthy, 1971 a, b, 1973 a, b, c, 1976, 1978, 1980 a, b, 1981 b ; Janardhanan, 1963, 1965).

The flora of Yellapur, North Kanara (Patil, 1956), Harishchandragar (Billore & Hemadri, 1969), Saptashringi (Cherian & Pataskar, 1969 a, b), Chandrapura district, Maharashtra (Malhotra & Moorthy, 1971 c, 1981 a), Jamnagar (Malhotra & Wadhwa, 1973), additions to the flora of Mt. Abu and few other interesting observations (Kanodia, 1963 ; Kanodia & Deshpande, 1961 ; Kanodia & Reddi, 1964) and descriptions of some new taxa (Ansari, 1968 ; Ansari & Kulkarni, 1971 ; Wadhwa & Ansari, 1968 ; Ansari & Hemadri, 1971 a, b ; Ansari *et al.*, 1970 ; Deshpande & Hemadri, 1970, 1971 ; Hemadri, 1968 b, 1971 a, b ; Hemadri & Ansari, 1971 ; Hemadri & Billore, 1970 ; Billore & Hemadri, 1970 ; Kulkarni & Hemadri, 1974) deserve mention. Kamble & Ansari (1976) reported on the somatic chromosomes of *Urginea polyantha* Blatter. The annotated bibliography to the taxonomic botany of peninsular India classifies about 1,880 references (Karthikeyan *et al.*, 1981).

The Circle is presently engaged in flora of various districts of Maharashtra and Karnataka. The work done so far on the different districts of Maharashtra will be amalgamated into the State Flora. The State Flora analysis of Gujrat and flora

of Kutch are also nearing completion. Revisionary studies on Capparaceae, *Ceropegia* L. and on some genera of Poaceae are in progress. The collaborative project on botany and chemistry of *Iphigenia* Kunth indicates the possible use of *I. stellata* Blatter as a source material for colchicine industry in India (Ansari & Rao, 1973 ; Kapadia *et al.*, 1972). An Experimental Garden at Mundhwa near Pune, is being developed.

14. The Central Regional Circle, Allahabad

The Central Regional Circle which was established in the year 1962 at Allahabad, originally comprised of the areas of Rajasthan, Madhya Pradesh and south eastern parts of Uttar Pradesh. Consequent upon the creation of the Arid Zone Circle at Jodhpur, the Circle presently covers most of the areas of the State of Madhya Pradesh and south eastern parts of Uttar Pradesh. The Circle did not inherit any old herbarium, but some collections of the Central Botanical Laboratory were handed over to this new Circle. It has organised a herbarium out of its own collections and has at present about 45,000 specimens. Studies on the flora of Allahabad, Madhya Pradesh and Rajasthan were the main projects at hand and various districts were explored. The attached botanical garden at Allahabad is utilised for the cultivation and/or introduction of plants of horticulture, medicinal and academic interests. Studies on the Indian Pteridophytes were carried out by G. Panigrahi and his associates (cf. Cryptogamic unit).

G. Panigrahi continued plant collections in Uttar Pradesh and Madhya Pradesh, initiated by earlier workers (Jain & Saran, 1961 ; Patil, 1963 ; Panigrahi & Rajagopal, 1967 a, b, 1968 ; Singh & Mitra, 1964 ; Rajagopal & Panigrahi, 1965, 1966, 1968 ; Panigrahi & Saran, 1967, 1968 ; Bose & Panigrahi, 1968 ; Bose & Pandey, 1969, 1971 ; Rajagopal, 1965). Later on, various areas of Bilaspur, Raigarh, Bastar, Raipur, Shivpuri National Park of Madhya Pradesh, and Gonda and Mirzapur districts of Uttar Pradesh were explored (Panigrahi & Arora, 1965 ; Arora, 1968 ; Panigrahi *et al.*, 1966 ; Panigrahi & Verma, 1965 ; Panigrahi & Prasad, 1966 ; Panigrahi & Singh, 1967 ;

Panigrahi, *et al.*, 1969 ; Shukla & Panigrahi, 1967 ; Uniyal & Srivastava, 1978). Afterwards considerable collections from Madhya Pradesh were added (Sen Gupta & Lal, 1973 ; Murti, 1972, 1975, 1976 a, 1979 ; Pant & Hanfi, 1975). R.B. Majumdar was interested in Rajasthan flora and reported several new records from the area (Majumdar, 1969, 1971 a, b, 1976 a, b, 1977 ; Majumdar *et al.*, 1969). D.M. Verma contributed earlier on ecological problems (Verma, 1963, 1964 ; Verma & Srivastava, 1963) and later, shifted to the floristic studies on Madhya Pradesh, particularly on little known parts of the south eastern regions and to Rajasthan flora (Verma, 1977 ; Verma *et al.*, 1965). The studies on the grasses and sedges of Madhya Pradesh were conducted by G.P. Roy and Verma & Chandra (1981). The districts of Bastar, Damoh, Seoni, Raipur, Ambikapur, Raigarh, Rajnandgaon and Balaghat are being visited botanically. Schemes for survey of 7 additional districts have also been approved with a view to analyse the State Flora of Madhya Pradesh. A resume of botanical explorations and floristic studies in Madhya Pradesh was presented by Sen Gupta (1977). In collaboration with the Cryptogamic unit, Headquarters Organisation, a dictionary of genera of ferns and a census of threatened ferns and fern-allies of India are under preparation.

15. The Andaman & Nicobar Circle, Port Blair

Since 1959, the Botanical Survey of India is conducting explorations to these islands including one joint scientific expedition to the Great Nicobar island (Thothathri and Thothathri *et al.*, 1960-1977). Out of 230 islands, about 85 islands have been botanized. The Andaman & Nicobar islands Circle, Port Blair was started in 1972. It has been estimated that till the year 1972, the flora of these islands' comprises about 2,200 species. Several scientific papers covering 25 new species and 58 new records of distribution have been added thereafter (Balakrishnan, 1974 b, 1976 a, b, c, 1977, 1978 b, 1980 a, b ; Balakrishnan & Bhargava, 1977, 1978, 1979 ; Balakrishnan & Burtt, 1978 ; Balakrishnan & Chakraborty,

1978 a, b ; Balakrishnan & Nair, 1973, 1976, 1977, 1978, 1979 a, b ; Balakrishnan & Thothathri, 1975 ; Bhargava, 1978, 1980, 1981 ; Bhargava & Balakrishnan, 1978 ; Bhargava & Nair, 1979 ; Chakraborty, 1979 ; Nair, 1975, 1976 a, b, 1977, 1978 a, b, 1979 and others). Studies on the flora of Great Nicobar, Car Nicobar, Katchal islands, South and Middle Andamans and Little Andamans are in progress. The enumeration of Pteridophytes, Gymnosperms and Monocotyledonous plants of the Andaman & Nicobar islands is under preparation. An air-conditioned building houses the herbarium and laboratory of the circle. The herbarium holds over 20,000 specimens.

The writing up of a recent flora of this area is being taken up by the scientists in the Regional Circle. One arboretum-botanical garden is being developed at Dhanikheri Dam, near Port Blair to grow endangered and endemic species of the area.

16. The Arid Zone Circle, Jodhpur

The Arid Zone Circle at Jodhpur was set up on 7th February, 1972 and comprises the State of Rajasthan, certain adjoining arid districts of the States of Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Gujrat and Saurashtra. High temperature, low rainfall and desiccation leave little moisture to support the vegetation in this region. Since its initiation, studies on the flora of the districts of Tonk, Jaisalmer, Pali, Bikaner, Churu, Banswara, Kota, Jalore and Barmer in Rajasthan were undertaken regularly to supplement the data already collected on the area. New schemes for the floristic study of 9 more districts have also been approved. A complete flora of the whole of Rajasthan is urgently required. The data for the State Flora analysis of Rajasthan are being compiled regularly. Earlier works on the area by workers of the Botanical Survey of India are by Puri *et al.* (1964), Majumdar (1969, 1971 a, b, 1976 a, b, 1977) and Majumdar *et al.* (1969). Recently, Singh (1977 a, b, c, 1978 a) and Singh & Pandey (1979) contributed to the flora of Rajasthan and published on the host range of the genus *Cistanche* Hoffm. & Link.

Accounts of the genera *Eragrostis* P. Beauv. and *Cassia* L. in Rajasthan were presented by Roy (1976) and Singh (1976, 1978 b). The herbarium houses over 10,000 specimens.

17. The Sikkim Himalayan Circle, Gangtok

A new Circle for Sikkim has been started at Gangtok in December, 1979 to explore the plant wealth of Sikkim Himalaya. The station is functioning under a Systematic Botanist-in-Charge. Botanical explorations were undertaken to have representative collections from Kupup, Changu lake and other adjoining areas for building up the herbarium. The herbarium holds over 5,000 specimens of Himalayan flora.

18. The Arunachal Field Station, New Itanagar

The Field Station at New Itanagar, Arunachal Pradesh was started in the year 1977 with a Systematic Botanist-in-Charge and some skeletal staff. The vast unexplored areas of north-eastern India will thus receive adequate attention for a study of the flora of this botanically rich zone. The station is being organised and explorations are being arranged to have representative collections from Kameng, Subansiri and Lohit districts including Taney valley. This region was a part of Eastern Circle, and from 1955 to 1976, the Botanical Survey of India organised about 25 collection trips to different parts of Arunachal Pradesh. It has been estimated that about 3,000 species belonging to nearly 1,200 genera occur in this region. The herbarium has nearly 6,000 specimens from North East Frontier area.

19. The Publication Section

The Publication section constitutes an important wing of the Botanical Survey of India. The *Bulletin of the Botanical Survey of India*, containing information on the flora and vegetation of the country, aims primarily to record expeditiously the scientific results of the present activities of the Survey. The Bulletin has now run into 21 volume up to December, 1981.

The release of the reprinted old standard floras, like *Flora of the Presidency of Madras* by J. S. Gamble & C. E. C.

Fischer (1957, 1967), the *Flora of the Presidency of Bombay* by T. Cooke (1958, 1967), the *Flora of the Upper Gangetic Plain* by J. F. Duthie (1960), the *Botany of Bihar & Orissa* by H. H. Haines (1961) and *Bengal Plants* by D. Prain (1963) at a moderate price, removed a long felt need of the botanists in our country to accelerate further floristic studies in different parts of the country. Papers of monographic nature and large papers are published in the *Records of the Botanical Survey of India*. Some of the recent significant publications in the Records of the Botanical Survey of India are, *Flora of Khandala* by H. Santapau (Vol. 16, no. 1 : 1953 ; 3rd ed. 1967), the *Monograph on Indian Cucurbitaceae* by H. L. Chakraverty (Vol. 17, no. 1 : 1958), the *Flora of Rajasthan* by G. S. Puri *et al.* (Vol. 19, no. 1 : 1964), *Flora of East Nepal* by M. L. Banerjee (Vol. 19, no. 2 : 1966), *Exotic Flora of Kodaikanal, Palni hills* by K. M. Matthew (Vol. 20, no. 1 : 1969), *Materials for the Flora of Bhutan* by several authors (Vol. 20, no. 2 : 1973), *Flora of the Punjab Plains* (Vol. 21, no. 1 : 1978) by N. C. Nair and others.

Some special publications of the Botanical Survey of India are *Illustrations of West Himalayan Flowering Plants* (1963) and *High Altitude Flowering Plants of West Himalaya* (1975) by M. A. Rau, several fascicles of *Roxburgh's Icones* (Vols. 1-8 : 1964-1978), *Orchids of Bombay* (1966) by H. Santapau & Z. Kapadia, *Chapters on the History of Botany in India* (1965) by I. H. Burkill, *Phycologia Indica* (1969, 1973) by K. S. Srinivasan and *Flora of Jowai* (1981) by N. P. Balakrishnan.

The *Annual Reports of the Botanical Survey of India* published from this section from the year 1954-1955 onwards to date, contain much information about the activities and developments in the Botanical Survey. In order to provide information on highlights of activities of the Survey and to create interest in the conservation of endangered species, a publication called the 'Newsletter' of the Botanical Survey of India is also being issued since 1975.

Speedy publication of results of floristic activity for dissemination of information and utilisation of data is being achieved

through the activities of the Publication unit of the Botanical Survey of India. The unit has established wide international relationship through exchange of journals and other publications.

20. The Library & Documentation Section

20.1. The Library Unit

One of the significant difficulties encountered by Indian taxonomists in their work is the scarcity of scientific literature and references. To some extent and as far as recent publications are concerned, workers in India depend mainly on recent abstracting journals.

However, as regards old classical works in taxonomy, the Library of the Indian Botanic Garden, Howrah with the collections of rare and valuable books, has been of great help. A representative herbarium and an attached library arranged on the modern lines, are indispensable tools for taxonomic research. With this end in view, the two libraries of the Botanical Survey of India at Howrah *e.g.*, the Central Library and the Indian Botanic Garden Library, have been reorganised and merged into one. A reference library with all old and authentic literature on Taxonomy from pre-Linnean period to to-date has been set up to facilitate researches on plants of India. Microfilms of some important literature not available in India have been procured. The *Kew Index to Taxonomic Literature* (3 Vols.) and *Author and Subject Catalogues* (9 Vols.) of the holdings of the Library of the Kew Gardens have also been received. Xerox prints of some literature not available in India, are occasionally obtained from Kew and other libraries.

The libraries of Regional offices are being enriched regularly with recent arrivals and reprints of classical literature. The modern reprographic methods and microfilming are being utilised for procuring inaccessible literature for these Regional Circles. The *Union Catalogue of Books* (Das, 1967-1969 in 3 vols.) and *Serials* (Dutta, 1976) in the libraries of the Botanical Survey of India and Catalogues of botanical articles published

in the *Journ. Asiatic Soc. Bengal* and *Journ. Bombay nat. Hist. Soc.* (Das, 1969, 1976) are useful contributions.

20.2. The Documentation Unit

The Documentation unit of the Botanical Survey of India aims at collection of information from literature, its processing, dissemination to the scientists (both departmental and outside), preparation of bibliographies for families and genera, and providing reprographic services on request. Various disciplines of botany relevant to objectives of Botanical Survey of India are covered by the Documentation unit. Several thousands of index cards were compiled, processed and arranged by genera within a family for the Flora of India project.

The Documentation unit is provided with equipment for microfilming, xerography etc. Recently, a new Korestat Copier (Library type) has been installed in the Reprography section. Facilities of xerography and microfilming of literature are now being supplied to the Flora of India workers and also to other research scientists on gift, exchange or payment basis.

21. The Artist & Photography Section

The help of trained artists is essential in illustrating botanical works. Mention may be made of the beautiful colour plates drawn under the supervision of W. Roxburgh about the year 1800 A.D. Some selected plates of Roxburgh have been reproduced by the artists of the Botanical Survey of India in 8 volumes (Icon. Roxb., 1964, 1968, 1969, 1970, 1971, 1973, 1976, 1978). The series of paintings of economic plants in the Industrial Section, Indian Museum and *Illustrations of West Himalayan Flowering Plants* by M.A. Rau (1963) have gained much appreciation. The Regional Circles and other units of the Botanical Survey of India are provided with artists and photographers for assistance in scientific publications and other work.

22. The Technical Section

The Technical section attached to the Headquarters

Organisation also form an important unit of the Survey. It collects information and compiles performance budget regarding the activities of the Survey and co-ordinates scientific programme of work of the Botanical Survey. The Section attends to all technical matters relating to 43 Research Scholars and 7 Fellows and allocates funds for them to various units of the Survey and different universities. The Emeritus Scientists Scheme, matters relating to identification, nomenclature and such other advisory services, the exchange of plants, seeds and other plant materials with Indian and foreign institutions are also dealt with by this section.

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ERRATA

Page	Line		
10	14	Rao, 1963	delete
11	25	for Maiti <i>et al.</i> , 1969	read Maiti <i>et al.</i> , 1979
12	19	" Chaudhuri, 1975	" Chaudhuri, 1973
14	8	Nair, 1974b	delete
17	33	" Panigrahi, 1976b	" Panigrahi, 1977b
19	15	" <i>Fisocreochoiton</i>	" <i>Eisocreochoiton</i>
20	15	" Jain & Pal, 1973	" Jain & Pal, 1972
36	22	" Panigrahi & Kar, 1966b	" Panigrahi & Kar, 1966
42	19	" Henry <i>et al.</i> , 1979	" Henry <i>et al.</i> , 1978
42	24	" Sebastine, 1963	" Sebastine, 1968
63	1	" Arora, R. K. and K. R. Agarwal	" Arora, R. K. and K. R. Aggarwal
77	15	Basu, Debjani 1980 (1981) <i>et seq.</i>	delete the entry
97	29	" <i>Acacia planiformis</i>	" <i>Acacia planifrons</i>
98	1	" Daniel, P. and H. C. Chowdhury	" Chowdhery, H. J. and P. Daniel
98	4	" Daniel, P., G. Panigrahi and M. V. Viswanathan	" Panigrahi, G., P. Daniel and M. V. Viswanathan
108	10	" Deb, D. B. and R. M. Dutta. 1975b	" Deb, D, B. and R. M. Dutta. 1965b
122	21	" <i>Hypochoeris ridiata</i> L.	" <i>Hypochoeris radicata</i> L.
141	7	" Jain. S. K. and D. C. Pal. 1974	" Jain, S. K. and D. C. Pal. 1972 (1974)
147	25	„ <i>Corybus purpurues</i>	" <i>Corybus purpureus</i>
153	13	Lal, Jagdish	Lal, Jagdish

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167	4	for Mathur, R., Som Deva and B. M. Wadhwa	read Som Deva, B. M. Wadhwa and R. Mathur
184	1	" Nair, N. C. and S. R. Ghosh	" Nair, N. C. and V. J. Nair
193	19	" Nayar, M. P. and R. K. Kochpar	" Nayar, M. P. and R. K. Kochhar
271	25	" <i>Prosopsis glandulosa</i>	" <i>Prosopsis glandulosa</i>