

# ANNUAL REPORT 1985



**Tropical Botanic Garden and Research Institute**  
Trivandrum

**Cover**

***Phalaenopsis* inflorescence from a hybrid seedling  
cultured in the laboratory**

# **ANNUAL REPORT**

## **1985**

**TROPICAL BOTANIC GARDEN AND RESEARCH INSTITUTE**  
**( T B G R I )**

**TRIVANDRUM - 695 011, KERALA, INDIA**

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**Grams : TROPGARDEN**

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## Prefatory Note

We have come a long way from the thatched shed and the natural forest area allotted to the botanic garden just a little before two years.

The first electric lamp began to shine in January 1985 and six months later our biotechnologists and herbarium staff moved into the first building that was completed at the site. The Visiting Scientist's Guest House, now ready will temporarily be partly used to accommodate the taxonomists, the library and the administrative staff. This year also saw the establishment of a small meteorological station, commissioning of the orchidarium, several water tanks to grow aquatic medicinal plants, and a small green house. The first phase of the extensive irrigation and road system was also completed. Three kms of barbed wire fencing around the garden came up during this year. Negotiations for the purchase of the site for staff quarters have been completed and plans for the library and laboratory complex are finalised.

In research and garden development also there was considerable progress. The medicinal plant garden, with 650 species including several rare plants, is reckoned as one of the finest in South India. The first Indian *Index Seminum* was published and it was enthusiastically received by botanic gardens and plant lovers all over the world. Our seed bank has active exchange programme with all important international botanic gardens. Work on the flora of the garden is completed. Attempts for mass multiplication of two rare medicinal plants were successful and mass multiplication of aesthetically important orchids is continuing. Another 200 species of saplings were introduced into the arboretum. And during the period under review, a number of papers written by our scientists have appeared in national and international journals.

The garden is still not out of the woods. We need adequate space for laboratory work. Even when the main part of the Visiting Scientist's Guest House is occupied by our staff only 30% of our space requirements would be satisfied. Other facilities immediately needed include glass houses for cacti and succulents, a second orchidarium, green houses for ferns and rare plants and an artificial lake to grow aquatic plants. Staff quarters have to be constructed. These facilities would cost an estimated expenditure of Rs. 540 lakhs during the next five years which would be difficult to raise from the available sources. A more serious difficulty is the lack of adequate number of experienced scientists in the programmes we are undertaking.

During the last two years we were able to overcome many of the hurdles mainly because of the devotion of our staff and the strong support we received from the Government, the Executive Committee and the Governing Body. With these assets, and with the experience of solving many problems which appeared to be almost insoluble, we are looking forward with faith and optimism.

Trivandrum  
March 1986

**Professor A.N. Namboodiri**  
Director

## PLANT BIOTECHNOLOGY

### Regeneration of novel sexual and somatic hybrids

Orchid being a floricultural crop, its breeding lines and commercial hybrid varieties are the ones most frequently sought after and hence, there exists a continuing need to generate new and novel hybrids from time to time. Though the classical breeding methods are sure to add many more fascinating hybrids, the potential application of protoplast fusion technique for generating hybrids of untried combinations beyond the range of conventional breeding cannot be underestimated. Both somatic and conventional hybridisation research, therefore were given priority during the period under report.

With the addition of 700 plants belonging to ninety different hybrids of *Dendrobium*, *Vanda*, *Phalaenopsis*, *Aranda*, *Renantanda*, *Ascocenda*, *Aerides* and *Aranthera* and also the North-Eastern orchids, material for large scale experiments became available and hybridization in 57 different combinations among the orchids was attempted. The following crosses appeared to be successful leading to pod development.

♀	♂
1. <i>Dendrobium</i> Jacqueline Thomas	<i>Dendrobium chrysanthum</i> Lindl.
2. <i>Dendrobium</i> Ng Eng Choew	<i>Dendrobium chrysanthum</i> Lindl.
3. <i>Dendrobium</i> Toshiko	<i>Dendrobium chrysanthum</i> Lindl.
4. <i>Vanda tessellata</i> Hook.	<i>Renanthera</i> Kalson
5. <i>Vandanopsis</i> twinkle	<i>Vanda tessellata</i> Hook.
6. <i>Renantanda</i> Storiata	<i>Vanda coerulea</i> Griff. ex Lindl.
7. <i>Renantanda</i> Henry Truman	<i>Vanda coerulea</i> Griff. ex Lindl.
8. <i>Dendrobium</i> Tay Swee King	<i>Dendrobium</i> Ng Eng Cheow
9. <i>Vanda</i> Roberta Chun	<i>Phalaenopsis</i> Jane L. Kingsbury x Ph. Anne Thorne No. A 64
10. <i>Renanthera</i> Kalson	-do-
11. <i>Dendrobium</i> Intuwong	<i>Dendrobium crumenatum</i> Sw.
12. <i>Dendrobium</i> Tay Swee Keng	<i>Dendrobium ovatum</i> (Willd.) Krzl.

The green pods harvested from some of these crosses have already been subjected to ovule culture. The fertility of the seeds in some of the hybrid pods varied from 10 to 60 %; others were found to be sterile.

Methods for mass isolation of protoplasts and protoplast fusion products were developed. A number of orchids including the imported hybrids and the Indian North-Eastern species were found to be amenable for protoplast isolation. The yield of purified protoplasts varied from  $5 \times 10^4$  to  $1.7 \times 10^6$  per gram fresh weight depending on the source of the tissue used. By far, the petals were found to be the best source of protoplasts compared to leaf, root and protocorm tissues in majority of the tested plants.

Differences in pigmentation in leaf and petal protoplasts formed the convenient marker for protoplast fusion experiments. Fusion occurred at reasonable frequencies (5 - 15%) in a mixture (pH 6.2) containing 20% PEG (MW 8000),  $\text{CaCl}_2$  10mM and MES 10mM. Unlike fusions between protoplasts of other plants, orchid protoplasts fused in the PEG treatment with very few fusions occurring during the subsequent wash. Besides, high concentration of  $\text{Ca}^{++}$  was not required. Use of high pH solution was not desirable as they caused discoloration of the petal protoplasts. Usually 10 - 15% of the PEG treated protoplasts were heterokaryocytes when petal protoplasts of *Aranda* Noorah Alsagoff were fused with mesophyll protoplasts of *Phalaenopsis* Mandai Welcome No. 174 and *Dendrobium* Jacqueline Thomas. Clear differences in size provided an additional marker, when smaller yellow petal protoplasts of *Oncidium* Golden Shower were fused with larger purple petal protoplasts of *Phalaenopsis* Fire Water Ponce.

## Micropropagation of ornamental plants

### *Orchids*

Though micropropagation *per se* is not considered a true biotechnological research activity as it deals with the multiplication of the existing germplasm, it proves to be an indispensable and powerful tool to multiply a precious hybrid obtained in a conventional or somatic hybridization programme. Thus progress in classical breeding in orchids is frequently hampered by the time required to develop lines from the seeds and the green pod culture (embryo culture) greatly helps in

cutting down this waiting period. An active breeding programme initiated during this year was suitably backed up by green pod culture. Thus far, hybrid pods obtained from atleast half a dozen crosses among *Phalaenopsis*, *Cattleya*, *Vanda* and *Dendrobium* were cultured and seedling raised. Nutrient requirements of embryo culture and subsequent protocorm development and differentiation of plantlets are now finalised for these hybrids. During the year, 250 seedlings of *Cattleya*, 150 seedlings of *Phalaenopsis* and 175 seedlings of *Cymbidium* were transferred to community pots. More than 100 *Cymbidium* seedlings and about 500 *Cattleya* seedlings are ready to be transferred. In addition, routine subcultures of the flasks materials were also done. Approximately 3000 young seedlings of the above two hybrids are in culture.

Of the four species of *Cymbidium* viz., *C. giganteum*, *C. elegans*, *C. munronianum* and *C. eburneum*, embryo cultures of the first three are well established. Where as the embryos of *C. elegans* were the first to germinate (that is within a month after sowing), those of *C. munronianum* (an endangered species) took 3-4 months to show visible signs of germination in Knudson-C (KnC) medium supplemented with peptone (500 mg/l), pyridoxine HCl and nicotinic acid (0.3 mg/l each). In general, liquid media were found to be better than the agar supplemented ones. Seeds of *C. eburneum* did not germinate in any of the media tried. In addition to these, culture conditions were also established for at least half a dozen North-Eastern orchid species including the endangered blue vanda (*Vanda coerulea*). The results suggest that the rare and endangered species of orchids could at best be conserved and propagated through *ex situ* means. It is proposed to distribute the thousands of blue vanda seedlings now in our possession to interested institutions in the country. Also it is intended to raise mericlones of the healthiest and fast growing seedlings.

The embryo culture method was also extended to selfed plants of *Renanthera* Kalson, a blue flowered *Cymbidium* sp. and *Phalaenopsis* William Thurston in the later part of the year.

Protocorms raised from a mature capsule of a *Phalaenopsis* hybrid with striped petals have been multiplied in culture using suitable media combinations and now we have in our possession a good number of healthy seedlings in culture. As the preliminary trials with meristem culture of *Spathoglottis plicata* were encouraging mericloneing is now

extended to *Aranda* Noorah Alsagoff, *Aranda* Christine 130, *Vanda* Amy and *Vanda coerulea*.

*Vanda* TMA seedlings were observed to grow extremely well producing healthy root and shoot system when Gaviota-63 (G-63), a culture medium imported from Singapore was used. Since it is difficult to get continuous supply of this medium from abroad, two experiments were set up using *Cattleya* seedlings and *Vanda* seedlings of uniform size and growing under the same environmental conditions in an attempt to standardize a medium which could replace G-63. The seedlings were cultured on basal KnC and VW medium with the following additives: Myoinositol (100 mg/l), banana pulp (70g/l), peptone (500 mg/l) and MS vitamins i.e nicotinic acid (0.52 mg/l), pyridoxine HCl (1 mg/l) and thiamine HCl (0.12 mg/l). The results are awaited.

Preliminary experiments conducted to compare the beneficial effects of coconut haustorial extract (2%, 4%, 6%) as a complex additive in basal nutrient medium for orchid culture over that of tender coconut water (CW) (10%, 15%) have shown that the former induces healthy growth of the seedling than the latter. A preliminary note on this has been sent for publication (Abraham, 1986) to enable others to do further work with this.

### *Mussaenda*

Seeds of the cultivated variety of *Mussaenda* with each flower having five persistent white sepals were cultured on MS medium (basal) and MS + Kinetin (3 mg/l). This plant rarely bears fruit and is usually propagated by stem cuttings. A good number of seedlings of this plant could be raised aseptically.

### *Ferns*

Spores of nine genera of ferns-*Platyserium*, *Phlebodium*, *Dicksonia*, *Drynaria*, *Davallia*, *Marattia*, *Alsophila*, *Blechnum*, *Matteuccia*-were sown in Beneck's solution. Of these, gametophytes and sporophytes were formed in seven and transferred to community pots. All cultures are thriving well. The spores were received as gift from Kew Garden (UK).

### Micropropagation of Medicinal Plants

Mass multiplication of rare and endangered medicinal plants being a priority area of our interest, tissue culture studies of *Rubia cordifolia*

and *Coscinium fenestratum* were initiated towards the end of the year. Shoot, and leaf explants of the former showed profuse callus proliferation in MS medium supplemented with different combinations of Kinetin and 2, 4-D. Transfer of the calli to media containing NAA (0.05 mg/l) and Kinetin (0.5 mg/l) resulted in the differentiation of a few shoots and large number of roots. Work on *Coscinium fenestratum* has not yet yielded positive results.

### **Production of haploids through anther culture in Cassava**

Studies on haploid regeneration using anther culture technique were carried out with Cassava hybrid M-4 which now occupies nearly 70% of the area under Cassava cultivation in Kerala. Optimization of nutrient requirements and other cultural regimes has resulted in the development of multicellular bodies from the newly formed pollen. An inverse relationship between callus formation and multicellular body formation was evident. Ploidy check with the multicellular bodies and experiments on the induction of vegetative shoots from the callus and multicellular bodies are now being done.

### **Biochemical changes during orchid differentiation**

Apart from the plant biotechnological projects mentioned above, a research project on orchid differentiation which has an interface with clonal multiplication work, was also undertaken for the purpose of throwing more light on protocorm development from somatic tissues. Half a dozen standard nutrient media with varied combinations of hormones were tried for obtaining high frequency protocorm formation from tender leaf bases of a *Cymbidium* hybrid. Vacin and Went nutrient medium supplemented with 1.0 mg/l BA, 2.0 mg/l NAA and 20% CW was found to be the most suitable for this purpose. In this nutrient medium, well differentiated globular protocorms, 1-3 in number were formed within 30-40 days. In cultures kept in the dark, subsequent differentiation of the protocorms into shoots occurred after 50 days.

Biochemical changes in newly developing protocorms from the tender leaf bases were studied. Growth of the leaf segments (1-2 mm thick) determined on fresh and dry weight basis showed a sigmoidal pattern with a well pronounced linear phase between 20 and 25 days. The early lag phase (up to 5 days) was characterized by spikes in the endogenous concentrations of sugars, DNA, RNA and proteins all of which

markedly declined after 10 days of culture. The fall in the level of free sugars was evidently matched by increased synthesis of starch which showed 15 fold increase on the 20th day with a corresponding increase in free sugars on 25th day. Fall in the levels of amino acids after 25 days and enhanced synthesis of proteins after 30 days were some of the other salient features observed. The observation on the increased accumulation of starch up to 20 days and its breakdown thereafter was corroborated by histochemical analysis of the developing protocorms and amylase assay.

It is possible that two different phases of activities occur during protocorm differentiation in cultured leaf tissues, the early one (before 5 days) in response to the nutrient environment (increased synthesis of RNA and DNA, sugar up take, cell wall loosening and breakdown of cell wall polysaccharides) mostly for cell elongation and cell division purposes and a later one (after 20 days) specific for purposes of protocorm differentiation (starch synthesis and breakdown and increased protein synthesis). The possible relationship between these two phases of activities, in relation to protocorm development, if it exists is not clear from the results obtained at the moment. It is evident, however, that *Cymbidium* leaf culture forms a dynamic system for differentiation studies in orchids.

## PLANT TAXONOMY

### *Plant Introduction*

As a part of the plant collection programme, the taxonomy division undertook several exploration trips to the forest areas of Ponmudi, Agasthyarkoodam, Bonaccaud, Munnar, Silent Valley and some locations of Tamil Nadu. During these trips 600 living specimens belonging to 250 species and more than 1200 plant specimens for the herbarium were collected. The collections include *Aphyllorchis montana* (a rare saprophytic orchid), *Ipsea malabarica* (a rare orchid), *Anaphyllum beddomei* (an endangered plant), *Anemia tomentosa* (a threatened fern), *Silentvalleya nairii* (a newly described grass genus of Silent Valley), a rare species of *Eriocaulon* and a taxonomically interesting species of *Balanophora*.

Three hundred and thirty seven live specimens belonging to 159 species /varieties were brought from nurseries, institutions and indivi.

duals for the purpose of introduction in the garden. In addition 91 field numbers and 25 species of living plants were collected from Ootacamund. 75 species of orchids including the endangered species *Vanda coerulea* and *Cymbidium munronianum* were also added.

### *Herbarium*

The herbarium got official recognition this year with the acronym TBGT. This information has already appeared in the November 1985 issue of *Taxon* and will be added in the next edition of *Index Herbariorum*.

At present, the herbarium harbours 4700 mounted specimens and 9300 duplicates of vascular plants. Besides, rare and interesting collection of bryophytes, mosses and insectivorous plants, and a few samples of timber specimens are preserved and displayed as Museum specimens. Processing of recently collected 1200 specimens is under way. Identified specimens are arranged according to Bentham and Hooker's classification.

About 1700 mounted specimens, collected by Bourdillon and Rama Rao during the 19th century and the beginning of this century, obtained from the Central herbarium of the University College, Trivandrum, form part of the herbarium collection. These are duplicates of specimens still retained in the University College Central Herbarium, and form part of the complete collection transferred by the Forest Department in 1950 through the efforts of Professor A. Abraham. The transfer of duplicates to our herbarium was made possible by efforts of Mr. Rudra Gangadharan, Director of Collegiate Education and the hearty cooperation of Professor Jacob Joseph, Head of the Botany Department, University College. All the specimens, a good number of which were mounted during the nineteenth century, are in good condition. Another 860 specimens were added to the herbarium by courtesy of Professor G. L. Shah of Sardar Patel University, Gujarat which includes endemic species like *Erinocarpus nimmonii* Grah., threatened plants like *Eulophia ochreatea* Lindl. and many rare species from Maharashtra State which are not represented in the herbarium.

### *Preparation of the flora of the Palode site*

Final manuscript of the flora was completed after revising the entire handwritten and typewritten scripts of the work. Diagnostic and bracke-

ted keys were prepared for all the families. Now the book is in print and is expected to be released by the end of May 1986.

## GARDEN DEVELOPMENT

### *Arboretum*

An area of 15000 square metres adjacent to the patch of natural forest in the garden was set apart for the arboretum. About 600 saplings belonging to 200 species were added to the arboretum during the year, thus raising the total tree species introduced to the area to 300. The majority of these are raised from seeds or seedlings collected from forest areas while the rest were either purchased from nurseries or germinated from the seeds supplied by national and international botanic gardens. Important collections include 38 species of *Ficus*, *Canarium strictum* (the blackdamar tree), *Peterocarpus santalanus* (red sandal) etc. Monthly growth performance of all the saplings is recorded in a register.

The trees present in the natural forest area near the iron bridge side in the garden at Palode were provided with display labels containing information about family, botanical and local names with distributional records and economic importance of each species.

### *Germplasm Collection and Conservation*

There is widespread international concern about the loss of genetic resources of our plants. Therefore, greater emphasis was given to conservation of the plant wealth. The Institute worked in close liaison with the Threatened Plants Committee (TPC) of the International Union for Conservation of Nature and Natural Resources (IUCN) in different programme. The list of rare and threatened plants of India compiled by the international Threatened Plants Committee (TPC), U.K. was checked with our collections. Thirteen plants listed by TPC were found to occur in our garden area and their names and source of availability were communicated to TPC. We are also cooperating with the Botanic Gardens' Conservation Strategy of IUCN, in its attempts to collect information about the means adopted by botanic gardens throughout the world for the conservation of plant wealth.

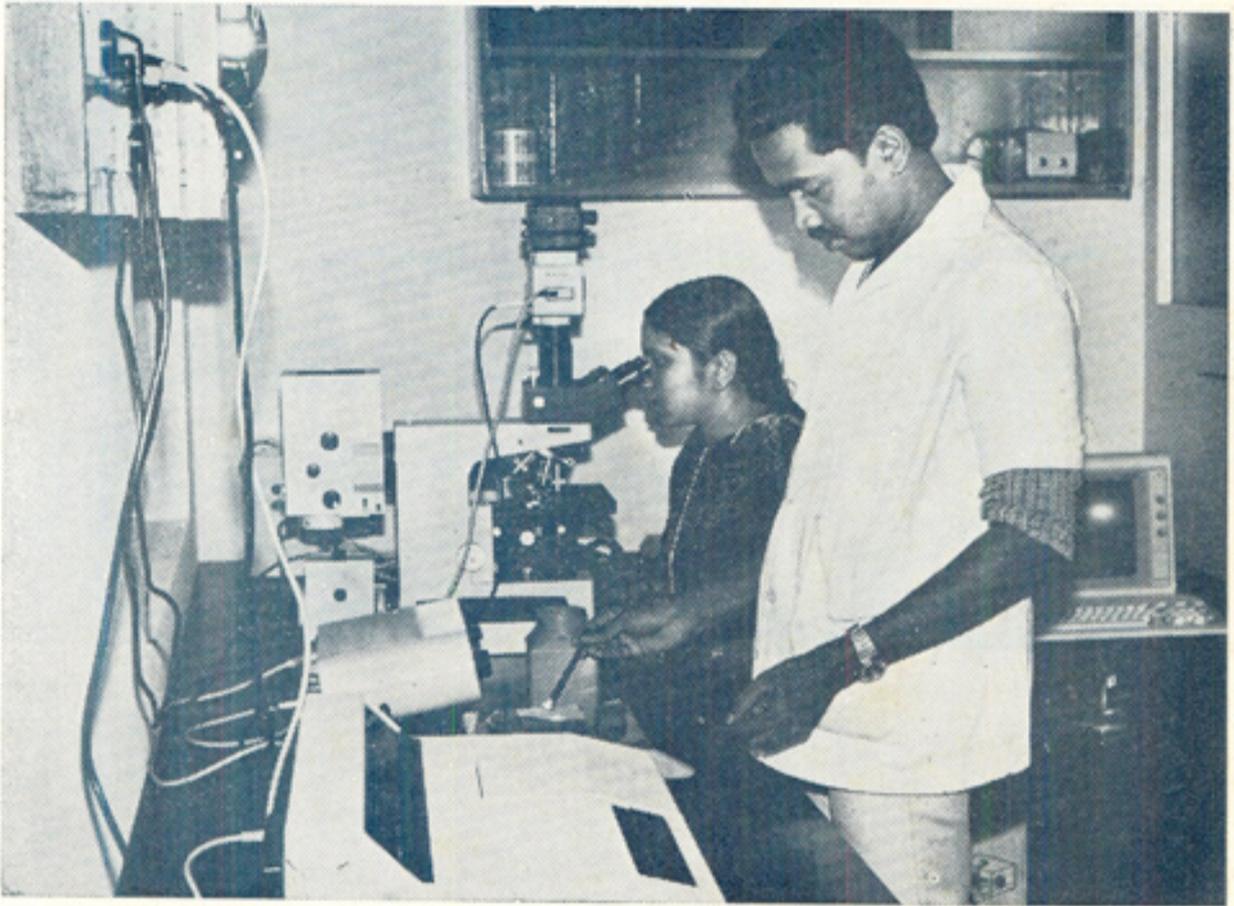
Steps were taken to establish modern facilities for longterm storage of seeds in the Institute. The International Board for Plant Genetic



Microbiology Laboratory



Circulation II



Inside the Biotechnology Laboratory





Air Conditioned Culture Room



Different stages of aseptic culture: (left) Protocorms and plantlets of the orchid *Cymbidium* (right) test tubes with young medicinal plants (*Kaempferia*)



Sanctuary for rare and endangered plants



A view of the terraced herbal garden

Resources (IBPGR) is being consulted for guidelines and technical advice on the erection and maintenance of seed storage facilities.

An *Index Seminum* consisting of 593 plant species coming under 120 families was printed and sent to other botanic gardens/institutions all over the world to enable exchange of germplasm. The index includes the flora of the garden site and established introductions, mostly medicinal plants. The response evoked by this publication was far beyond our expectation. Apparently our *Index seminum*, for the first time, supplied data on Indian plants to international organisations and this booklet initiated active seed exchange programme with important botanic gardens all over the world.

Actually, seed exchange programme started even before the publication of *Index Seminum*. Seed samples of 24 tree species were supplied to the Municipal Commissioner of Quilon, Kerala for the development of a garden at Quilon. Several species of medicinal plants were given for the Social Forestry Programme. Also seeds were supplied to the following international botanical gardens and institutions.

Royal Ontario Museum, Toronto, Canada

Botanischer Garten der Sektion Bioswissenschaften an der  
Martin - Luther Universität, GDR

Glasgow Botanic Gardens, Scotland

Hortus Botanicus, Guangzhou, China

Montreal Botanic Garden, Montreal, Canada

National Botanical Research Institute, Lucknow

Royal Botanic Gardens, Kew, UK

101 Saplings / seedlings of 34 families were purchased from Government Botanical Garden at Ootty and Sim's park, Coonoor and planted in the Garden. In addition, tree seedlings representing 10 families were collected from the social forestry nurseries in Trivandrum for introduction in the arboretum. Seed samples of about 200 species were obtained from the following sources:

Waimea Arboretum and Botanical Garden, Hawaii, U.S.A.

Botanic Gardens, University of Helsinki, Finland

Botanic Gardens, Queensland, Australia

Botanischer Garten, München, West Germany

Department of Botany and Faculty of Forestry, University of  
Toronto, Canada

Forest Research Institute and Colleges, Dehra Dun

J.L. Hudson, Seedsman, California, USA.

Royal Botanic Gardens, Kew, U.K.

### *Medicinal Plants*

Attempts to build up the largest germplasm collection of medicinal plants in South India continued. Four hundred species of herbals were collected during the year, raising the total living collection to more than 600. This was made possible by extensive field collection trips arranged to various locations in Kerala and Tamil Nadu. Domesticated plants include rare species like *Coscinum fenestratum*, *Kaempferia rotunda*, *Rotula aquatica*, *Commiphora mukut*, *Rubia cordifolia* and *Embelia ribes*.

Each plant in the garden is labelled, showing the botanical name, family, Malayalam name, Sanskrit name and its medicinal uses. This sort of labelling is resorted to enable the students and public to get themselves acquainted with the plants.

Additional facilities made in the medicinal plant garden include:

1. a small medicinal green house
2. a water tank for aquatic medicinal plants
3. a pond to keep collection of *Nelumbium speciosum*
4. a green house to preserve shade-loving plants.

A collection of aromatic plants is also being built up.

A medicinal plant herbarium is taking shape as part of the main herbarium. So far sheets of about 200 species have been prepared. In association with the Herbarium unit, medicinal plant section organizes a museum exhibiting officinal parts of the medicinal plants.

Seeds of medicinal plants in the garden are collected regularly and kept for raising plants in the garden and also for exchanging with other gardens and individuals. Last year, planting materials were supplied to the Social Forestry Wing of Kerala Forest Department and to the Pharmacognosy Department of the Government Ayurveda College, Trivandrum.

The activities of the Medicinal Plant Division are well known and our small staff have to cope up with ever increasing requests for material, exchange of material and identification of plants. The Indo-German collaborative project Ayurvedic and Tatas have approached us for consultancy, but it is felt that more preliminary work has to be done before taking up joint ventures that these organisations have in mind.

The Institute continued to receive the advice and assistance of Professor V.P.K. Nambiar and Ashtavaidyan N. S. Moosath, for development of the medicinal plant garden.

### *Ornamental Plants*

Plants of horticultural importance were collected locally and from nurseries and gardens in Bangalore, Ooty and Lucknow.

Altogether 240 different ornamental species were procured during the year. At present, Ornamental Plants Section harbours 250 endemic orchids, 800 imported orchid hybrids, 256 rose varieties and 368 taxa of other flowering and foliage plants.

### *Orchids*

A spacious orchidarium with platforms for the upkeep of potted orchids, facilities for the hanging ones and provisions for watersprays and shade was constructed last year. All orchids preferring partial shade have been shifted to this place. Now the orchidarium houses about 700 plants, belonging to different hybrids of *Dendrobium*, *Vanda*, *Aranda*, *Ascocenda*, *Renanthera*, *Aerides* and *Aranthera* brought from Singapore, in addition to 75 species of north-east Indian orchids and some species of local orchids collected during 1985. All the vandaceous hybrids which grow in bright sunlight are planted in open orchid beds.

### *Foliage plants*

During the year 88 taxa of foliage plants were added. Important collection include *Codiaeum variegatum* (20 var/cv), *Dracaena* (9 spp/var), *Acalypha* (7 spp/var), *Dieffenbachia*, *Coleus* etc.

### *Other Ornamentals*

152 taxa were added to this group which includes 40 species/cultivars of *Hibiscus*, 21 cv. of *Gerbera*, 36 cv. of *Dahlia*, 6 cv. of *Gladiolus*, 4 species of *Allamanda* and 7 species/varieties of *Ixora*.

## LIBRARY

### *Books and Periodicals*

During this year 616 books and bound volumes of periodicals were added to the Library. The number of Journals for 1986, for which payment has already been made, rose to 77 from 74 in 1985. In addition, periodical publications from 20 institutions, most of them international, were also received regularly.

### *Other Documents*

More reports, reprints and photocopies were added to the respective collections. 50 sheets of topographical maps of Kerala were also procured from Survey of India, Trivandrum. Steps have already been taken to buy some important herbarium collections in microfiche along with a microfiche reader. Preparation of an album of photographs at six-month intervals and building up of a colour slide collection of interesting plants and locations in the garden are also being done.

### *Services*

Circulation of books and periodicals, Current Awareness Service, Selective Dissemination of Information, Bibliography preparation and Photocopying documents for research purposes were continued. These services, which were hitherto confined to the City office were extended to the garden site at Palode also where some of the research divisions now work. The library continued to be intensively used by the staff and besides by students, research scholars, teachers and scientists from Kerala University, Agricultural University and mofussil colleges. A bibliography of articles and short communications related to Kerala flora was compiled. This will be of immense use when the project on 'Flora of Kerala' is taken up.

### *Outreach Programmes*

As a preliminary step to develop the Library into the Information and Extension Division, publication activities were also taken up. The first issue of the newsletter of the Institute, 'TROPIC GARDEN NEWS' is in press and will be released in January 1986. Memberships of the Botanic Gardens Conservation Co-ordinating Body, Royal Botanic Gardens, Kew, U.K. and American Association of Botanical Gardens

and Arboreta, USA were taken. Contacts were established with the Tropical Development and Research Institute (TDR), London, International Council for Research in Agroforestry (ICRAF), Nairobi, Kenya, International Board for Plant Genetic Resources (IBPGR), Rome, International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria, International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo Syria etc.

Short descriptions of the objective and work of the Institute have already appeared in the "World of Learning", Times of India Directory and Yearbook, and will be entered in the new edition of the Directory of Research Centres, published by Longman, London.

### *Museum*

In addition to the 1167 postal stamps of 'fruits and flowers' already available, another album containing 652 stamps of 'trees' mounted on 70 sheets was also secured. Steps are under way to display photographs and models depicting the various activities of Divisions of the Institute, in the Museum.

## **CIVIL WORKS**

After months of upsets, frustrations and procedural delays, 11KV lines were drawn from the distant Bharathanoor to the garden site and electricity was switched on to the installations in our garden in January 1985.

The distance from the city and the lack of basic amenities discouraged civil contractors to take up work at the garden site. Our first contractor who signed up for building a semi-permanent structure took an inordinately long time to complete the project. Electrification and sanitary connection also were delayed but finally the building with a large culture room, an instrument room, two laboratories and a herbarium was completed and biotechnologists and herbarium staff began to work here from July 1985.

Construction of Visiting Scientist's Guest House also had several teething troubles. There was no provision to pump water to the construction site and it had to be brought up in barrels in lorries. The newly put up road could not hold heavy duty traffic. The architect's services were discontinued by the time the foundation was completed and the

future of the project was in peril. However, our consultant engineers could do the design and the work was continued. The building may be commissioned in a few months and will temporarily house the taxonomy wing, the administration and the library, retaining part of the building for visiting scientists.

A pump house on the river bank was built and an overhead tank (58,000 litres) was constructed as a part of the extensive irrigation system covering the medicinal plant section and nursery area.

Earth work of widening and straightening the main road is over and metalling is in progress. The road on the periphery of the arboretum was improved and several secondary roads and foot paths were constructed in the arboretum, medicinal plant garden and natural forest patch No. I.

Construction of a storage tank and laying of pipes for supply of potable water to the laboratories were completed.

An orchidarium (100' x 30') with a water tank, raised platforms in the centre as well as along the walls for potted plants and provision for water sprays and partial shade was completed in April 1985.

A small meteorological station was established and recordings are regularly made from September 1985.

The security aspects of the garden were further strengthened by the construction of 3 km of barbed wire fencing along the boundary. With the 1 km of fencing completed last year the entire boundary of the garden except the river frontage is now protected.

## APPENDICES

## Seminars and Symposia

The 'TROPGARDEN FORUM' organised the following seminars in 1985.

<i>Date</i>	<i>Speaker</i>	<i>Topic</i>
19 January 1985	Dr Andrew M Greller Queens College New York	Bioclimatology of eight geographic zones in Sri Lanka
22 February 1985	Dr P.N. Nair Chief Conservator of Forests (Development) Kerala	Forests of the Western Ghats
12 April 1985	Mrs Asha S. Nair	Mass propagation of apple plants by tissue culture methods
27 April 1985	Dr T. S. Nayar	Potentialities of palyno- logy as taxonomic criteria

Professor A. Abraham, Chairman of the Executive Committee delivered the keynote address in the National seminar on 'the Biology, Conservation and Culture of Orchids' held at Chandigarh in April 1985.

## List of Publications

1. Abraham, A. 1985. New trends in orchid breeding. Proceedings of the National Seminar on Biology Conservation and Culture of Orchids. Chandigarh (in press)
2. Koshy, K.C. & Shah, G.L. 1985. *Ertocaulon dianae* var. *richardianum* Fyson in Gujarat State. J. Eco. Tax. Bot. 7(1): 213—214
3. Manilal, K. S. & Sathish Kumar, C. 1985. Ground orchids of Silent Valley tropical rain forest Proc. Nat. Aca. India 55 (B) 2: 51—65
4. Manilal, K.S. & Sathish Kumar, C. 1985. *Dendrobium panduratum* (Orchidaceae) a new record for India. J. Ind. Bot. Soc. 64 (2—2): 299—301

5. Manilal K. S. & Sathish Kumar, C. 1985. A review of researches on Indian Orchids. Abstract: Seminar on Biology Conservation and Culture of Orchids, Chandigarh: P. 1
6. Mii, M., Seení, S., Fowke, L. C. and King, J. 1985. The isolation and cultivation of protoplasts from all suspensions of a pantothenate-requiring auxotroph of *Datura*. *Can. J. Bot.* 63: 779-783
7. Namboodiri, A. N. and Meera Bhaskar, 1984. Pollen wall diffusates of *Chlorophytum* and their role in pollen germination. *Phytomorphology* 33:31-36
8. Nayar, T. S. 1984. Deletion of two erroneous records for Maharashtra State. *J. Eco. Tax. Bot.* 5 (1): 247-248
9. Nayar, T. S. 1984. *Sagina japonica* (Swartz) Ohwi—a new record for peninsular India. *J. Eco. Tax. Bot.* 5 (5): 1171-1173
10. Nayar, T. S. 1985. *Abelmoschus angulosus* Wallich Ex Wight and Arnott in the former Bombay Presidency and its collection after 73 years. *J. Bombay Natural Hist. Soc.* 82 (1): 233.
11. Nayar, T.S. and R. K. Kochhar. 1984. A new record of *Habenaria* Willd. for Maharashtra State. *J. Eco. Tax. Bot.* 5(4): 920
12. Sathish Kumar, C. 1984. A new species of *Oberonia* (Orchidaceae) from India. *Kew Bul.* 39(1): 121-122
13. Sathish Kumar, C. 1984. A new species of *Eria* Lindl. (Orchidaceae) from India. *J. Eco. Tax. Bot.* 5(2): 483-485
14. Sathish Kumar, C. 1984. *Robiquetia josephiana* Manilal and Sathish Kumar - a new orchid from India. *Orch. Rev.* 92 (1901): 293- 295
15. Sathish Kumar, C. 1985. Sri Lankan Orchids in Kerala, *Orchid News* 1(1)
16. Sathish Kumar, C. and Rasmussen, Finn N. 1985. A new species of *Cheirostylis* (Orchidaceae) from India. (Accepted for publication in *Nordic Journal of Botany*)
17. Seení, S. and Abraham, A. 1985. Studies on orchids at Tropical Botanic Garden and Research Institute, Trivandrum. *Orchid News* 1(1)
18. Seení, S. and Abraham, A. 1985. Screening of wild species and hybrids of orchids for protoplast isolation in ; Proc. Vth Asean Orchid Congress Seminar, 1984 Singapore ed. A N Rao pp. 23-27



Visiting Scientists' Guest House

**Visitors**

<b>Prof. Andrew Greller</b>	<b>Queens College, New York</b>
<b>Dr. David Cooke</b>	<b>First Secretary, British High Commission</b>
<b>H. E. Manfredo Maciotti</b>	<b>Ambassador, European Economic Community</b>
<b>Dr. P. N. Nair</b>	<b>Chief Conservator of Forests (Dev) Kerala</b>
<b>Dr. P. K. Gopalakrishnan</b>	<b>Member, State Planning Board, Kerala</b>
<b>Dr. C. A. Ninan</b>	<b>Professor &amp; Head, Department of Botany, University of Kerala</b>
<b>Dr. M. P. Nayar</b>	<b>Director, Botanical Survey of India, Calcutta</b>
<b>Dr. K. V. Sundaram</b>	<b>Adviser, Planning Commission, New Delhi</b>
<b>Mr. &amp; Mrs. J. Hanson</b>	<b>Minister, Cultural Affairs, British High Commission, New Delhi</b>
<b>Mr. &amp; Mrs. Alan Maley</b>	<b>British High Commission, Madras</b>
<b>Prof. M. S. Channaveeriah</b>	<b>Dean, Faculty of Science, Karnataka University</b>
<b>Dr. C. V. Subramanian</b>	<b>University of Madras</b>
<b>Dr. M. H. Marigowda</b>	<b>Retd. Director of Horticulture (Karnataka), Bangalore</b>
<b>Dr. V. S. Ramadas</b>	<b>Pro-Vice Chancellor, S. V. University, Tirupathi</b>
<b>Mr. M. S. Santiah</b>	<b>British Council, Madras</b>
<b>Dr. K. V. Ahmed Bavappa</b>	<b>Director, Central Plantation Crops Research Institute, Kasaragod</b>
<b>Dr. K. L. Chadha</b>	<b>Director, Indian Institute of Horticultural Research, Bangalore</b>
<b>Dr. Foja Singh</b>	<b>Scientist, Indian Institute of Horticultural Research, Bangalore</b>
<b>Mr. B. Somasekhar</b>	<b>Hon. Minister for Horticulture, Karnataka</b>
<b>Mr. P. Susheelan</b>	<b>Director of Agriculture, Kerala</b>
<b>Mr. L. Hanumaiah</b>	<b>Joint Director of Horticulture, Karnataka</b>
<b>Rev. K. M. Mathew</b>	<b>St. Joseph's College, Tiruchirappally</b>

<b>Dr. S. Vasudev</b>	<b>Chairman, State Committee on Science, Technology and Environment (SCSTE), Trivandrum</b>
<b>Dr. A. D. Damodaran</b>	<b>Director, Regional Research Laboratory, Trivandrum</b>
<b>Dr. K. Raghavan Nambiar</b>	<b>Professor, Engineering College, Trichur</b>
<b>Dr. V. K. Damodaran</b>	<b>SCSTE, Trivandrum</b>
<b>Dr. K. V. Kurien</b>	<b>SCSTE, Trivandrum</b>
<b>Dr. M. P. Parameswaran</b>	<b>Kerala Sastra Sahitya Parishad, Trivandrum</b>
<b>Mr. J. Venugopalan Nair</b>	<b>Kerala State Pollution Control Board, Trivandrum</b>
<b>Mr. V. Ramachandran</b>	<b>Chief Secretary, Government of Kerala</b>
<b>Dr. Harsh Gupta</b>	<b>Director, CESS, Trivandrum</b>
<b>Dr. T. R. Govindachari</b>	<b>Formerly Director of CIBA, Madras</b>
<b>Dr. Dagmar Jicinska &amp; Dr. M. N. Koncalova</b>	<b>Botanical Institute, Czechoslovak Academy of Science, Czechoslovakia</b>
<b>Prof. Awinash P. Bhatkar &amp; Dr. (Mrs) Helga Sirttertz Bhatkar</b>	<b>Department of Entomology, Texas A&amp;M University College Station TX 77843, USA</b>
<b>Mr S. Ananthakrishnan</b>	<b>Formerly Chief Secretary, Kerala State</b>
<b>Dr B.F. Blake</b>	<b>First Secretary, British Council, Madras</b>

**Administrative Division**

Shri M. K. Sankaranarayanan	Administrative Officer
Shri K. K. Kuttappa Kurup	Accounts Officer
Shri K. G. Ajithkumar	P. A. to the Director
Smt. S. Radhalekshmi Ammal	P. A. to the Accounts Officer
Shri Suresh Chandran	Assistant Gr. I
Shri Benno A. Fernandez	Assistant Gr. I (on leave)
Smt. C. Syamala	Accountant
Smt. V. Jayasree	Assistant Gr. II
Smt. A. Santha	Typist Gr. II
Smt. G. Subhadra	-do-
Smt. C. Gracy	Stenographer Gr. II

**Drivers**

Shri. M. Ramaswamy	Driver Gr. I
Shri V. Rajendran Nair	Driver Gr. II
Shri D. Mohanachandrakumar	-do-
Shri A. Salim	-do-
Shri R. Gopinathan Nair	-do-

**Others**

Shri R. Bhargavan	Helper Gr. I
Shri S. Chandran Chettiar	Helper Gr. II
Shri C. Sathyan	-do-
Shri B. Vijaya Kumar	-do-
Shri T. Mohana Kumar	-do-

**Engineers**

Shri K. I. Idiculla	Consulting Engineer
Shri K. C. Eapen	-do-
Shri P. P. Markose	Site Engineer

**Purchase Section**

Shri C. M. George	Purchase Officer
Smt. R. Sarala Devi	Assistant Gr. I
Smt. N. Rajalekshmy Ammal	Typist Gr. II

**Field Section**

Cherian P. Koshy	Garden Works Manager
Shri G. K. Udayadas	Garden Maistry
Shri P. Mony	-do-

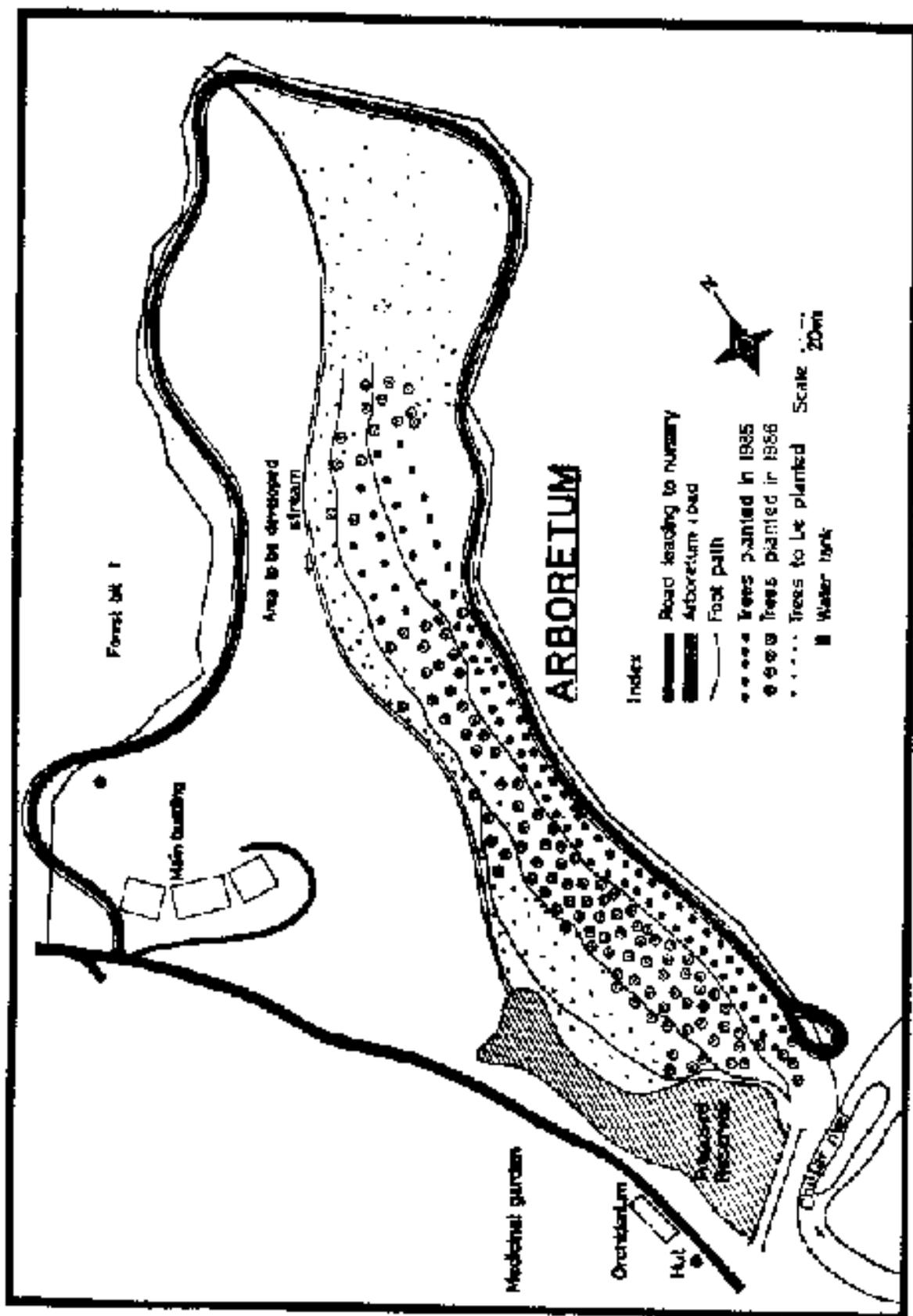
<b>Shri K. Selvaraj</b>	<b>Garden Maistry</b>
<b>Shri T. Bhaskaran</b>	<b>-do-</b>
<b>Shri J. Michael</b>	<b>Gardener</b>

*Security Wing*

<b>Shri Abdul Salam</b>	<b>Security Officer</b>
<b>Shri P. Chandrasekharan Nair</b>	<b>Security Guard</b>
<b>Shri P. Jain</b>	<b>-do-</b>
<b>Shri K. Ramachandran Nair</b>	<b>-do-</b>
<b>Shri A. Johnson</b>	<b>-do-</b>
<b>Shri K. Mohanan</b>	<b>-do-</b>
<b>Shri K. G. Vijaya Kumar</b>	<b>-do-</b>
<b>Shri S. Bhuvanachandran Nair</b>	<b>-do-</b>
<b>Shri S. Chandran</b>	<b>-do-</b>
<b>Shri Somasekharan Nair</b>	<b>-do-</b>
<b>Shri C. Stanly</b>	<b>-do-</b>

*Other Staff in City Office*

<b>Shri Lazer Joseph</b>	<b>Night Watchman</b>
<b>Shri M. Bhuvanachandran</b>	<b>-do-</b>
<b>Smt. R. Valsala Devi</b>	<b>Part-time Sweeper</b>





Introduced plants on cut terraces merge with the sylvan setting of the Garden.