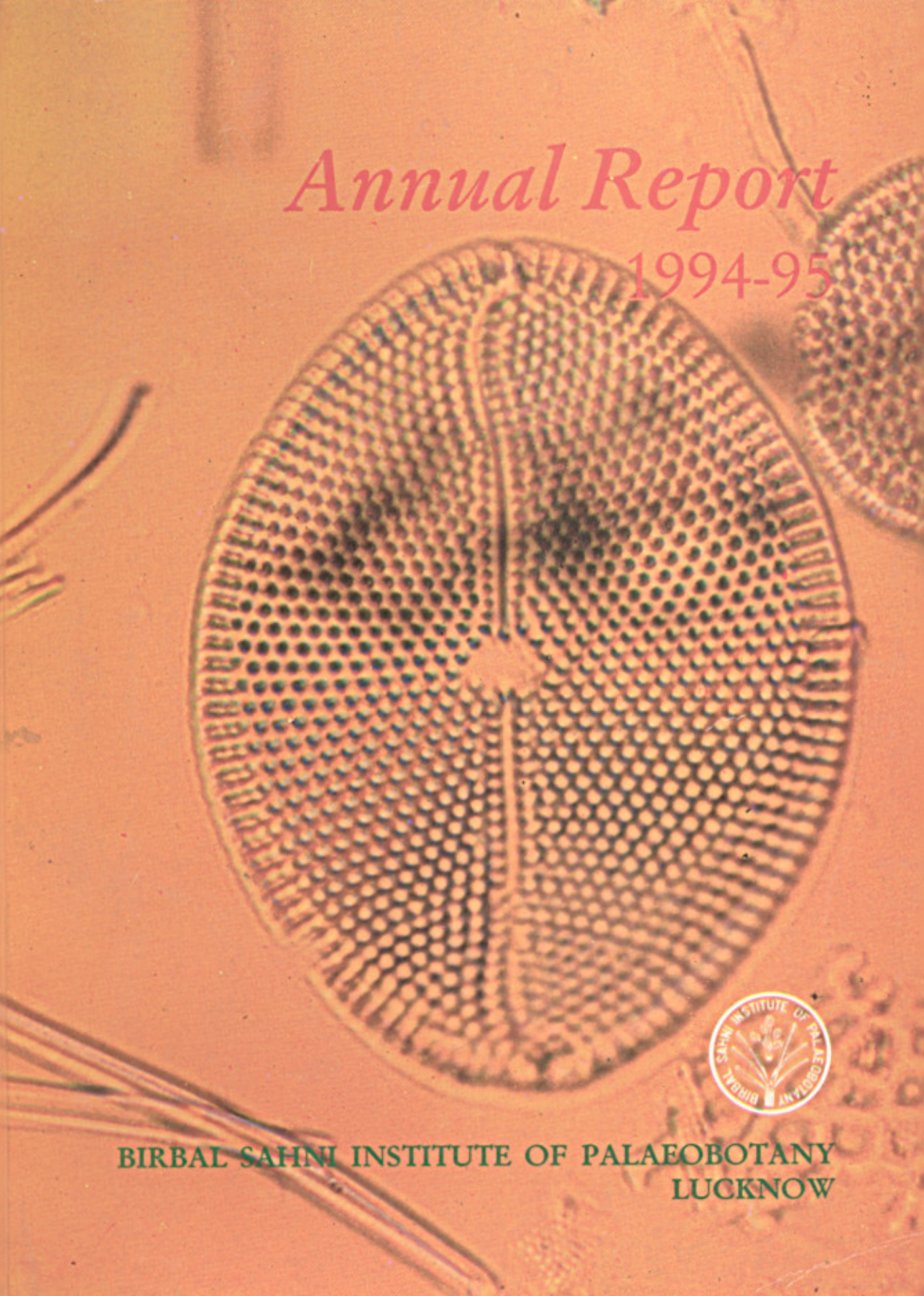
Annual Report

1994-95



BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY
LUCKNOW

पुस्तकालय

ANNUAL REPORT
1994-95

Front Cover Photo : A diatom–*Mastogloia splendida* (Gregory) Cleve from the Miocene sediments of Anderson Island, Andaman & Nicobar Islands.

Back Cover Photo : A Middle Miocene fossiliferous bed exposed in the foot-hills of Haridwar, Uttar Pradesh.

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We are grateful to the Department of Science and Technology, Government of India, New Delhi; to the Research Advisory Council and the Governing Body of the Institute for continued support.

Contents

Foreword

Palaeobotany— the science of fossil plants, is passing through a rapid change in relation to its effective bearing upon the areas of fossil fuel exploration, high resolution biostratigraphy, palaeoenvironment, palaeoclimate of the recent past, antiquity of early life, evolutionary patterns of floras, geosphere-biosphere system, and other related aspects. The utility of this science for the society has also come into the perview of major projects and planning. Such a gradual change in the perspective of palaeobotany requires ever-growing collaboration with allied sciences, utilitarian data-base, state-of-the-art techniques and laboratory support and development of purposeful consultancy system.

The research activities of the Institute during the year 1994-95 were continued within the frame-work of objectives laid down at the beginning of the current Five Year Plan, but at the same time, adaptation to the newer ideas were made to meet the demand of the change in its bearing. Efforts were made to motivate multidisciplinary collaborative work and to encourage sponsored projects on problems related to the recent trends. Laboratory support in terms of facilities were upgraded by installation of thin-section-cutting machine, remodelling of chemical- processing laboratories, rehabilitation of Herbarium, expansion of computer facilities and restoration of fossil repository. Consultancy facilities in the areas of Carbon-14 dating, palynology, biopetrology and training of personnel were provided to other organizations.

The research activities of the Institute are organized under 11 Projects with few to several programmes under most of the projects.

During the year 1994-95, the yearly target of each programme has been, by and large, achieved and many other scientific activities were undertaken in the direction of generation and dispersal of palaeobotanical knowledge, popularization of palaeobotany, training of personnel, and sharing of information. In the present Annual Report, details of each programme, with next year's target and other related efforts have been given.

The members of Scientific Programming Committee of the Institute — Drs G. Rajagopalan, K.P. Jain, H.K. Maheshwari, P.K. Maithy, R.K. Kar and Suresh C. Srivastava have helped in preparing this document. The valuable advice of the Research Advisory Council for research programmes and the unabated support by the Governing Body of the Institute for implementation are gratefully acknowledged. Drs Suresh C. Srivastava, Archana Tripathi and B.D. Singh, Sri B.K. Jain and Smt. V. Nirmala of Co-ordination Unit, Dr. J.S. Antal of Publication Unit and Mr S.C. Bajpai, Registrar helped in various ways to bring out this report. The support rendered by several colleagues in the Scientific, Technical and Administrative staff is thankfully acknowledged.

R.S. TIWARI
Director

Major Achievements and Activities of the Institute

The research activities of the Birbal Sahni Institute of Palaeobotany are aimed to analyse various aspects of plant life which existed in the geological past. The remains of the plants are found as fossils in the sequence of sedimentary rocks. These fossil plants indicate the antiquity, radiation and evolutionary pattern of early life, conditions of coal formation, origin and evolution of different plant groups — including the flowering plants, environment of deposition of various sediments, climate of the past and age and correlation of sedimentary deposits. Besides, the study of plant remains from Pre- and Proto-Historic culture, the analysis of tree-ring system in the modern *vis-a-vis* fossil plants and study of pollen from various lakes revealing the climate of the recent past are also included in the study of palaeobotany. It is thus clear that Palaeobotany has interaction with Botany on one hand and Geology on the other.

During the year 1994-95, some of the significant achievements carried out at the Institute for each Project and Programme are as given below.

Research Achievements

Early Life

Attempts to decipher the activities of life during Precambrian and Cambrian time (in 2500-500 million years old rocks) were continued. The study of black cherts containing stromatolites and other fossils from the Nagod Limestone Formation (800 million years old), Bhander Group of Khemri Kotar Hill, Satna District, Madhya Pradesh has revealed the presence of mat building biota belonging to cyanobacteria. It is a well known fact that the trails and burrows of living invertebrate animals are left on the clay or fine sand. These traces are in due course of time are fossilized and preserved as "trace fossils". Studies in this direction have shown two types of marks of surface trails in the Cambrian rocks which indicate the movements of arthropods and annelids. Diversified organic remains have also been recorded from Kolkur, Gundgurthi and Chennur villages, Bhima Basin, Karnataka.

Gondwana sequence and associated coals

The nature and habitat of plants which formed our precious coal reserves of Permian age (250-280 million years old) are being studied at the Institute. The studies of plant fossils from Auranga Coalfield, Bihar have revealed the presence of *Vertebraria* axes in the coal seam. The vertical position of these axes in the coal seams may indicate their *in situ* preservation.

The first appearance of flowering plants, i.e., angiosperms, is still an enigma for palaeobotanists. Our continued efforts to find out megafossils of angiosperms in the Early Cretaceous (100 to 140 million years old rocks) have revealed the presence of a fossil fruit,

named as *Buteacarpon*, in the intertrappean beds at Sonajori locality of Rajmahal Basin, Bihar. Its resemblance with the fruit of the modern genus *Butea* reveals the definite record of an angiosperm megafossil in the Rajmahal Formation.

The analysis of fossil spores, pollen and other organic material of Lower Permian Barakar coals from Talcher Coalfield, Orissa indicates that low energy, lacustrine conditions were prevailing during the deposition of these sediments (at about 270 million years back).

Evolution of life is a continuous process in nature which has been operative from the beginning of life on earth through millions of years. The study of characters of various fossils found in different geological ages unfolds the mystery of evolution in plant life. In one of such studies when the bladders of modern conifer pollen, which are hollow, were compared with fossil pollen of similar configurations it was found that this character initiated at about 250 million years back.

The study of spores and pollen found in the coal seams is an important area of research at the Institute. In search of new coal reservoirs, the organisations like Geological Survey of India and Mineral Exploration Corporation of India, are having extensive drilling programmes in virgin areas. The determination of age of the coal-bearing horizons found in these bore-cores is an essential part for further exploration and exploitation of this important fossil fuel. The palaeobotanical analyses of spores, pollen and other organic material found in these core material of several bore-holes from Godavari Basin, Andhra Pradesh, Panagarh area in West Bengal, Rajmahal area in Bihar, Talcher Coalfield in Orissa, and Sohagpur and Pachmarhi areas in Madhya Pradesh have been carried out and the age and correlation of assemblages found in the coal-bearing sequences of rocks have been suggested.

Quality and grade of Indian coals and lignites

The microscopic study of coal pellets under fluorescent light reveals certain characters of coals/lignites which are helpful in determining their quality and grade. This is one of the important techniques for which the expertise has been developed at the Institute. In continuation of our efforts to analyse the Indian coals/lignites, the studies were extended to the Hura Coalfield, Bihar and Panandhro lignitefield, Gujarat.

Such investigations were also carried out on bore-core samples from Chuperbhita Coalfield, Rajmahal area, Bihar and Koyagudem area, Godavari Basin, Andhra Pradesh to assess the gelification index of coals. A critical evaluation of published literature on the reactivities of certain components during carbonisation of the Indian Gondwana coals has also been made.

Flowering plants of the past and palaeoenvironment

The plants which bear flowers belong to the most recently evolved group in the history of plant kingdom through time. They are supposed to have appeared during Early Cretaceous, i.e., about 120 million years back, and dominated the scenario of the world

vegetation during the last 60 million years. The quest for understanding the origin and diversification of flowering plants is one of the important areas of research in palaeobotany.

During the year attempts were continued to study the varied types of fossil pollen which belong to flowering plants. The study of subsurface sediments near Kapurdi and Jalipa near Barmer, Rajasthan reveals striking resemblance with Matanomadh Formation of Kutch in its pollen content. A Palaeocene-Eocene age (about 55 million years back) has been suggested for this pollen flora. This assemblage indicates a low-land, fresh-water swamp-type environment of deposition, with water edge and coastal elements.

In order to build up the model of vegetational changes through time, sequence of rocks are analysed for the types of pollen found in them. Such a study was conducted from Kalakot area, Jammu where three characteristic zones of pollen assemblage have been identified which are correlated with those described from Kalka-Simla and Banethi-Bagthan area of Himachal Pradesh. The composition of spores, pollen and other plant microfossils reveals a shallow marine environment of deposition for the sediments of Subathu Formation.

Well-preserved flowers are rarely found as fossils. The search of such fossils from the Palaeocene (55-65 million years old) sediments of Barmer, Rajasthan and Makum Coalfield, Assam has resulted in the finding of spike-like male flowers of *Nipa* palm. This has a bearing on the past distribution of palms on the Indian Peninsula.

Pollen analysis of sedimentary core from Berijam Lake, Palni Hills, Tamil Nadu has revealed three vegetational stages. Phase I (20,000 to 16,000 years before present) records the existence of grassland; Phase II (16,000 to 4,000 years before present) reveals the appearance of herbaceous plants associated with Shola forest, with decrease in grasses and amelioration of climate to warm and humid; Phase III (4,000 years before present till date) indicates increasing cold and decreasing humid climatic regime.

Similar studies on fossil pollen recovered in the bore-core from Sadanand area, Mahanadi delta, Orissa have deciphered the occurrence of distinct transgression and regression of sea at 40,000 years before present in this region. The age of these events has been determined by the C-14 method at the Carbon-dating laboratory of the Institute.

Distribution of plant fossils and geography of the past

During the remote past, the Himalayan region of the present time was occupied by a sea — named as Tethys. The plant fossils found in the Tethyan Himalaya relate the story of floral affinity with mainland Indian Peninsula on one hand and the Middle East-Angara-China on the other. Relationship of floras also reflects the geographic positions of various regions during the geological past.

There are several programmes in which the sediments of Himalaya are investigated for plant fossils. Some of such studies undertaken during the year have revealed that the spore and pollen flora from Niti, Spiti and Kashmir Himalaya had a close affinity with the floras of Gondwana during Permian and Triassic time, i.e., about 220-270 million years back.

It has been found that Tulsi (*Ocimum*) was existing at about 50 million years back on the Indian subcontinent. The Early Eocene sediments from Kuchaur - Benia area, Bikaner District, Rajasthan have yielded hexacolpate pollen which resemble the pollen of Tulsi (*Ocimum*). Further researches may throw light on the distribution of this plant in other parts of the peninsula.

The study of plant megafossils collected from the Siwaliks of West Bengal, Uttar Pradesh and Nepal indicates the prevalence of tropical conditions with plenty of rainfall at the time of sedimentation. Similarly, the plant remains collected from Northeast India also reveals tropical conditions with high precipitation.

Phytoplankton stratigraphy

The study of fossil planktonic assemblages in the marine sedimentaries is an important aspect of oceanography modelling of the past. In this area of research, the study of dinoflagellate cysts from the Cretaceous/Tertiary of Meghalaya and East Coast petroliferous basin has been continued.

The occurrence of Early Miocene nannofossils in volcanogenic sediments of Lacum Point Section of Havelock Island, Andaman and Nicobar Islands suggests an assignment of assemblage to Nannofossil zone : *Helicosphaera ampliaperta* (NN4) which is an important oil-bearing horizon in South-east Asian basins. This also marks an event matching the opening of Andaman Sea.

Data on fossil diatoms and silicoflagellates from Anderson and Interview islands have been compiled.

Climate of the recent past

In response to the yearly seasons, characteristic growth rings form in the tree trunks. These tree-rings are the chronometers of climatic changes which have occurred during the life of a tree. It has been found that a good correlation between tree growth and summer precipitation exists in the master chronology (1872 to 1989 AD) developed for Teak (*Tectona grandis*) from Korzi, Andhra Pradesh.

Studies on the age determination by C-14 dating and that of the climate by pollen analysis were carried out on the Quaternary sedimentary profiles from Himachal Pradesh. This investigation has indicated that a cold arid climate was prevailing at about 1,900 years before present in the area of study.

Plant remains from Pre- and Proto-Historic sites

The archaeological sites are the treasure houses of plant remains in the form of carbonized seeds, fruits, wood-charcoals and other parts. The study of these remains — known as Archaeobotany, deciphers agricultural practices of a particular culture, and interaction of pre-historic man with floral wealth of that time. The Institute's programme concerning archaeobotanical researches has brought out interesting results. The botanical remains recovered from Banawali, district Hisar, Haryana demonstrate a rich and varied plant economy of Pre-Harappan and Mature Harappan communities, from 2,750 to 2,000 B.C.

Crop remains recovered from Pre-Harappan period (2,750-2,500 B.C.) include barley, wheat, jwar, gram, pea, lentil, til, etc. In the Mature Harappan period (2,500-2,000 B.C.) rice, moong and date are additionally found.

From the same site, discovery of a carbonized sample having components of herbal shampoo — *reetha, shikakai* and *anwala* (2,750-2,500 B.C.), suggests that the Pre-Harappan communities in India knew the properties of these plant products.

Other Activities

During the year, 60 research papers and 30 abstracts have been published and 73 papers were submitted for publication. Twenty research papers were presented in the National and International conferences. This year, 28 scientists were deputed to conferences in the country, 9 scientists to foreign International conferences. In the Institute, 7 lectures were delivered by the scientists from other institutions, while 24 scientists of the Institute delivered lectures in other organisations.

Distinguished visitors in the Institute's Museum (from left to right–Professor C.V. Subramanian, Professor Satish Dhawan, Professor U.R. Rao, Professor K. Kasturirangan and Dr R.S. Chaturvedi).

A view of the Institute's stall at 82nd Indian Science Congress Exhibition, Calcutta.

Under the In-House-Training programme for computer training, 49 members of the Institute were trained in three batches; eight members of Geology and Botany Departments, Lucknow University, Lucknow were also invited for the training. A geological excursion was organised by the Institute for studying the geomorphological and sedimentary features in the catchment area of Gomti River and around Lucknow.

Technical assistance has been provided to various universities and organisations for palynological dating of samples, scanning electron microscopy, petrology, and radiocarbon dating. The herbarium facilities have been provided to various institutes, colleges and universities of the country. About 600 samples have been collected for the Herbarium, which include plant specimens, fruits and seeds. Under a special programme — Palaeobotany for Education, several specimens of fossil plants were sent to various educational institutions in the country. Scientists from USA, UK, South Africa, West Indies, France and

Sri Pranab Mukherjee, Minister for External Affairs, Government of India showing keen interest in the exhibits.

Hungary visited the Institute's Museum. Besides, several other distinguished visitors and members of educational institutions in the country also visited the Museum. During the year, forty-five field excursions were undertaken by the scientists of the Institute and 2,106 specimens and 5,294 samples were collected from 127 localities. This collection shall be taken up for palaeobotanical investigations in the next year, i.e., 1995-96.

Exhibitions were arranged by the Institute at the 82nd Indian Science Congress, Calcutta and at the Regional Science Centre, Lucknow on the National Science Day, on the themes "Lab to Man" and "Science for Health", respectively. On the occasion of National Science Day, a Quiz Competition was organised in collaboration with the Regional Science Centre, Lucknow and prizes were distributed to the winners. About 600 students of 10 educational institutions visited the Institute on this occasion.

The Institute has published numbers 2 and 3 of Volume 42 of the journal — The Palaeobotanist, and the Annual Reports for the year 1993-94, both in English and Hindi. A special publication on "Coaliferous fossil fuel resources of India : Parameters of studies in palynology and biopetrology" is in process.

A state-of-the-art machine for thin-sectioning of rocks comprising plant fossils has been installed; this facility shall cater the needs of our departments who require finely finished sections for their study.

During the year 1994-95, the Electronic Data Processing Unit has acquired a number of HCL-HP machines. Now the total number of systems installed in the Institute is 25, including nine ATs (3 486DX/33 & 6 486SX/25). Different softwares, viz., COREL,VENTURA 4.2, MS Windows 3.1, and FoxPRO 2.6 have been procured which will enhance the use of computer in publications and other developmental works.

Under the programme of consultancy services on palynology, biopetrology and radiometric dating, the facilities have been provided to eight organisations.

The Founder's Day was celebrated at the Institute on 14 November, 1994 with floral tributes at the "Samadhi" of Professor Sahni. On this occasion, the "24th Birbal Sahni Memorial Lecture " and " 40th Sir Albert Charles Seward Memorial Lecture" were delivered by Professor B.M. Johri, Scientist Emeritus, Botany Department, University of Delhi and Dr M.A. Rau, Mysore, Former Deputy Director, Botanical Survey of India, respectively.

Besides scientific activities, the Institute celebrated the National festivals — Independence Day and Republic Day, with great enthusiasm. On these occasions indoor and

Pushpanjali at Professor Birbal Sahni's Samadhi.

On Founder's Day Function—from left Dr K.P. Jain, Dr M.A. Rau, Dr R.S. Tiwari, Dr O.P. Agrawal (Chief Guest), Professor B.M. Johri and Dr G. Rajagopalan.

outdoor games, and cultural programmes were organised by the Staff Welfare Committee. The staff members and their families took part in these functions.

The Nagar Rajbhasha Karyanvayan Samiti has given a "Certificate" to the Institute for the year 1993-94 for doing commendable work in Hindi. On the occasion of Hindi Diwas, several competitions like debate, essay writing and Hindi typing, etc., were organised and prizes were distributed to the winners.

The Government of India appointed the Fourth Review Committee for the Birbal Sahni Institute of Palaeobotany. It consisted of Professor W.G. Chaloner as Chairman, Professor R.A. Spicer, Professor K.S. Valdiya and Dr M.A. Rau as Members, and Sri Ashok Harnal from the Department of Science and Technology, Government of India as Secretary. The meeting of the Committee was held during 16-21 January, 1995. The Committee vis-

On Founder's Day Function—from left Dr K.P. Jain, Dr M.A. Rau, Dr R.S. Tiwari, Dr O.P. Agrawal (Chief Guest), Professor B.M. Johri and Dr G. Rajagopalan.

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Saraswati Vandana.

ited various departments/sections/units of the Institute, had meetings with various cadres of the Institute's staff and gone through various documents pertaining to the history, development and achievements of the Institute. Future plans of the Institute were also discussed in detail. The recommendations of the Review Committee and the decisions of the Governing Body are being implemented.

The total strength of the Institute Staff is one hundred ninety, out of them eighty-four are scientists and rest include technical and administrative staff members. Seventeen appointments and eighteen promotions have been made during the year. One staff member retired from the service.

The Institute has lost a young member, Sri Rajendra Kumar, Peon, after a prolonged illness.

On-Going Efforts : 1995 - 96

During the year 1995-96 most of the programmes already identified under different projects will continue. The efforts on the investigation of following aspects will be continued.

The macro- and microbiota representing early life forms will be studied in Bainkuiyan and Bhima Basin. The work on calcareous algae from Bagh beds and Tiruchirapalli District shall be completed. The study of plant fossils from Auranga, Jharia, South Rewa Basin, Raniganj, Karanpura, Bokaro and Talcher coalfields; and Rajmahal and

Chief Guest—Dr O.P. Agrawal, accepting the flowers from Dr R.S. Tiwari, Director, BSIP.

Professor B.M. Johri accepting the flowers from Dr R.S. Tiwari, Director, BSIP.

On Independence Day celebrations a baby presenting her song.

Gangapur beds is to be continued for building-up the floras through ages. The investigations will help to understand the evolutionary lineages and significance of plant fossils in stratigraphy. The ultrastructural studies of plant parts — cuticles, seeds, megaspore, etc. are also planned which will facilitate the taxonomic placement and also tracing the affinity with the parent plant group. The efforts for palynodating of coal-bearing sediments in Rajmahal, Panagarh, Deocha-Pachami areas, Raniganj, Sohagpur, Pali-Parsora, Tatapani-Ramkola, Kothagudem and Satpura Basin of peninsular India are to be made which have a bearing on coal exploration. Studies on Spiti Himalaya, peri-Gondwana and Arunachal Pradesh will be carried out to correlate the marine and non-marine palynological assemblages as well as plant megafossils. Such study has immense value for chronostratigraphy of non-marine sequences.

Cenozoic vegetation and plant biogeography are planned to be studied in the Deccan Intertrappean sediments in Madhya Pradesh and also in the Tertiary sediments from Assam, Bihar, Bengal, Kerala, Rajasthan, Himachal Pradesh, Uttar Pradesh and Gujarat. Likewise, the studies of microfossils, i.e., phytoplankton are to be continued for their biostratigraphical aspects in Cauvery Basin and Andaman and Nicobar islands.

The flora and vegetational pattern in Quaternary sediments will be studied in Silent Valley, south India, Spiti Valley, Himachal Pradesh and Garhwal Himalaya. Studies in the mangrove vegetation from Chilka Lake, Mahanadi delta are to be continued. The efforts will be made to develop climatically responding tree ring chronologies. Analysis of the

archaeobotanical remains from Kushan Period (100-300 A.D.) at Ludhiana, Punjab; Pre-Harappan and Mature Harappan cultures (2300-1700 B.C.) at Kaithal, Haryana and 600-200 B.C. old site at Kudan, Nepal will be continued. The isotopic analysis on the deposits of Gangetic plain for dating of flood plain, coastal and lake deposits are to be continued.

Under the project Geobotany, efforts will be made for installation of Atomic Absorption Spectrometer to facilitate the analysis of material collected last year. The studies under a project on Palaeobiochemistry, the plant fossils from Garhwal Himalaya are to be taken up.

Besides on-going programmes, some new programmes have been proposed in the Institute. Similarly, collaborative programmes on mutual scientific support basis, with Geological Survey of India, Mineral Exploration Corporation Ltd. and Coal India Ltd. will be undertaken. This will enhance the multi-Institutional collaboration in our projects. Apart from the research programmes, emphasis will be given to the In-House Seminars for young scientists, training course in geology for non-geologists, generating computer database in various disciplines and writing of popular articles to popularise palaeobotany amongst the common man.

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International Geological Correlation Programmes

IGCP Project no. 237 : **"Floras of Gondwanic continents"**
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Member, National Working Group
H.K. Maheshwari
Co-convener, National Working Group

IGCP Project no. 303 : **"Precambrian-Cambrian events stratigraphy"**
P.K. Maithy
Member, National Working Group
R. Babu
Member, National Working Group

IGCP Project no. 320 : **"Neo-Proterozoic events and resources"**
Manoj Shukla
Corresponding Member, International Working Group

IGCP Project no. 329 : **"Palaeogeographic and palaeoecologic evolution of Paratethyan basins during Neogene and their correlation to global scales"**
R.K. Saxena
Member, National Working Group

IGCP Project no. 359 : **"Nonmarine Triassic"**
R.S. Tiwari
Member, International Working Group
Vijaya
Member, International Working Group

Lectures Delivered

By Institute's scientists

R.S. Tiwari

— "*Concepts, potential and prospects of palynology*", U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow (A series of two lectures).

— "*Palynoevent biostratigraphy in Gondwana sequence*", Botany Department, Allahabad University, Allahabad.

K.P. Jain

— "*Fossil dinoflagellates and their significance in geological exploration*", U.G.C. sponsored Refresher Course, Department of Geology, University of Lucknow.

H.K. Maheshwari

— "*Palaeobotany : An introduction*", U.G.C. sponsored Refresher Course, Department of Geology, University of Lucknow.

— "*Indian Gondwana : Palaeobotany*", U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.

P.K. Maithy

— "*Earliest traces of life*", U.G.C. sponsored Refresher Course, Geology Department, Lucknow University, Lucknow.

— "*Emergence of animals*", U.G.C. sponsored Refresher Course, Geology Department, Lucknow University, Lucknow.

— "*Evidences for earliest traces of life*", Geology Department, Utkal University, Bhubaneswar, Orissa.

G. Rajagopalan

— "*C-14 dating method : principle, technique and limitations*", Geology Department, Kumaon University, Nainital.

— "*Radiocarbon dating method and its applications to the study of vegetational changes and climatic inferences*", U.G.C. sponsored Refresher Course, Botany Department, Lucknow University, Lucknow.

— "*Dating methods for geological samples*", U.G.C. spon-

sored Refresher Course, Geology Department, Lucknow University, Lucknow (A series of two lectures).

Anil Chandra — *"Elements of diatom study"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.

— *"Silicoflagellates and cleaning of siliceous microfossils"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.

Shaila Chandra — *"Origin of life"*, Geology Department, Delhi University, Delhi.

— *"Land plants and their evolution"*, Geology Department, Delhi University, Delhi.

— *"Gondwana flora"*, Geology Department, Delhi University, Delhi.

— *"Palaeoclimate and palaeogeography during Gondwana time period"*, Geology Department, Delhi University, Delhi.

— *"Reconstructing past vegetation"*, Geology Department, Delhi University, Delhi.

— *"Early land plants and their evolution"*, U.G.C. sponsored Refresher Course, Geology Department, Lucknow University, Lucknow.

S.A. Jafar — *"Scanning and transmission electron microscopy of plant material"*, ISIC Centre, Punjab University, Chandigarh.

— *"Phytoplankton Symmetry"*, Centre for Advanced Studies in Geology, Punjab University, Chandigarh.

— *"Calcareous nannofossils : A major component of Mesozoic-Cenozoic pelagic sediments"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.

— *"Impact of calcareous nannofossil research : Academic and economic scenario"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.

R.K. Kar — *"Concept of Palaeoecology"*, Botany Department, Pune University, Pune.

Rahul Garg	— *"Fossil radiolaria through time"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.
	— *"Significance of radiolarians in Palaeoceanography"*, U.G.C. sponsored Refresher Course, Department of Geology, Lucknow University, Lucknow.
C.M. Nautiyal	— *"Meteorites : The space messengers"*, Regional Science Centre, Lucknow.
A.K. Srivastava	— *"Insect/Plant relationship in Late Palaeozoic flora of India"*, U.G.C. sponsored Refresher Course, Zoology Department, Lucknow University, Lucknow.
N. Jha	— *"Permian Triassic palynology of Godavari graben and its comparison with other Gondwana continents"*, Exploration Division, Singareni Collieries Co. Ltd., Kothagudem.
H.A. Khan	— *"Pollen and spores : Past and present"*, Amravati University, Amravati.
Pramod Kumar	— *"Importance of palynological studies in stratigraphic correlations with special reference to coal horizons"*, Geology Division of MECL, Nagpur.
	— *"Fauna, flora and environment during Cretaceous Period"*, U.G.C. sponsored Refresher Course, Zoology Department, Lucknow University, Lucknow.
B.K. Misra	— *"Fluorescence microscopy of Indian coals and lignites"*, Staff Training College of Central Mine Planning and Design Institute Ltd., Ranchi.
C. Srivastava	— *"Use of medicinal plants in ancient India"*, *National Science Day Lecture*, Nari Shiksha Niketan, Lucknow.
Vijaya	— *"Evolutionary biohorizon stratigraphy in Gondwana sequence of India"*, Department of Palynology and Palaeobotany, Nanjing Institute, China.
Asha Gupta	— *"Applications of palynology with reference to bryophytic and pteridophytic spores"*, Felicitation ceremony, Bareilly College, Bareilly.
Jyotsana Rai	— *"Science and superstition"*, to school children at B.S.I.P.
Mukund Sharma	— *"Microfloral diversity of Mesoproterozoic sediments of India"*, Geological Society of India, Bangalore.

Rajni Tewari — *"Birbal Sahni Institute of Palaeobotany and an introduction to palaeobotany", National Science Day Lecture*, Nari Shiksha Niketan Degree College, Lucknow.

By outside scientists in the Institute

Dr M.M. Narayanan — Nuclear Centre, New Delhi *"NSC pelletron and accelerator mass spectrometry"* on April 12, 1994.

Dr Trilochan Singh — Wadia Institute of Himalayan Geology, Dehradun *"Geological and cultural glimpses of Spiti Valley"* on May 19, 1994.

Professor John Anderson — National Botanical Institute, Pretoria, South Africa *"Towards natural reality in palaeobotanical biodiversity"* on September 28, 1994.

Professor G.F. Hart — Louisiana State University, Baton Rouge, U.S.A. *"Particulate organic matter/organic Petrology"* on November 11, 1994.

Dr S.A. Rasool — Director, IGBP, Data and Information System, University of Paris, France *"Remote sensing and global changes"* on December 30, 1994.

Dr Rafi Ahmad — University of the West Indies, Jamaica, *"Evolution of alluvial fans in neotectonic terranes located in Plate Boundary Zone : An example from Jamaica, West Indies"* on January 4, 1995.

Professor W.G. Chaloner — Bourne Royal Holloway, University of London, *"Naming of fossil spores"* on January 21, 1995.

Recognition

— Nagar Rajbhasha Karyanvayan Samiti gave a "*Certificate*" to the Institute for the year 1993-94 for "Following and doing commendable work under Rule 11 of the Rajbhasha Act".

R.S. Tiwari

— Chief Guest, National Workshop on "*National Children Science Congress - 1994*", held at Regional Science Centre, Lucknow.

— Chaired the Inaugural Session of State level "*National Children Science Congress - 1994*", held at B.S.I.P.

— Presided the Valedictory and Prize Distribution Functions of "*National Children Science Congress - 1994*"

— Chaired, a Technical Session at "*Symposium on Recent Advances in geological studies of Northwest Himalaya and the foredeep*", G.S.I., Lucknow.

H.K. Maheshwari

— Awarded "*First Prize*" and Rs. 500/- by B.S.I.P. for doing the maximum official work in Hindi.

P. K. Maithy

— Judge, for the debate competition on Hindi Diwas (September 14, 1994), B.S.I.P., Lucknow.

— Chief Judge, Science Drama Competition, National Regional Science Centre, Lucknow.

Anil Chandra

— Elected Fellow, The Palaeobotanical Society, Lucknow.

H.P. Gupta

— Elected Fellow, The Palaeobotanical Society, Lucknow

S.A. Jafar

— Invited by President, INA to deliver keynote lecture on "*Miocene nannoplankton of Indian Ocean*" at Nannosea Workshop, Kuala Lumpur, Malaysia (August, 1994).

— Elected Fellow, The Palaeobotanical Society, Lucknow.

C.M. Nautiyal

— Guest, Regional Science Centre, Lucknow during the Inaugural Function of Space Science Week.

— Guest, Central Institute for Medicinal and Aromatic Plants, Lucknow on Hindi Diwas and was presented a Plaque for contributions to Science Popularisation in Hindi.

— Judge, competition during Space Week at Regional Science Centre, Lucknow.

J.S. Antal & B.K. Jain — Awarded "*Second Prize*" and Rs. 300/- each for doing the maximum official work in Hindi.

N. Jha — Awarded "*Second Prize*" in Essay Competition conducted by Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

Asha Khandelwal — Convener of Poster Session "*VI Aerobiology epidemiology and disease forecasting/dispersal of biotic and abiotic particles/computer and statistical applications in Aerobiology*". 5th International Conference on Aerobiology, Bangalore.

R. Babu — Selected for National overseas scholarship for higher studies abroad by the Ministry of Welfare, Government of India, 1994-1995.

Asha Gupta — Elected Fellow, and awarded a Memento by the Society for Plant Research.

A. Rajanikanth — Awarded "*Third Prize*" in Debating Competition, organised by the Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

Mukund Sharma — Awarded "*First Prize*" in the Essay Competition organised by Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

— Awarded "*Second Prize*" for his article *Dhoomketu Ka Dhamaka* presented in a Workshop organised by NCSTC and *Bhartiya Lok Sanchar Parishad* at Lucknow.

Rashmi Srivastava — Awarded "*Merit Certificate*" for Second Position in a debate organised by Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

Kavita Kumar — Awarded "*Third Prize*" in Essay Competition organised by Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

Reeta Banerji — Awarded "*First Prize*" in Debating Competition organised by Rajbhasha Karyanvayan Samiti of the Institute on the occasion of Hindi Diwas.

Ramesh Chandra R. Kukreti & Prem Prakash — Awarded "*Third Prize*" and Rs. 150/- each by B.S.I.P. for doing the maximum official work in Hindi.

Representation in Committees/Boards

R.S. Tiwari	• Chief Editor, '*The Palaeobotanist*'
	• Secretary, The Palaeobotanical Society, Lucknow (up to December, 1994)
	• Co-Editor, '*Asian Journal of Plant Sciences*'
	• President, International Society of Applied Biology
	• Member, Editorial Board, '*Biological Memoirs*'
	• Member, National Organising Committee, IV International Congress of Ethnobiology
	• Corresponding Member, Committee for Quantitative Stratigraphy
	• Member, National Organising Committee, Symposium on Recent Advances in Geological Studies of Northwest Himalaya and the foredeep, Lucknow
	• Member, Executive Council, The Palaeobotanical Society
K.P. Jain	• Secretary, Indian Association of Palynostratigraphers
	• Member, Executive Committee, The Palaeobotanical Society (up to December, 1994)
	• Editor, '*The Palaeobotanist*'
H.K. Maheshwari	• Member, Committee for Fossil Plants, International Association for Plant Taxonomy
	• Editor, Indian Association of Palynostratigraphers
	• Editor, '*The Palaeobotanist*'
P.K. Maithy	• Editor, '*The Palaeobotanist*'
	• Member, Editorial Board '*Geoviews*'
G. Rajagopalan	• Member, National Organising Committee, Nuclear Track Society of India, Calcutta
	• Member, Academic Committee of School of Archaeological Dating, Jadavpur University

Anand-Prakash	• Treasurer, The Palaeobotanical Society (up to December, 1994)
	• Treasurer, Indian Association of Palynostratigraphers
	• Member, Executive Council, The Palaeobotanical Society, Lucknow
	• Member, Solid Mineral Fuels Sectional Committee, Bureau of Indian Standards
N. Awasthi	• Vice-President, The Palaeobotanical Society (since January, 1995)
	• Chief Editor, '*Geophytology*' (up to December, 1994)
Anil Chandra	• Member, Executive Council, Palaeontological Society of India, Lucknow
	• Editor, '*Geophytology*' (up to December, 1994)
Shaila Chandra	• Vice-President, Indian Society of Geoscientists
	• Member, Steering Committee, Golden Jubilee Celebration of The Palaeobotanical Society
H.P. Gupta	• The Secretary, The Palaeobotanical Society (since January, 1995)
	• Business Manager, Indian Association of Palynostratigraphers
S.A. Jafar	• Organizing Secretary, Lucknow Chapter, Zaheer Science Foundation, New Delhi
	• Member, Editorial Committee, Symposium on "Recent advances on geological studies of Northwest Himalaya and the foredeep"
R.K. Kar	• Founder Member, Indian National Earth Science Academy
Suresh C. Srivastava	• Chief Editor, '*Geophytology*' (since January, 1995)
	• Member, CIMP, England
C.M. Nautiyal	• Member, National Expert and Evaluation Committee, NCSC-94
	• General Secretary, National Children's Science Congress - 1994 (U.P.)

	• Member, State Coordination Committee on Jeevan Jyoti (I & B Ministry and UNICEF), 1994
	• Member, Organising Committee, 'Science Journalism Course' sponsored by NCSTC (DST), 1994.
R.K. Saxena	• Secretary, Indian Society of Geoscientists
	• Member, Editorial Board, *I.S.G. Bulletin*
A.K. Srivastava	• Member, Advisory Board, "*Journal Neo Botanica*"
	• Editor, '*Geophytology*' (since January, 1995)
	• Member, Editorial Board, Indian Society of Geoscientists
	• Treasurer, Indian Society of Geoscientists
G.P. Srivastava	• Treasurer, The Palaeobotanical Society (since January, 1995)
	• Member, Editorial Board, '*Journal of Living world*'
Shyam C. Srivastava	• Honorary Member, Palaeobotany : Botanical Society of America
Archana Tripathi	• Editor, '*Geophytology*' (since January, 1995)
Usha Bajpai	• Member, Managing Council, Indian Association of Palynostratigraphers
	• Member, Executive Council, The Palaeobotanical Society (up to December, 1994)
J.S. Guleria	• Joint Secretary, The Palaeobotanical Society (since January, 1995)
H.A. Khan	• Editor, '*Indian Journal of Bio-Research*'
Asha Khandelwal	• Member, Executive Council, Indian Aerobiological Society
B.K. Misra	• Joint Secretary, Indian Society of Geoscientists
Rakesh Saxena	• Associate Member, International Committee for Coal Petrology
Vijaya	• Editor, "*Geophytology*" (up to December, 1994)
	• Corresponding Member, Committee for Quantitative Stratigraphy
	• Corresponding Member, International Commission on Triassic Stratigraphy

	• Voting Member, International Working Group on Carboniferous Stratigraphy
Asha Gupta	• Member, Editorial Board, *International Research Journal on Biological Sciences - Flora and Fauna*
A. Rajanikanth	• Joint Secretary, The Palaeobotanical Society (up to December 1994)

Deputation/Training/Study/Visit Abroad/in Country

P.K. Maithy, H.P. Gupta & Sheenu Sharma

Attended DST sponsored "*6th Group Monitoring Meeting on SERC Projects on Earth Sciences*" held at Bhubaneshwar from February 16-18, 1995.

S.A. Jafar

Attended "*National Workshop on Electron Microscopy*", held at I.S.I.C. Centre, Punjab University, Chandigarh in April, 1994.

After attending the *Nanno-sea Workshop* held at Kuala Lumpur, Malaysia from August 16-18, 1994, visited Petronas, the Premier Oil Exploration Company headquarters.

Suresh C. Srivastava

After attending *CIMP Symposium* at Sheffield, visited British Geological Survey, Keyworth, Nottingham, England from September 10-16, 1994.

C.M. Nautiyal

Attended National Workshop on "*National Children's Science Congress - 1994*", held at Regional Science Centre, Lucknow from April 8-10, 1994.

Participated in consultation meeting organised by the Ministry of Information and Broadcasting and UNICEF on "*Electronic Media*" held at Dehradun in July, 1994.

Attended Symposium on "*INSA Young Scientists : A 20 year retrospective*", held at Indian National Science Academy, New Delhi from October 4-5, 1994.

J.S. Antal, C.M. Nautiyal, A. Rajanikanth, M. Sharma & R. Srivastava

Attended a Training Workshop on "*Science Journalism*" organised by National Council for Science and Technology Communication (NCSTC), Government of India held at Regional Science Centre, Lucknow from July 28-31, 1994.

J.S. Guleria

Attended a short training course from February 25 to March 4, 1995 at Logitech Ltd., Glasgow (U.K.) to operate Logitech cutting and polishing machine installed recently at the Institute; visited Geology Department, University of Glasgow, Earth Sciences Department of Open Hall University, Milton Keynes, Jodrell Laboratory of Wood Anatomy and Royal Botanic Gardens, Kew at London during March 4-9, 1995.

Asha Khandelwal

Attended meetings of "*All India Coordinated Project on Aeroallergens and human*

health" sponsored by Ministry of Environment and Forests, Government of India held at New Delhi from May 26-27, 1994 and at Bangalore from August 10-15, 1994.

J.P. Mandal

Visited laboratories of Geological Institute of Czech Academy of Sciences, Central Geological Institute, Palaeontology Department of Charles University, Natural History Museum and Botanical Garden of Prague during a visit to Czech Republic under INSA exchange programme from November 11 to December 9, 1994.

B.K. Misra

Visited Coal and Organic Petrology Laboratories of Technical University, Aachen; Federal Institute of Geological Sciences and Mineral Resources, Hannover and Geologisches Landesamt, Krefeld, besides Department of Geology, Koln University under International Exchange Programme of INSA-Deutsche Forschungsgemeinschaft in June, 1994 for a period of three weeks.

Vijaya

After attending the "*International Symposium on Permian Stratigraphy*", Guiyang, China visited Institute of Palaeontology and Palynology, Nanjing, China from September 1-5, 1994.

A. Bhattacharyya

After attending the "*International Conference on Tree rings, environment and humanity : Relationship and processes*" held at Tucson, Arizona (U.S.A.) during May 17-21, 1994, visited the Laboratory of Tree Ring Research, University of Arizona, USA for about one and half months. Application of several computer softwares for various statistical analysis used in the tree ring studies were learnt.

A. Rajanikanth

Attended Third National Convention ISWA "*What is wrong with Indian science*" held at the Indian National Science Academy, New Delhi from February 18-19, 1995.

Mukund Sharma

Attended a fourteen week course on "*Science Journalism*" organised by Jeevaniya Society in collaboration with Lucknow University from February 11, 1995.

Ramesh Chandra

Attended "*Technical Workshop on Administrative and establishment rules*" held at New Delhi from August 24-26, 1994.

Deputation to Conferences/Symposia/Seminars/Workshops

K.P. Jain **Mahesh Prasad** **Asha Gupta**	•	"*9th Himalaya-Karakorum-Tibet Workshop*" held at Kathmandu (Nepal) from April 1-4, 1994.
Chanchala Srivastava	•	"*Workshop : Young Archaeologists Meet*" held at Patna from April 9-14, 1994.
A. Bhattacharyya	•	"*International Conference on Tree Rings, Environment and Humanity : Relationships and Processess*" held at Tucson, Arizona (USA) from May 17-21, 1994.
G.P. Srivastava	•	"*Museum Association of India–Annual Conference*" held at Lucknow from May 7-9, 1994.
Anil Chandra	•	"*International Satellite Symposium on Recent Advances in Phycology*" held at Madras from July 11-15, 1994.
Asha Khandelwal	•	"*5th International Conference on Aerobiology*" held at Bangalore from August 6-17, 1994.
S.A. Jafar	•	"*Nanno-sea Workshop on Neogene Nannoplankton*" held at Kuala Lumpur (Malaysia) from August 16-18, 1994.
Vijaya	•	"*International Symposium on Permian Stratigraphy, Environment and Resources*" held at Guiyang (China) from August 28-31, 1994.
Suresh C. Srivastava	•	"*CIMP Symposium on Stratotypes and Stages : Palynology, Palaeoenvironment and Stratigraphy*" held at Sheffield (England) from September 6-10, 1994.
N. Awasthi	•	"*5th Round Table Conference on Dipterocarps*" held at Chiang Mai (Thailand) from November 7-9, 1994.
Rashmi Srivastava	•	"*3rd Pacific Regional Wood Anatomy Conference*" held at Rotorua (New Zealand) from November 20-24, 1994.
R.K. Kar **G.P. Srivastava** **B.N. Jana** **Madhabi Chakraborty** **Prem Prakash** **Pradeep Mohan**	•	"*82nd Session of Indian Science Congress Association*" held at Calcutta from January 3-8, 1995 (Installation of an Exhibition on Palaeobotany & applications by B.S.I.P. at ISC)

Sheenu Sharma	• *"XI Convention of Indian Association of Sedimentologists Conference"* held at Roorkee in January 1995.
R.S. Tiwari **G. Rajagopalan** **H.K. Maheshwari** **Anand-Prakash** **Chhaya Sharma** **R.K. Saxena** **Manoj Shukla** **Vijaya** **Usha Bajpai** **Samir Sarkar** **Ram Awatar** **M.S. Chauhan** **Asha Gupta**	• *"Symposium on Recent Advances in Geological Studies of Northwest Himalaya and the foredeep"* held at GSI, Lucknow from February 21-23, 1995.
G. Rajagopalan	• *"IX National Symposium on Solid State Nuclear Track Detectors (SSNTD-95)"*, held at BARC, Bombay from March 8-10, 1995.

Papers presented at Conferences/Symposia/Meetings

Arya, R. & Awasthi, N. — Leaf- impressions from Kasauli Formation, Kasauli, Himachal Pradesh and their palaeoecologic and palaeoenvironmental significance. *Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep*, G.S.I., Lucknow, February 1995.

Awasthi, N. — Dipterocarpaceae in the Indian subcontinent : Past, present and future. *V Round Table Conf.*, Chiang Mai, Thailand, November 1994.

Bhattacharyya, A. & Yadav, R.R. — Dendrochronological analysis of some Himalayan conifers. *Int. Conf. on Tree Rings Environment and Humanity : Relationships and Processess*, Tucson, Arizona, May 1994.

Chandra, A. — Siliceous microfossils from Andaman and Nicobar Islands, India. *Int. Symp. Recent Advances in Phycology*, Madras, July 1994.

Chauhan, M.S. & Sharma, C. — Pollen analysis of Mid-Holocene sediments from Kumaon Himalaya. *"Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep"*, G.S.I., Lucknow, February 1995.

Garg, R., Jaikrishna, Jain, K.P. & Khowaja-Ateequzaman — Late Jurassic ammonoids and their associated dinoflagellate cyst assemblages from Tethys Himalaya : An integrated approach. *IX Himalaya-Karakorum-Tibet Workshop*, Kathmandu, Nepal, April 1994.

Khandelwal, A. — Aerospora of Lucknow with remarks on pollen spurts in atmosphere and surface sediments. *5th Int. Conf. Aerobiol.*, Bangalore, August 1994.

Khandelwal, A. & Gupta, H.P. — Honey bees and yellow rain. *5th Int. Conf. on Aerobiol.*, Bangalore, August 1994.

Maheshwari, H.K., Kapoor, H.M. & Bajpai, U. — Palynofossils from the Dunpathri Member of Mamal Formation, Kashmir. *Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep*, G.S.I., Lucknow, February 1995.

Prasad, M. — Siwalik flora from Koilabas area in the Nepal Himalaya and its significance on palaeoenvironment and phytogeography. *IX Himalaya - Karakorum - Tibet Workshop*, Kathmandu, Nepal, April 1994.

Sharma, C., Chauhan, M.S., Gupta, A. & Rajagopalan, G. — Vegetation and climate of Garhwal Himalaya during last 4,000 years. *Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep*, G.S.I., Lucknow, February 1995.

Sharma, C. & Gupta, A. — Vegetational history of Nachiketa Tal, Garhwal Himalaya,

India. *9th International Himalaya- Karakorum-Tibet Workshop*, Nepal, April 1994.

Sharma, S., Babu, R., Maithy, P.K. & Kumar, S. — Lithostratigraphy and environment of deposition of the carbonate sequence, The Iron Ore Group, Barbil area, Orissa : A preliminary report. *XI Conv. Indian Assoc. Sedimentol.*, Roorkee, January 1995.

Srivastava, C. — Man and plants : An archaeological perspective. *Workshop : Young Archaeologists Meet*, Patna, April 1994.

Srivastava, R. — Systematic anatomy of fossil woods in the Tertiary flora of India. *III Pacific Regional Wood Anatomy Conf.*, Rotrua, New Zealand, November 1994.

Srivastava, Suresh C. & Bhattacharyya, A.P.— Early Permian microfossils in faunal coal balls from Arunachal Pradesh, India : Phytogeographic and palaeoenvironmental significance. *CIMP Symp. Stratotypes and Stages- Palynology, Palaeoenvironment and Stratigraphy*, Sheffield, September 1994.

Singh, T., Tiwari, R.S., Vijaya & Ram-Awatar — Stratigraphy and palynology of the Permian and Early Triassic sequences in Spiti Valley, H.P. *Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep*, G.S.I., Lucknow, February 1995.

Vijaya — Carboniferous-Permian event : Rise of Glossopteris flora on Gondwanaland. *Int. Symp. Permian Stratigr. Environm. Res.*, Guiyang, China, August 1994.

Yadav, R.R. & Bhattacharyya, A. — Tree ring of some Indian tropical trees. *Int. Conf. Tree Rings Environment and Humanity : Relationships and Processess*, Tucson, Arizona, May 1994.

Doctoral Degree Awarded

Name	*University*	*Title of Thesis*
O.P. Singh (Research Fellow in a DST Project)	Banaras Hindu University, Varanasi	Late Miocene calcareous nannofossils from Neill Island, Andaman-Nicobar Basin, India

Field Excursions

Following field-trips/consultation/discussion visits were undertaken by the scientists and technical staff of the Institute :

R.S. Tiwari & S.A. Jafar

Visited Andaman-Car Nicobar islands to collect samples for palynological study and to examine outcrops having Triassic reworking.

P.K. Maithy, R. Babu & S. Sharma

Visited Noamundi, Iron Ore Supergroup, Orissa for collecting samples of cherts and stromatolites.

An exposure of Iron ore Supergroup with black cherts (± 3000 Ma) at Kasia Mine, Barbil, Orissa.

A section showing contact of Bijori Formation and Pachmarhi Sandstones (arrow) exposed in Tawa River near Tawa Dam Bridge, Hoshangabad District, Madhya Pradesh.

M. Shukla & M. Sharma

Visited Bhima Basin for systematic sampling of shales, sandstone and limestone.

M. Sharma

Visited Bastar region of Madhya Pradesh for reconnoitre sampling of Indravati Group sediments exposed around Jagadalpur area.

B.N. Jana & A.K. Ghosh

Visited the Cretaceous localities of Bagh beds, Madhya Pradesh; collected samples of coralline and nodular limestones for the study of calcareous skeletal algae.

J. Banerji & B.N. Jana

Visited several fossiliferous localities in Rajmahal Basin for the collection of plant megafossils.

A. Rajanikanth

Visited Pranhita-Godavari graben for collection of plant megafossils from various localities of Gangapur Formation.

Anand-Prakash, G.P. Srivastava & R. Kar

Visited Ramkola-Tatapani and Talcher coal basins and Mahuadand area for the collection of coal samples and plant fossils and other field studies.

Box structure in Ironstone shales in Banki River Section, Tatapani-Ramkola Coalfield, Madhya Pradesh.

B.K. Misra & B.D. Singh

Visited Central Mine Planning and Design Institute Ltd., Mineral Exploration Corporation Ltd., Geology Department of the University in Ranchi; Central Fuel Research Institute, Jealgora, Dhanbad for consultation and discussions. Samples of coal and associated sediments from Seam No. II of Lalmatia Colliery, Hura Basin (Rajmahal Coalfield) were also collected.

O.S. Sarate

Visited various localities of Godavari Valley coalfields for collection of coal/shale samples from Belampalli, Ramagundam, Mailaram, Shravanapalli and other areas for palynological and petrological studies.

A.K. Srivastava & R. Tewari

Visited Auranga and Jharia coalfields, Bihar to collect plant megafossils from various localities.

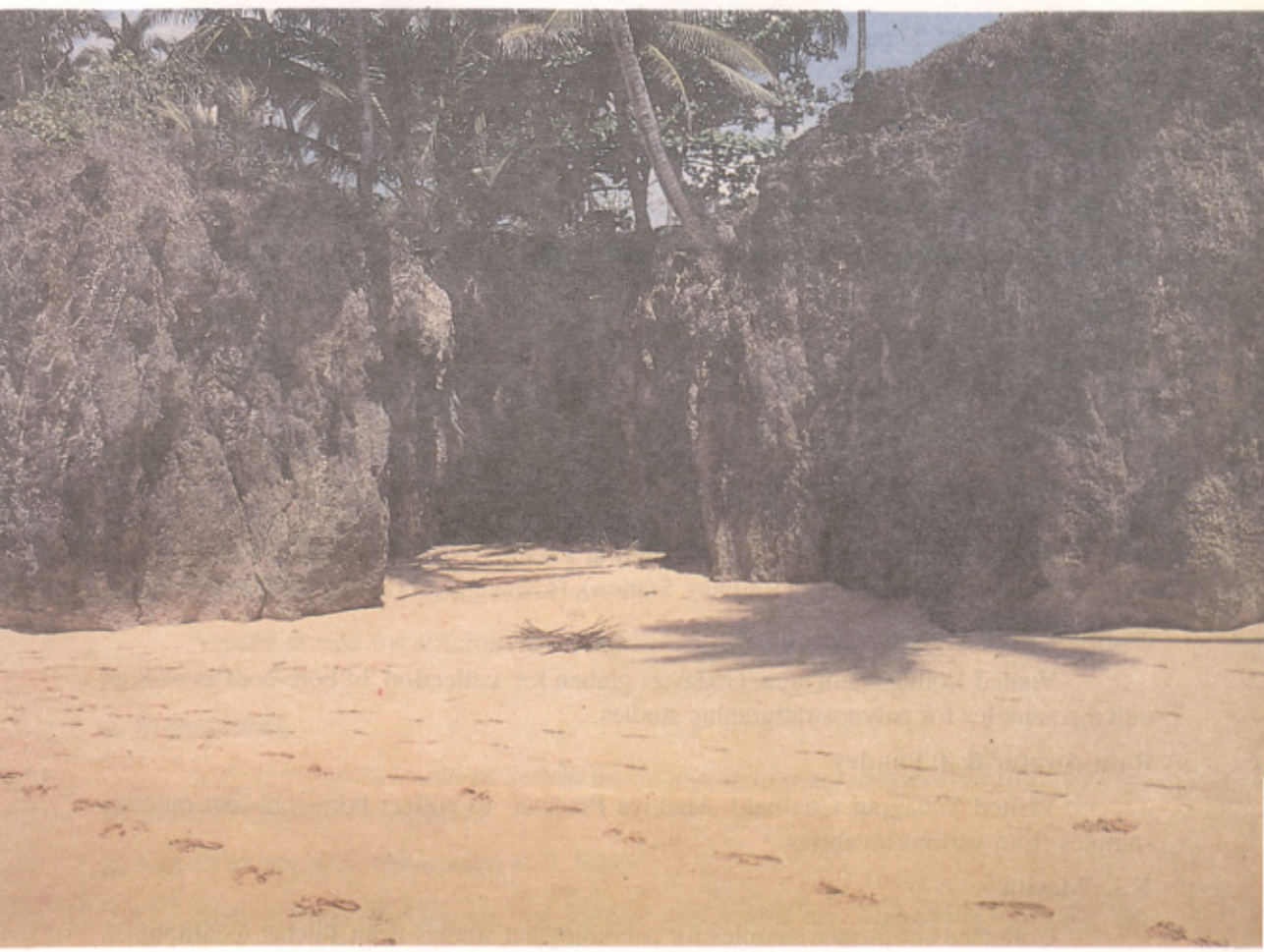
S.M. Singh

Visited North and South Karanpura and Bokaro coalfields, Bihar for collection of plant megafossils and rock samples from the Barakar Formation.

A. Tripathi & Vijaya

Visited Geological Survey of India, Calcutta to discuss the palynological reports on Rajmahal and Panagarh, Damodar Basin and Talcher Coalfield, and to consult the Library.

A view of Sawai Bay Formation exposed near Kakana Village, Car-Nicobar Island.



Late Palaeocene variegated clay of Matanomadh Formation exposed at Matanomadh, Kutch, Gujarat.

A. Tripathi, Vijaya & Chandra Pal

Visited Korba Coalfield, Madhya Pradesh for collection of palynological samples.

Vijaya

Participated in a pre-Symposium field excursion to the proposed section for the Permian-Triassic boundary in marine sequences of South China.

P. Kumar

Visited central region, Geological Survey of India, Nagpur to collect bore-cores of ANH-3 (Anhoni area) of Denwa Formation, Satpura Basin, Madhya Pradesh; collected clay facies of Pachmarhi Formation (exposed at Patalkot Hill), Chhindwara District and Bagra Formation (around Bagra Railway Station), Hoshangabad District, Madhya Pradesh.

N. Jha & R. Kar

Visited Kothagudem area, Godavari graben for collection of bore-core as well as outcrop samples for palynostratigraphic studies.

Ram-Awatar & J. Pandey

Visited Sohagpur Coalfield, Madhya Pradesh to collect bore-core and outcrop samples from various localities.

K.L. Meena

Collected subsurface samples for palynological studies from Talcher Coalfield.

R. Garg, Khowaja-Ateequzzaman & K.K. Pandey

Visited Kutch Basin to collect rock samples for phytoplankton investigations from Palaeogene-Neogene sequences.

A. Chandra & R.K. Saxena

Visited Havelock and Car Nicobar, Andaman and Nicobar Islands for collection of samples for study of diatoms.

R.K. Saxena & S. Sarkar

Visited Kargil, Khalsi and Dras areas of Ladakh for collecting Palaeocene-Eocene sediments for palynological studies.

R.K. Saxena, M.R. Rao, S.K.M. Tripathi & V. Prasad

Visited Garo Hills, Meghalaya for collection of rock samples from Palaeocene-Lower Miocene sequences for palynological studies.

M.R. Rao

Visited Kerala Basin for collection of rock samples from Kundra clay mine quarry, Quilon District and Varkala beach, Trivandrum District for palynological studies.

R.K. Kar

Visited Mannargudi, Veeranam Eri, Neyveli of Tamil Nadu to collect palynological samples.

R.K. Kar, M. Chakraborty, M. Nanda & P. Sharma

Collected surface and subsurface samples from Gujarat and Rajasthan.

R.K. Kar, P. Sharma & Luna

Collected samples from Gujarat and Rajasthan.

K. Ambwani

Visited Garo Hills, Meghalaya for the collection of rock (Palaeocene-Eocene) samples for palynological investigation.

J.P. Mandal & M. Kumar

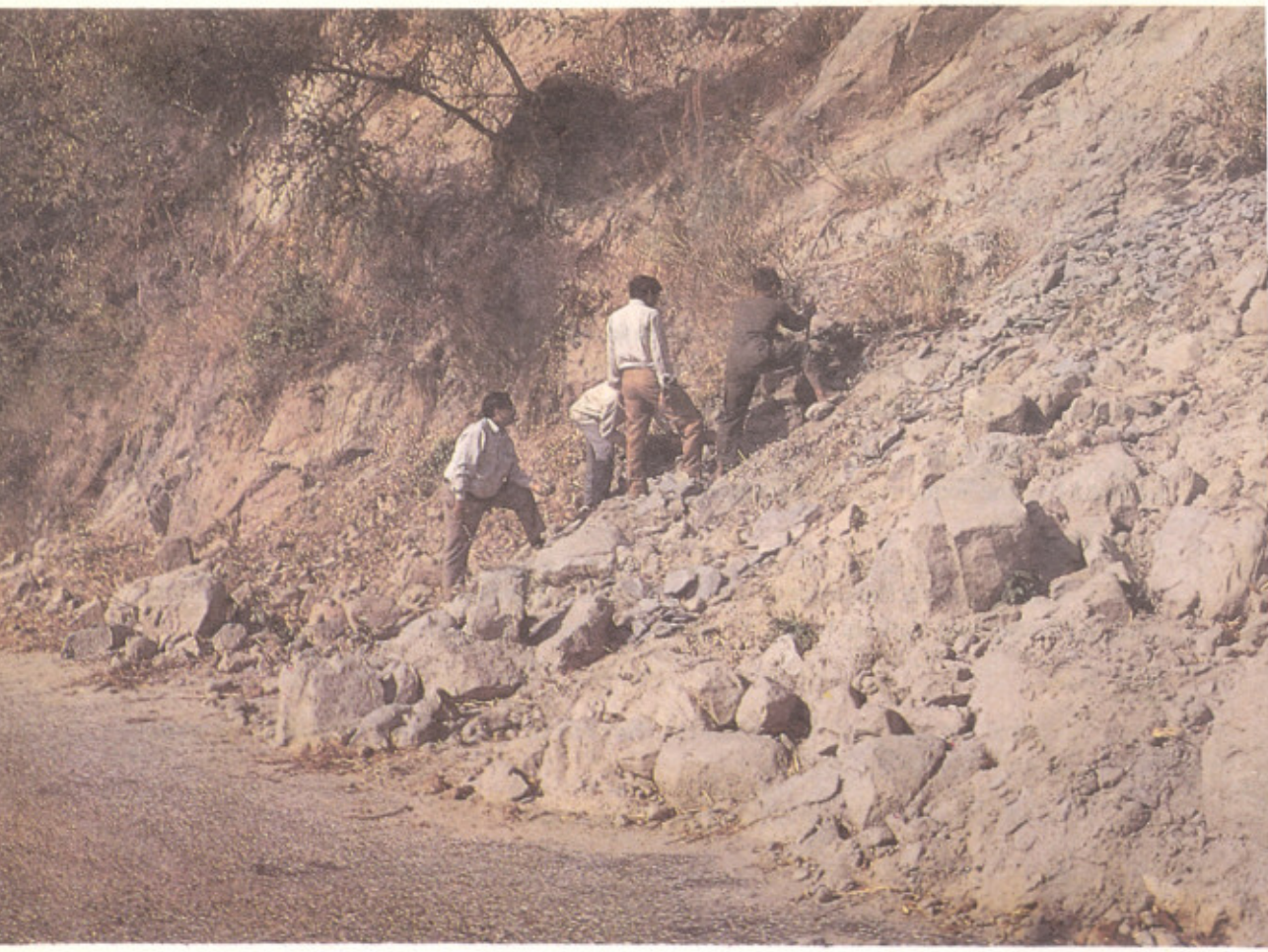
Visited Kutch and Bharuch districts, Gujarat to collect palynological samples.

R.S. Singh

Visited Garo Hills, Meghalaya to collect samples for palynological study from Garo Group (Upper Cretaceous) of sediments.

B.D. Mandaokar

Visited Gujarat-south Saurashtra to collect the Tertiary sediments for palynological investigation from different localities.



An exposure of Siwalik sediments comprising leaf-impressions and fruits near Mansa Devi Temple, Haridwar, Uttar Pradesh.

Visited Tirap, Tipang, Namchik, Miao, Arunachal Pradesh to collect Tertiary sediments for palynological investigation.

G.K. Trivedi

Visited Umrangsho, North Cachar Hills, Assam (Kopili Formation) from Kopili River Section and to Jowai - Badarpur Road (Kopili Formation), Meghalaya to collect samples for palynological studies.

J.S. Antal & Mahesh Prasad

Visited Forest Research Institute, Dehradun for consultation of Herbarium to identify the leaf-impressions already collected from Siwaliks.

J.S. Antal & M. Prasad

Visited the Himalayan foot-hills of Mohund near Dehradun and Haridwar area in Uttar Pradesh, for collecting plant megafossils from Tertiary Sequence (J.S. Antal. & M. Prasad). To the Siwaliks of Kalagarh, Kathgodam and Tanakpur for collection of plant megafossils (M. Prasad).

A. Agarwal

Visited Neyveli Lignite Field, Tamil Nadu for collection of megafossils.

K.S. Saraswat & A.K.S. Pokharia

To collect plant remains from archaeological excavations at Balu, district Kaithal and at Karnal, district Hissar, Haryana.

R.R. Yadav & A. Bhattacharyya

To study disc samples of teak visited the Wood Museum of the Institute of Wood Science and Technology, Bangalore and collected tree ring samples (cores) from *Podocarpus wallichianus* growing in the Tirunelveli Hills, Tamil Nadu.

A. Bhattacharyya & V. Chaudhury

Visited eastern Himalayan region to collect cores from a number of trees of various conifer taxa. Some surface sediment samples have also been collected from Larch-Silver fir and *Tsuga-Rhododendron* forest to understand pollen/vegetation relationship in the eastern Himalaya.

S.K. Bera & A. Farooqui

Visited Marian shola, Konalar swamp under Berijam Forest Division and Kuntan shola, Silver Cascade forest, Kodaikanal Forest Division of Tamil Nadu.

J.S. Guleria, S.K. Bera & D.C. Saini

Visited Malanjkhand Copper mine and Ukwa Manganese mine areas, Balaghat District, Madhya Pradesh for collection of samples for geobotanical studies.

D.C. Saini

Collected extant plant specimens and samples of fruits and seeds from Allahabad, Raibareilly and Lucknow in Uttar Pradesh and Katni, Jabalpur, Seoni and Balaghat districts in Madhya Pradesh for Herbarium.

S. Chandra & K.J. Singh

Visited Talcher Coalfield and Hinjrida Ghati, Orissa for collection of plant megafossils. A reconnaisance survey was also undertaken to Korba Coalfield for study of megafossils.

Consultancy/Training Programmes

The Institute has started to provide "Consultancy Services" in various aspects of palaeobotany, palynology, coal/lignite biopetrology, radiometric dating and microscopy. Training of personnel in palynology and biopetrology has also been undertaken.

Professor P.K. Banerji	—	Emeritus Scientist, C.S.I.R., Calcutta
Sri B.L. Malla	—	Research Associate, Indira Gandhi National Centre for the Arts, New Delhi
Sri K. Adinarayanan	—	Neyveli Lignite Corporation, Tamil Nadu
Dr A.K. Saha	—	Honorary Secretary, C.S.M.E., Calcutta
Professor Ali Ahmed	—	Department of Geography, North Eastern Hill University, Shillong
Sri S. Bhaigya Singh	—	Suptd. of Archaeology, Manipur Government, Imphal
Dr Mrs S. Devi	—	Department of Geography, Andhra University, Vishakhapatnam
Dr P.M. Shakya	—	Project Manager, Lumbini Development Trust, Nepal

It has been decided to publish a book on "*Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology*" On this theme a special training course which was conducted at the Institute during December, 1993. The following scientists have contributed their chapters for this book covering all relevant information on fundamental and applied aspects of studies in the light of latest researches and concepts.

R.S. Tiwari	—	"*Introduction to the theme*"
Anand-Prakash	—	"*Coals and lignites of India*"
R.K. Kar	—	"*Concepts, potential and prospects of palaeopalynology*"
S.K.M. Tripathi	—	"*Techniques of palynological studies*"
K. Ambwani	—	"*Techniques of SEM studies*"
R.K. Saxena	—	"*Morphology of angiosperm pollen*"
Archana Tripathi	—	"*Morphology of Late Palaeozoic and Mesozoic palynofossils*"
Vijaya	—	"*Palynostratigraphy of Permian sequence in India*"

R.K. Saxena	—	*"Biostratigraphic zonation and correlation"*
Anand-Prakash & Alpana Singh	—	*"Fundamentals of organic petrology"*
B.D. Singh	—	*"Coal microconstituents and their classification"*
B.K. Misra	—	*"Application of biopetrological studies in utilization of coal and lignite"*
R.S. Tiwari	—	*"Futuristic approach"*

In continuation of our programme for computer literacy at the Institute under In-House Computer Training Programme, this year the training was conducted in three batches, from July 11 to October 21, 1994. The training had two modules — the Basic Module and the Advanced Module, covering (i) Computer Fundamentals, (ii) Disk Operating System, (iii) Word Processor, (iv) Data Base Management System, and (v) Electronic Spreadsheet. These courses were specifically prepared (with a series of lectures and practical demonstrations) for easy understanding of the computer concepts and its efficient use. Under the Supervision of Dr G. Rajagopalan, the lectures and demonstrations were given by Kamal Narang, K. Nagapooshnam, R. Nandhagopal and Y.P. Singh.

The following members of staff deputed from Scientific, Technical and Administrative cadres of the Institute attended the training course :

First Batch (11th July - 12th August, 1994)

Shaila Chandra	Ratan Kar
S.A. Jafar	Manisha Nanda
Rahul Garg	D. Pradhan
M.R. Rao	V. Nirmala
S.K. Bera	M. Jagath Janni
Amit K. Ghosh	N. Unnikannan
A. Rajanikanth	Deepak Kohli
D.C. Saini	Poonam Sharma
K.J. Singh	

Second Batch (16th August - 16th September, 1994)

Chhaya Sharma	Rajni Tewari
Jayasri Banerji	Vandana Prasad
J.S. Guleria	E.G. Khare
Asha Khandelwal	V.K. Nigam
B.N. Jana	N.N. Joshi
Anil Agarwal	Dhoom Singh
R.C. Mehrotra	M. Pillai
Jitendra Pandey	

Third Batch (19th September - 21st October, 1994)

Anil Chandra	C.L. Verma
G.P. Srivastava	Keshav Ram
Pramod Kumar	V.P. Singh
Samir Sarkar	R.L. Mehra
Neerja Jha	Swapna Majumdar
Ram-Awatar	K.P. Singh
Mukund Sharma	S.N. Meena
Chanchala Srivastava	R.C. Misra
Asha Guleria	

Beside the Institute's staff, the following scientists were deputed by the Departments of Botany and Geology, Lucknow University to attend the Computer Course.

N.K. Mehrotra	R. Bali
N. Nautiyal	S. Gupta
N. Pandey	P. Srivastava
D.S. Singh	S.P. Singh

Under an *In-House Training Programme* — "Basics of field geology for palaeobotanical studies", which was organised during October, 1993, an excursion to in- and -around Lucknow was undertaken to show the fluvial geomorphological features and sedimentary structures to the trainees.

The following areas on the banks of Gomti River were visited to study and understand the characteristic landforms and sedimentational features :

1. Near Kasim Baba ki Mazar, Dilkusha Garden
2. La Martiniere Boy's College
3. Gomti Barrage, Ring Road
4. Kathauta Tal, Chinhat
5. Sharda Sahayak Canal passing over Gomti River
6. Kukrail Nala, near CIMAP and Ring Road
7. Chowk, Kuria Ghat, Imambara, etc.

River terraces, channel shifting, meandering, flood plain, back swamp, ox-bow lakes, point bars, cross laminations, erosion of soft sediments and formation of gullies, etc. have been shown to the participants. The effect of various geomorphological and sedimentational processes and formation of features have been discussed at the site itself.

The Director (Dr R.S. Tiwari), Incharge of Coordination Unit for Scientific Activities (Dr Suresh C. Srivastava) and Senior Geologists (Drs Anand-Prakash, Manoj Shukla & Rahul Garg), and following members of the staff participated in this excursion.

Jayasri Banerji
G.P. Srivastava
Archana Tripathi
Vijaya
B.N. Jana
Usha Bajpai
Asha Khandelwal
J.P. Mandal
Neerja Jha
M.R. Rao
S.K.M. Tripathi
Chanchala Srivastava
Ram-Awatar
Rupendra Babu
Anjum Farooqui
Ratan Kar
Manisha Nanda
Shinjini Sarana
Madhabi Chakraborty
Vandana Chaudhary
R.C. Mehrotra
Alpana Singh
A. Rajanikanth
Rashmi Srivastava
Rajni Tewari
Madhav Kumar
O.S. Sarate
M.S. Chauhan
S.K. Bera
G.K. Trivedi
Asha Gupta
Neeru Prakash
Vandana Prasad
Jitendra Pandey
Amit K. Ghosh
S.M. Singh
A.K.S. Pokharia
E.G. Khare
Poonam Sharma
Luna

Technical Assistance rendered

Technical assistance

Dr Ashok Kumar, Wadia Institute of Himalayan Geology, Dehradun

Sri Khanin Baragohai, Research Scholar, Geology Department, Dibrugarh University, Dibrugarh

Sri J. Bright, Department of Geology, A.C. College, University of Madras, Madras

Radiocarbon dating of samples

Geological Survey of India, Lucknow

Physical Research Laboratory, Ahmedabad

Wadia Institute of Himalayan Geology, Dehradun

Kumaon University, Nainital

Indian Institute of Science, Bangalore

Professor S. Chanda, Centre for Study of Man and Environment, Calcutta

National Institute of Oceanography, Goa

National Geophysical Research Institute, Hyderabad

Departments at the Institute (Heads)

1. Department of Non-Vascular Plants
   (Dr P.K. Maithy)
2. Department of Palaeophytic Evolutionary Botany
   (Dr H.K. Maheshwari)
3. Department of Mesophytic Evolutionary Botany
   (Dr Shyam C. Srivastava)
4. Department of Cenophytic Evolutionary Botany
   (Dr N. Awasthi)
5. Department of Quaternary Biogeography and Archaeobotany
   (Dr H.P. Gupta)
6. Department of Pre-Gondwana and Gondwana Palynostratigraphy
   (Dr Suresh C. Srivastava)
7. Department of Post-Gondwana Palynostratigraphy of Peninsular India
   (Dr R.K. Kar)
8. Department of Post-Gondwana Palynostratigraphy of Extra-Peninsular India
   (Dr R.K. Kar; additional charge)
9. Department of Planktonology
   (Dr K.P. Jain)
10. Department of Biodiagenesis
    (Dr Anand-Prakash)
11. Department of Radiometric Dating
    (Dr G. Rajagopalan)

Units

Library

The services of the library were made available to scientists/teachers/students of other organisations and universities. Now the total number of registered borrowers is 197. At present, 65 current periodicals are being procured on exchange basis and 80 current periodicals are subscribed by the library.

The holdings of the Library are as under :

Particulars	*Additions during 1994-95*	*Total*
Books	161	4,804
Journals	104	10,086
Reprints	235	34,931
Reference Books	50	239
Theses	—	83
Reports	—	46
Maps & Atlases	1	60
Microfilms/Fisches	—	294

Reprints Section

Reprints of research papers purchased	29
Reprints sent out in exchange	2,587
Institutions on exchange list	54
Individuals on exchange list	391
Professor Sahni's papers sent out	246
Institute publications sent out	125

Computer aid to Library

The use of computer at library counter has been started and on LAN under UNIX O/S. The Software employed in UNIFY RDBMS and the utilities were programmed in 'C' giving different level of securities, data entry is in progress and around 6,500 records have already been entered.

This year the library facility was provided to the following organizations :

Department of Botany, Allahabad University
Botany Division, CDRI, Lucknow
K.G. Medical College, Lucknow

Department of Geology, A.C. College, Chepauk, Madras
Neyveli Lignite Corporation, Neyveli
Department of Geology, Punjab University, Chandigarh
Hindu College, Moradabad
Geology Department, M.S. University, Baroda
Geology Department, Lucknow University, Lucknow
Botany Department, Lucknow University, Lucknow
Louise Purtoa, Oxford University
National Botanical Research Institute, Lucknow
Dibrugarh University, Assam
Geological Survey of India, Lucknow
Jawaharlal Nehru University, Delhi

Herbarium

The Herbarium of the Institute is being developed with an objective to provide authentically identified plant material to the scientists for comparative study of fossil specimens. During the year, it has been decided that Herbarium should be developed parallel to the Museum of the Institute. Beside the collection and maintenance of extant plant material and their preparations, display of maps, paintings depicting various types of vegetation and forests, some models of rare and endangered plants, posters and charts showing plant diversity and environmental problems are to be made to make Herbarium more educative and informative. Keeping this in view a spacious Hall has been provided. The entire Herbarium material lodged on the first floor has been shifted to this hall. The systematic arrangement of materials is being done.

On the National Science Day (28th February, 1995) about 500 students from various educational organisations visited the Herbarium and took keen interest in various exhibits.

Preparation of the Inventory of Herbarium holdings (Carpothek and Xylarium) is in progress. This year about 550 plant specimens have been collected from different localities in Madhya Pradesh. About 80 samples of fruits and seeds have also been collected from different localities in Uttar Pradesh, Madhya Pradesh and Gujarat. During the year, about 200 herbarium sheets were checked for their correct identification; 600 plant specimens mounted and identified, and about 40 pollen and 110 wood slides prepared.

The holdings of the Herbarium materials are as under:

Particulars	*Additions during 1994-95*	*Total*
Herbarium		
Herbarium sheets of plant specimens	600	14,175
Herbarium sheets of leaf specimens	100	315
Xylarium		
Wood blocks	30	3,988
Wood discs	-	32
Wood core samples	109	440
Wood slides	100	4,838
Sporothek		
Pollen slides	40	11,459
Carpothek		
Fruits/seeds	80	2,356

This year, the Herbarium facility have been provided to the following :

Dr A.R. Saxena
Department of Botany,
D.A.V. Degree College,
Azamgarh

Mr S.K. Shukla
Department of Botany,
Garhwal University,
Srinagar,
Garhwal

Mr Haresh Kumar Singh
Department of Geology,
Faculty of Science,
M.S. University,
Baroda, Gujarat

Dr V.P. Mishra
Palaeontology Division
G.S.I. (Northern Region)
Lucknow

Miss Charu Gupta
Department of Botany,
Allahabad University
Allahabad

Dr A.S. Reddy
Department of Life Sciences,
Sardar Patel University,
Vallabh Vidya Nagar,
Gujarat

Mr R.K. Kera
Flixir Pharmaceuticals Ltd.,
Mull Building,
Ashok Marg,
Lucknow

Students of Department of Botany,
Delhi University,
Delhi

Museum

Dissemination of palaeobotanical knowledge is one of the main objectives of the Institute. Museum is also a nodal centre for undertaking such activities. On the occasion of 82nd Indian Science Congress at Jadavpur, Calcutta, an exhibition was arranged from January 2-8, 1995 on the theme "Lab to Man". The exhibition was inaugurated by honourable Sri Pranab Mukherji, Minister for External Affairs, Government of India. He took keen interest in the exhibits. Besides the delegates of the Congress, a large number of visitors visited the stall. To popularise the Palaeobotany, pamphlets about the Institute and its activities were distributed to the public.

National Science Day was also celebrated at the Institute. This year the theme of National Science Day was *"Science for health"*, hence an exhibition on the Medicinal plant remains of ancient India, and plant allergens was organised. Popular lectures were delivered by the Institute's scientists in the Institute as well as in local schools and colleges. A science quiz competetion was held jointly with Regional Science Centre, Lucknow and prizes were distributed to winners. 28th February, 1995 was observed as an Open House Day. About 500 students of 10 educational institutions visited the Institute's Museum, Library, Herbarium and other Laboratories. Educational films were also screened to the visitors.

Shifting of fossil repository and store from ground floor to the basement was completed. The process of rearrangement is nearing completion.

Data entering in computer and checking of specimens pertaining to Inventory - Part III is in progress. The work of preparing bilingual labels for Museum has been initiated.

Several fossil specimens were sent to seven educational institutions in the country under our special programme PALAEOBOTANY FOR EDUCATION.

Students and teachers of fourteen educational institutions visited the Museum. Scientists from U.S.A., U.K. and Hungary also paid a visit to the Museum.

Type and Figured specimens/slides/negatives

To the Repository of the Museum, the scientists of the Institute deposited specimens/slides/negatives of research papers submitted by them for publication.

Particulars	*Additions during 1994-95*	*Total*
Type and Figured specimens	83	5,287
Type and Figured slides	249	10,998
Negatives of the above	554	14,359

New Collections

Specimens/samples collected from 127 localities of the country, collected during field excursions, were submitted to the Museum by the Institute's staff.

Department	*Specimens*	*Samples*
Non-Vascular Plants	464	271
Palaeophytic Evolutionary Botany	413	8
Mesophytic Evolutionary Botany	891	-
Cenophytic Evolutionary Botany	338	-
Post-Gondwana Palynostratigraphy of Peninsular India	-	1,778
Planktonology	-	194
Quaternary Biogeography and Archaeobotany	-	596
Biodiagenesis	-	220
Pre-Gondwana and Gondwana Palyno-stratigraphy of India	-	1,490
Post-Gondwana Palynostratigraphy of Extra-Peninsular India	-	737

Presentation of fossil specimens

Department of Geology, Delhi University, Delhi

Department of Geology, Govt. Institute of Science, Aurangabad

Government Maharaja College, Chhatterpur, M.P.

National Science Centre, Pragati Maidan, New Delhi

Department of Botany, Science College, Dhule

City Montessori School, Aliganj, Lucknow

K.N. Kaul Institute of Life Sciences, Kanpur University, Kanpur

Institutional Visitors

University of North Bengal, Siliguri

Kendriya Vidyalaya, Aliganj, Lucknow

Eitheraj College for Women, Madras

Government Maharaja College, Chatterpur, M.P.

Gargi College, New Delhi

Teachers attending Refresher Courses, organised by Academic Staff College, Lucknow University, Lucknow

Seth M.R. Jaipuria School, Lucknow
Rani Laxmi Bai Memorial School, Lucknow
St. Dominic Savio College, Lucknow
I.T. College, Lucknow
Jai Narain Degree College, Lucknow
Lucknow University, Lucknow
Doon School, Dehradun
Eram Convent, Lucknow
St. Mary Convent, Lucknow

Section Cutting Unit

The Section-Cutting Unit is one of the basic requirements for palaeobotanical investigations of megafossils. The unit, established in a spacious hall, has four section-cutting machines and two grinding machines. This year a heavy-duty rock-cutting machine was fabricated locally and got installed. The machine has now enabled the scientists to have sections of large specimens.

In addition, state-of-art cutting and lapping machines from the Logitech Ltd., Glasgow, U.K. have been added to this Unit. These machines are installed in a separate air-conditioned room attached to the main hall of Section-Cutting Unit. The machine will cater the need of the scientists for obtaining well polished specimens and slides of precise and uniform thickness.

Maceration Facilities

Improvement in the existing facilities for maceration and processing of the research material was a long felt requirement of the scientists working at the Institute. Required funds were made available to renovate the Maceration Rooms — three old maceration rooms plus an adjoining room converted into a Preparation Room. The three Maceration Rooms are provided with newly installed Fume-Hood chambers, working tables with spartex tiles, covered racks for chemicals, new sinks, changed water taps, vinyl flooring, etc. Likewise, the Preparation Room, too, has been renovated with updated working facilities.

Electronic Data Processing Unit

This unit was involved in several types of activities like — Computer training to staff, Library information management system, software development for scientific, administration and accounts section, providing technical support to staff, rendering basic maintenance to the systems, and planning for the coming year.

This year Computer Hardware procurement was done. After thorough evaluation of various systems by a competent committee constituted for the purpose, the systems were acquired and installed in October, 1995. With the inclusion of Nine ATs (three 486DX/33 & six 486SX/25), the total number of systems rose to 25. The systems were then redistributed to various departments. COREL VENTURA 4.2 under MS Windows 3.1, a publishing software, was also procured for pagemaking. This has given a fillip to the computing facilities in the Institute.

Second In-house Computer Training Programme was organised from July to October in 3 batches to train 50 staff members of the Institute and 8 faculty members from Lucknow University (Geology and Botany Departments). Courseware was redesigned in WordStar 6.0 and Master Copy was printed on Laser Printer.

For making the improvements in our Library, CDRI and IIM libraries were visited to understand their working. The BLIMS (BSIP Library Information Management System) System developed in UNIX/UNIFY/C environment was fine tuned and finally installed for regular use in the Library. Cabling and testing of the network were carried out to put a terminal at library issue-return counter.

Lower Division Clerks recruitment process was conducted on the computers. Application processing, related reports, shortlisting of the candidates for entrance examination, preparation of results, shortlisting for typing and interview were some major tasks involved.

Budget casting for the year 1994-95, Monthly Account Report and Cash book were also carried out at Accounts Section Terminal.

Designing and Laser Printing of various Charts, Banners, Displays, Slides and Posters were also done for the scientists.

Publications of the Institute

Journal—The Palaeobotanist

This year Number 2 and 3 of Volume 42 of the Institute's Journal "*The Palaeobotanist*" were published.

The manuscripts of the next issue, i.e., Volume 43(1) were edited and sent to Press for publication.

Manuscripts of the next Special Volume 44 of "*The Palaeobotanist*" were also taken up for processing and some of them were edited. This Special Volume would be published as the First Golden Jubilee Volume and shall be released on 10 September, 1995. The remaining manuscripts received for this Volume would appear in the Second Golden Jubilee Volume of The Palaeobotanist.

Another Special Publication entitled "*Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology*" would also be published and released on 10 September, 1995. Some of the manuscripts of this book were sent to Press for publication. The remaining manuscripts are being edited.

Annual Reports

The Annual Reports of the Institute for the year 1993-94, both in English and Hindi were published and sent to various institutions and organizations. Besides the Institute's regular activities, other ceremonial activities were also included in the Report which were reproduced by colour photos.

Sale of Institute's publications

This year the publications of the Institute netted an income of Rs. 2,14,797.50, out of which about Rs. 1,20,993.00 were earned in foreign exchange which is approximately equivalent to us US $ 3,903.00.

Distinguished Visitors

Professor Satish Dhawan
Ex-Chairman ISRO, Bangalore

Professor U.R. Rao
Ex-Chairman ISRO, Bangalore

Dr K. Kasturirangan
Chairman ISRO, Bangalore

Professor B.M. Johri
Emeritus Scientist,
Delhi University, Delhi

Dr M.A. Rau
Deputy Director (Retd.),
Botanical Survey of India, Mysore

Dr Barun Baru
11 Margoy, Q. Hill, CT. U.S.A.

Dr J. Richardson
Medowside Little Thope Recom
N. Yorkshire, England

Dr A.K. Moitra
INSA, New Delhi

Professor John Anderson
National Botanical Institute, Pretoria, South Africa

Professor G.F. Hart
Louisiana State University, Baton Rouge, U.S.A.

Dr S.A. Rasool
Director, IGBP, University of Paris, France

Professor W.G. Chaloner, F.R.S.
Bourne Royal Holloway, University of London, U.K.

Dr A. Spicer
Department of Earth Sciences
The Open University, Milton Keynes,
England

Dr K.S. Valdiya
Professor of Geology, Kumaon University,
Nainital

Scientific Personnel

Director

R.S. Tiwari, Ph.D., F.Pb.S., F.I.A.P., F.P.S., F.S.G.

Deputy Directors

K.P. Jain, Ph.D., F.Pb.S., F.I.A.P., F.P.S.
Hari K. Maheshwari, Ph.D., F.Pb.S., F.I.A.P., F.P.S., F.G.S.
P.K. Maithy, Ph.D., F.Pb.S., F.P.S.
G. Rajagopalan, Ph.D., F.Pb.S., F.S.G.

Assistant Directors (Special Grade)

Anand-Prakash, Ph.D., F.I.A.P., F.Pb.S.
Nilamber Awasthi, Ph.D., F.Pb.S., F.I.A.P.
Anil Chandra, Ph.D., F.P.S., F.S.G.
Shaila Chandra, Ph.D., F.S.G., F.Pb.S.
H.P. Gupta, Ph.D., F.I.A.P.
S.A. Jafar, Dr.Phil.nat., F.P.S.
R.K. Kar, Ph.D., F.Pb.S.
Chhaya Sharma, Ph.D., F.I.A.P.
Suresh C. Srivastava, Ph.D., F.I.A.P., F.Pb.S.

Assistant Directors

Krishna Ambwani, Ph.D., F.S.G., F.P.S.
J.S. Antal, Ph.D.
Jayasri Banerji, Ph.D.
Rahul Garg, Ph.D., F.P.S., F.S.G.
C.M. Nautiyal, Ph.D.
K.S. Saraswat, Ph.D., F.B.S.
R.K. Saxena, Ph.D., F.S.G., F.P.S.
Manoj Shukla, Ph.D., F.G.S.
A.K. Srivastava, Ph.D., F.S.G., F.I.C.S.
G.P. Srivastava, Ph.D.
Shyam C. Srivastava, Ph.D.
Archana Tripathi, Ph.D., F.P.S., F.G.A.R.C.

Senior Scientific Officer

Anil Agarwal, Ph.D.
Ram-Awatar, D.Phil. (w.e.f. 26.07.94)
Usha Bajpai, Ph.D.
J.S. Guleria, Ph.D.

B.N. Jana, Ph.D.
Neerja Jha, Ph.D.
H.A. Khan, Ph.D.
Asha Khandelwal, Ph.D.
Pramod Kumar, Ph.D.
J.P. Mandal, Ph.D.
B.K. Misra, Ph.D., F.S.G.
M.R. Rao, Ph.D.
Samir Sarkar, Ph.D.
Rakesh Saxena, Ph.D.
R.S. Singh, Ph.D.
Chanchala Srivastava, Ph.D.
S.K.M. Tripathi, Ph.D.
Vijaya, Ph.D., F.L.S., F.P.S.
R.R. Yadav, Ph.D.

Junior Scientific Officers

Rupendra Babu, Ph.D.
S.K. Bera, Ph.D.
Amalava Bhattacharyya, Ph.D.
A.P. Bhattacharyya, Ph.D.
M.S. Chauhan, Ph.D.
Anita Dwivedi, Ph.D.; (Up to 11.08.94 A.N.)
A.K. Ghosh, Ph.D. (w.e.f. 21.04.94)
Asha Gupta, Ph.D., F.L.S., F.P.S.
Khowaja-Ateequzzaman, Ph.D.
Madhav Kumar, Ph.D.
B.D. Mandaokar, Ph.D.
K.L. Meena, Ph.D.
R.C. Mehrotra, Ph.D.
Jitendra Pandey, Ph.D.
Neeru Prakash, Ph.D.
Mahesh Prasad, Ph.D.
Vandana Prasad, Ph.D.
A. Rajanikanth, Ph.D., F.G.S.
Jyotsana Rai, Ph.D.
D.C. Saini, Ph.D.
O.S. Sarate, Ph.D., LL.B.
Mukund Sharma, Ph.D., F.G.S.
Alpana Singh, Ph.D.
B.D. Singh, Ph.D., F.S.G.
K.J. Singh, Ph.D.
Rashmi Srivastava, Ph.D.

Rajni Tewari, Ph.D.
G.K. Trivedi, Ph.D., F.P.S.

Emeritus Scientist

H.P. Singh, Ph.D., F.Pb.S.

Birbal Sahni Research Scholars

Ratan Kar, M.Sc.
Manisha Nanda, M.Sc.
K.K. Pandey, M.Sc. (Up to 24.02.95 A.M.)
A.K.S. Pokharia, M.Sc.
S.M. Singh, M.Sc.

Sponsored Project (DST)

Deepak Kohli, M.Sc. (SRF)
Poonam Sharma, M.Sc. (JRF)

Technical and Administrative Personnel

Laboratory Services

H.N. Boral, B.Sc. (S.T.O.)

B. Sekar, B.Sc., A.I.C. (T.O.)

Madhavi Chakraborty, M.Sc. (J.T.O.)

Indra Goel, B.Sc. (J.T.O.)

Asha Guleria, B.Sc. (J.T.O.)

E.G. Khare, M.Sc. (J.T.O.)

T.K. Mandal, B.Sc. (J.T.O.)

V.K. Singh, M.Sc. (J.T.O.)

Reeta Banerji, B.Sc. (S.T.A.)

Chandra Pal, B.Sc. (S.T.A.)

V.P. Singh, B.Sc. (S.T.A.)

A.K. Srivastava, B.Sc. (S.T.A.)

R.C. Misra, B.Sc. (J.T.A.)

Keshav Ram, B.A. (J.T.A.)

Publication

R.L. Mehra, B.A., D.P.T., P.G.D.C.A. (Proof Reader)

Library

Kavita Kumar, B.Sc., B.Lib.Sc. (S.T.A.)

Mamta Navrekar, B.Sc. (J.T.A.– Computer)

V.K. Nigam, M.Com., B.Lib.Sc. (J.T.A.)

Y.P. Singh, B.Tech. (J.T.A.–Computer)

S.R. Yadav, B.A. (J.T.A.)

Avanish Kumar, B.Sc., LL.B., P.G.D.C.(Console Operator)

Museum

J.N. Nigam, B.A., B.Lib.Sc. (J.T.O.)

P.K. Bajpai, B.F.A. (J.T.O.–Artist)

Kamla M. Chhabra, B.Sc. (J.T.O.)

Diwakar Pradhan, B.Sc. (S.T.A.)

Prem Prakash, B.Sc. (S.T.A.)

Shree Narayan Meena, B.Sc. (J.T.A. w.e.f. 08.04.94)

Herbarium

Sunita Khanna, B.Sc. (S.T.A.)

Photography

P.C. Roy (S.T.A.)

Pradeep Mohan, B.F.A. (J.T.A.)

Technical Services

Kamal Narang, B.Tech. (Programmer – Computer)

K. Nagapooshanam, B.Tech. (Programmer – Computer, w.e.f. 13.05.94)

Madhukar Arvind, B.Sc. (J.T.A.– Computer)

R. Nandhagopal, B.Sc.,P.G.D.C.A.,C.S.A. (J.T.A. –Computer)

A.K. Srivastava, B.Com., B.Lib.Sc. (Console Operator)

Vinesh Kumar, B.Sc. (J.T.A., w.e.f. 05.04.94)

Chandra Bali, I.T.I., N.C.T.V.T. (Mechanic)

A.K. Ghosh, G.I.T.I., N.C.T.V.T., E.S.C. (Electrician)

Chhotey Lal, I.T.I., N.C.T.V.T., D.E.E.S.I. (Mechanic)

V.S. Panwar (Glass Blower)

M.S. Rana (Generator Operator)

P.S. Saluja, S.T.S.C.T.I. (Mechanic II-5)

S.C. Singh, B.A. (Mechanic-cum-Section Cutter)

Sponsored Projects

Jagdish Prasad (T.A.)

Administration

Registrar

S.C. Bajpai, M.Sc., LL.B., F.I.E.T.E.

Accounts Officer

J.C. Singh, M.A.

P.S. to Director

S.P. Chadha, B.A.

Section Officers

B.K. Jain, B.A.

I.J. Mehra, B.A.

Bhagwan Singh

H.S. Srivastava, B.Com.

R.K. Takru, B.A.

Maintenance Officer

R.B. Kukreti, B.A.

Assistants

I.J.S. Bedi

Ramesh Chandra

N.N. Joshi

Upper Division Clerks

Usha Chandra

R.K. Kapoor, B.A.

Hari Lal

V. Nirmala

P. Thomas

Cashier

Dhoom Singh, B.A.

Jr. Stenographer (Temporary)

M. Jagath Janani, B.A.

Lower Division Clerks

Ruchita Chatterji, M.A.

Swapna Mazumdar, B.A.

S. Murukan Pillai, B.A.

Shail S. Rathore, B.A.

Gopal Singh, B.A.

K.P. Singh

Renu Srivastava, M.A.

Koshy Thomas

N. Unnikannan

S.S. Panwar, B.A. (w.e.f. 08.12.94)

Shiv Shanker Shastri (w.e.f. 08.12.94)

Mishri Lal, M.A. (w.e.f. 08.12.94)

Sunit Kumar (w.e.f. 09.12.94 to 18.12.94)

Avinash Kumar Srivastava, B.A., B.Ed. (w.e.f. 03.01.95)

Rameshwar Prasad (w.e.f. 12.12.94)

Drivers

Nafees Ahmed

D.K. Misra

M.M. Mishra

Balbir Singh

V.P. Singh

Attendants

K.C. Chandola

Prem Chandra

Sunder Lal

Haradhan Mahanti

Raja Ram

Satruhan

Ram Singh

General Help

Sarju Prasad (Daftari)

Sia Ram (Duplicating Machine Operator)

Mohammad Shakil (Binder)

Rameshwar Prasad Pal (Skilled Mali)

Peons

K.K. Bajpai, B.A.

Maya Devi

Hari Kishan

Dhan Bahadur Kunwar

S.C. Mishra

Munni

Kailash Nath

Mani Lal Pal

Mahadev Prasad

Ram Dheeraj

Ram Kishan

Ram Ujagar

Shree Ram

Bam Singh

Kedar Nath Yadav

Chowkidars

Bishnu Dutt

Kesho Ram

Vishnu Kumar

Ram Deen

Ram Dhari

Prem Shanker

Appointments and Promotions

Appointments

Dr Ram- Awatar, Senior Scientific Officer, w.e.f. 26.07.94

Dr Amit Kumar Ghosh, Junior Scientific Officer, w.e.f. 21.04.94

Dr (Mrs) Anjum Farooqui, Junior Scientific Officer, w.e.f. 23.06.94

Sri K. Nagapooshanam, Programmer, w.e.f. 13.05.94

Sri Vinesh Kumar, Junior Technical Assistant, w.e.f. 5.04.94

Sri Shree Narayan Meena, Junior Technical Assistant, w.e.f. 08.04.94

Miss Mamta Navrekar, Junior Technical Assistant, w.e.f. 18.04.94

Sri Shailendra Singh Panwar, Lower Division Clerk, w.e.f. 08.12.94

Sri Shiv Shanker Shastri, Lower Division Clerk, w.e.f. 08.12.94

Sri Mishri Lal, Lower Division Clerk, w.e.f. 08.12.94

Sri Sunit Kumar, Lower Division Clerk, w.e.f. 09.12.94

Sri Rameshwar Prasad, Lower Division Clerk, w.e.f. 12.12.94

Sri Avinesh Kumar Srivastava, Lower Division Clerk, w.e.f. 03.01.95

Sri Ram Kewal, Mali, w.e.f. 20.06.94

Sri Mathura Prasad, Mali, w.e.f. 20.06.94

Sri Ram Chander, Mali, w.e.f. 20.06.94

Promotions

Dr Hari K. Maheshwari, A.D. (SG) to Deputy Director, w.e.f. 01.04.94

Dr P.K. Maithy, A.D. (SG) to Deputy Director w.e.f. 01.04.94.

Dr (Mrs) Chhaya Sharma, A.D. to Assistant Director (Special Grade), w.e.f. 01.04.94

Dr S.A. Jafar, A.D. to Assistant Director (Special Grade), w.e.f. 01.04.94

Dr R.K. Saxena, S.S.O. to Assistant Director, w.e.f. 01.04.94

Dr (Mrs) Archana Tripathi, S.S.O. to Assistant Director, w.e.f. 01.04.94.

Dr K. Ambwani, S.S.O. to Assistant Director, w.e.f. 01.04.94

Dr Manoj Shukla, S.S.O. to Assistant Director, w.e.f. 01.04.94

Dr Rahul Garg, S.S.O. to Assistant Director, w.e.f. 01.04.94

Dr (Mrs) Chanchala Srivastava, J.S.O. to Senior Scientific Officer, w.e.f. 01.04.94

Sri H.N. Boral, T.O. to Senior Technical Officer, w.e.f. 01.04.94

Sri E.G. Khare, S.T.A. to Junior Technical Officer, w.e.f. 01.04.94

Smt Kavita Kumar, J.T.A. to Senior Technical Assistant, w.e.f. 01.04.94

Sri Avinesh Kumar Srivastava, J.T.A. to Senior Technical Assistant, w.e.f. 01.04.94

Smt Reeta Banerjee, J.T.A. to Senior Technical Assistant, w.e.f. 01.04.94

Sri Chandra Pal, J.T.A. to Senior Technical Assistant, w.e.f. 01.04.94

Sri V.P. Singh, J.T.A. to Senior Technical Assistant, w.e.f. 01.04.94

Sri P.S. Saluja, Mechanic Gr. II(4) to Mechanic Gr. II(5), w.e.f. 01.04.94

Birbal Sahni Research Scholar

Smt Shinjini Sarana, M.Sc., Birbal Sahni Research Scholar, w.e.f. 31.08.94

Sponsored Projects

Dr Rashmi Tewari, M.Sc., Ph.D. Research Associate, w.e.f. 5.10.94

Smt Priti Agarwal, M.Sc., Junior Research Fellow, w.e.f. 5.10.94

Sri Shantanu Chatterjee, M.Sc. Junior Research Fellow, w.e.f. 28.10.94

Sri V.D. Gupta, Technical Assistant, w.e.f. 5.10.94

Sri L.M. Joshi, Field Assistant, w.e.f. 05.10.94

Retirements

Sri J.C. Srivastava, Junior Technical Officer (Herbarium) retired on 30.06.94.

Obituaries

Sri Rajendra Kumar, Attendant expired on 28.09.94.

Research

Projects and Programmes

PROJECT 1 : ANTIQUITY, RADIATION AND EVOLUTIONARY PATTERNS OF EARLY LIFE

Programme 1.1 : **Palaeobiology of Vindhyan Basin**

Objective : *To identify metaphytes and metazoan body fossils, ichnofossils and their relics from the Proterozoic succession and their evolution and diversification*

: *To identify organo-sedimentary structures found in association of metaphytes and metazoans and to decipher environmental conditions*

: *To determine the significance of metaphytes and metazoans in biostratigraphy*

Black chert containing oncolites, stromatolites and interbedded cherts from the Nagod Limestone Formation, Bhander Group of Khemri-Kotar Hill, Satna District, Madhya Pradesh were studied. A mat building biota was identified. The mat contains colonial spheroidal remains and tubular aseptate forms, both belonging to Cyanobacteria. Problematic marks from the same formation (at Bainkuiyan) were also investigated. The marks compare with ichnofossils, belonging to surface trails. Two types are discernible in which

A trace fossil (x 5) from Bhander Limestone Formation exposed around Bainkuiyan area, Rewa District, Madhya Pradesh.

one shows paired remains while the other rentring one. The first may be the tracks of arthropod movement and the second of an annelid.

Study of macrofossils referable to problematic algae collected from the argillaceous sediments of Rohtas Formation exposed at Murlipahar and Amjhore, Rohtas District, Bihar was completed. The algal forms are distinctly segmented bearing laterally spheroidal structures or ?fruiting bodies. Morphologically it appears to be nearer to Phaeophyceae forms or Ectocarpales.

P.K. Maithy & Rupendra Babu

Programme 1.2 : Palaeobiology of the Proterozoic sediments in Cuddapah, Kaladgi and Bhima basins

Objective : To record distribution of Precambrian microfossils in Proterozoic succession of Cuddapah, Kaladgi and Bhima basins

Diversified organic remains have been recorded from the Halkal Shale Formation, Bhima Basin. The megascopic circular, elongated, linear and curved carbonaceous compressions and impressions have been recorded on the bedding surface of shales from Kolkur, Gundgurthi and Chennur villages. Some of the forms compare with *Chuaria, Beltinia* and *Ovidscina*. The affinities of linear forms is being examined. The section measurement has been done at these localities to chart the precise vertical distribution of the carbonised films. These forms show gigantism at certain levels.

The rock samples from Sahabad Limestone Formation and Rabanpalli Sandstone Formation show poorly preserved movement traces. Detailed study of these traces was continued to understand their affinity and stratigraphic importance, if any.

Acid resistant organic remains recovered through maceration of shales from Kolkur Village show the presence of smooth-walled acritarchs, filamentous algal sheaths and coccoid algae. Presence of mineralised shell pieces has also been recorded in bulk maceration using hydrofluoric acid. The affinities of these shells are being worked out.

Manoj Shukla & Mukund Sharma

Programme 1.3 : Calcareous skeletal algae from Indian Phanerozoic sediments

Objective : To study the morphology of skeletal algae and their significance in biostratigraphy

A survey of literature was made concerning the previous work done in calcareous algae from the Phanerozoic sediments of India.

Thin sections of calcareous limestones were made and 150 slides were prepared from the previously collected samples from the Cretaceous of Bagh Group, Dhar District, Madhya Pradesh and Niniyur Group of Tiruchirapalli District, Tamil Nadu. Study of calcar-

Axial vertical section of *Rivularia lissaviensis* (Bornemann 1887) Dragastan 1985 filaments (x 50) from the Upper Cretaceous near Sendurai, Niniyur Group, Tamil Nadu.

eous algae belonging to Cyanophyceae, Chlorophyceae and Rhodophyceae was carried out. *Actinoporella cretacia* was recorded for the first time from the Cretaceous of Bagh beds.

Calcareous fossil algae belonging to the group Porostromatae were described for the first time from the Cretaceous of Sendurai, Tiruchirapalli District, Tamil Nadu. The algal biota consists of : *Rivularia lissaviensis, R. piae, R. theodori* and *Rivularia* sp. cf. *R. dianae* belonging to the family Rivulariaceae (Cyanophyceae) and *Garwoodia toomeyi* belonging to the family Codiaceae (Chlorophyta).

Nomenclatural problem on the coralline red alga — *Archaeolithothamnium* Rothpletz has been resolved and all the species of *Archaeolithothamnium* recorded from India have been transferred under the genus *Sporolithon* Heydrich based on priority. A manuscript entitled " On the present status of the Coralline red alga *Archaeolithothamnium* Rothpletz recorded from India" has been prepared.

P.K. Maithy, B.N. Jana & A.K. Ghosh

PROJECT 2 : GONDWANA COAL AND ASSOCIATED SEDIMENTS : GENESIS, FLORAL EVOLUTION AND BIOSTRATIGRAPHY

Programme 2.1 : Morphotaxonomy, floristics, evolution and stratigraphic significance of plant fossils in Koel Valley and Jharia Coalfield

Objective : *To study morphotaxonomy, evolution and stratigraphical distribution of the flora*

: *To decipher ecological and climatological regimes*

Investigation on plant fossil assemblages from Murup, Datum and Sikri collieries of Auranga Coalfield and Rajhara colliery of Daltonganj Coalfield was completed. The flora is represented by the species of *Sphenophyllum, Trizygia, Neomariopteris, Gangamopteris, Glossopteris, Noeggerathiopsis, Saportaea, Rhipidopsis, Ginkgoites* and *Paranocladus*-type conifer.

Number of *Vertebraria* axes recovered from the coal seams of Sikni open-cast project and from the section exposed in Sukri River near Sassang Village were studied. Their vertical position and morphological features possibly indicate their *in-situ* preservation in the Auranga Coalfield.

A.K. Srivastava

Identification and photodocumentation of 17 species of the genus *Glossopteris* recovered from different collieries, viz., Nichipur, Gondudih, Khas Kusunda, Godhar, Basuria and East Basuria of the Jharia Coalfield have been completed. Apart from *Glossopteris* leaves, the presence of the species of *Sphenophyllum, Noeggerathiopsis, Neomariopteris, Gangamopteris, Lidgettonia* and different types of seeds has also been recorded. This is the first report of well-preserved plant megafossils from the Barakar Formation of Jharia Coalfield, Bihar.

Ten samples from the Talchir Formation in Libji Nala, Amanat and Sukri rivers were macerated to recover seeds and megaspores but were found to be barren.

Rajni Tewari

Programme 2.2 : **Comparative morphology, floristics, biostratigraphy and palaeoecology of Permian Gondwana plants in Son-Mahanadi Graben**

Objective : *To study morphotaxonomy, floristics, biostratigraphy and palaeoclimate of the Permian Gondwana formations in the area*

: *To study fructifications in order to understand the evolutionary aspect of pteridophytes and gymnosperms*

Study of plant fossils from Talcher Coalfield were carried out. Cuticular preparations of the leaf forms–*Gangamopteris, Noeggerathiopsis, Glossopteris* and *Surangephyllum* collected from the South Belanda Colliery were made. The morphotaxonomic studies of *Gangamopteris cyclopteroides, G. subauriculata, G. attenuata, Noeggerathiopsis hislopi, Glossopteris communis, Schizoneura wardii, Surangephyllum indicum* were completed. The flora indicates Early Permian age for Seam 1 of the South Belanda Colliery.

Epidermal features of a new species *Euryphyllum maithyi* are reported, besides three specimens assignable to the type species of the genus *E. whittianum* Feistmantel. SEM studies of the epidermal features are continued.

A conifer twig with attached seed from south Belanda Colliery, Talchir Coalfield, Orissa.

Conifer cuticles from South Belanda colliery were also prepared and examined.

Shaila Chandra & K.J. Singh

Programme 2.3 : **Evolutionary perspective of megafloral diversification in the Nidpur plant bed**

Objective : *To carry out fine resolution, morphotaxonomical investigations and to decipher affinities and inter-relation of different plant organs*

: *To attempt whole plant reconstructions*

Eight types of detached fruiting bodies and five attached types have been categorized. On the rock surface six specimens have been found identical to the one isolated from bulk maceration. In all, 167 specimens have been photographed, out of which drawings of 157 specimens have been prepared.

From amongst the forked *Dicroidium*, *D. odontopteroides* has been identified on the basis of exomorphic and epidermal features. So far, the records were made only upon external morphology and the specimens were not forked. Presence of *D. odontopteroides* in Nidpur bed is of significance because of its wide-spread occurrence all over the Gondwanaland.

Nearly 500 specimens of *Dicroidium* leaf in varied forms are being studied in order to evaluate the fossil population of *Dicroidium* found in the Indian Peninsula as well as in other Gondwana regions.

Shyam C. Srivastava

Programme 2.4 : Palynostratigraphy of Gondwana Sequence in Son-Mahanadi Graben

Objective : *To analyse palynoassemblages with a view to interpret floral changes, boundary transitions and age determination at a finer level in the intra-formational succession of Son Valley coalfields*

: *To identify Talchir/Athgarh relationship in the Talcher Coalfield and Athgarh Basin*

The palynological studies of samples of bore-hole TCC-19, drilled by Geological Survey of India near Chendipada, Talcher Coalfield have yielded three distinct palynoassemblages. The Assemblage I is recorded from the lowermost coal horizon of the sequence at 170.96 to 177.24 m depth, dominated by the pteridophytic spores –*Microbaculispora* together with *Brevitriletes and Lacinitriletes*. The Assemblage II at 65.60 to 169.22 m depth is dominated by the nonstriate bisaccate *Scheuringipollenites* and is recorded from the coal-bearing sediments just below the marker conglomeratic pebbly bed. Assemblage III, recorded at 10.75 to 60.47 m depth in the coal-bearing horizon above the conglomeratic bed, shows the dominance of striate bisaccate pollen *Faunipollenites* and *Striatopodocarpites*. The Assemblages I and II are comparable with the palynoflora of Early Barakar Stage while Assemblage III is comparable to the mioflora of Late Barakar Stage. The occurrence of acritarchs at 65.60 to 67.21 m and 10.75 to 60.45 m depth indicates presence of high salinity condition which started before the deposition of conglomeratic bed and continued even after its deposition. The palynofacies analysis of coal samples reveals that low energy, lacustrine conditions were prevailing during the coal deposition.

The palynological studies of bore-hole TP-8, drilled by MECL in Talcher Promotional Block, reveal Late Permian assemblage equivalent to Raniganj palynoflora of Damodar Basin and is represented by the dominance of *Striatopodocarpites* and *Faunipollenites* along with characteristic palynotaxa, viz., *Gondisporites, Navalesporites, Satsangisaccites* and *Falcisporites*. The taxa *Lundbladispora, Playfordiaspora, Lunatisporites* and *Goubinispora* at 350 m depth indicate its affiliation with Early Triassic palynoassemblage of Raniganj Coalfield. The assemblages from younger levels have dominance of *Striatopodocarpites* but with increased frequency of *Lundbladispora* and *Lunatisporites* at 334.00 m depth and

Lunatisporites alongwith *Guttatisporites, Lundbladispora* and acritarchs at 307.30 m depth. The composition of assemblage from 334.00 m depth shows presence of distinct Early Triassic assemblage.

Archana Tripathi

Samples from bore-holes TP-9 and TP-10 drilled by MECL have been analysed for palynodating. The sandy shales and sandstones representing the Supra-Barakars have yielded *Lundbladispora, Lunatisporites, Playfordiaspora* representing Early Triassic assemblage at 280.50 to 259.50 m (in TP 9) and 352.80 m (in TP 10) depths.

Archana Tripathi & K.L. Meena

The palynological studies of samples of bore-hole RT-12 from Mand-Raigarh Coalfield were carried out, in which Karharbari palynoassemblage encountered between 163.00 m to 316.00 m, Barakar palynoassemblage between 69.15 to 152.00 m and Raniganj assemblage was found at 35.00 m depths. The genus *Parasaccites* shows dominance in Karharbari assemblage, *Scheuringipollenites* in Barakar assemblage and the Raniganj assemblage is characterized by the presence of striate and non-striate genera such as *Faunipollenites, Crescentipollenites, Striatopodocarpites* and *Scheuringipollenites* alongwith several trilete genera such as *Microfoveolatispora, Microbaculispora*, etc.

B.N. Jana

Protoeusaccites gen. nov. from Pali Formation, Sohagpur Coalfield showing character state of partially filled saccus (x 850).

Compiled the results of bore-hole SPB-18, Sohagpur Coalfield in which three palynoassemblages have been identified. Assemblage-I (Leiosphaerid zone; depth 26.00-27.85 m) is mainly dominated by Leiosphaerids (80%) alongwith few striate bisaccate pollen. This seems to be a reworked palynoflora as the specimens are deformed. Assemblage-II (*Scheuringipollenites-Faunipollenites* Assemblage; depth 27.85-49.15 m) shows the dominance of non-striate bisaccate pollen alongwith few apiculate spores. The taxa in this assemblage are *Gondisporites raniganjensis* and *Faunipollenites perexiguus.* In Assemblage-III (*Faunipollenites-Striatopodocarpites* Assemblage Zone; depth 50.15-163.20 m) striate-bisaccates are dominant alongwith the rare occurrence of *Chordasporites* and *Weylandites*. The marker species in this assemblage are *Crescentipollenites fuscus* and *Corisaccites alutus.*

In two samples (SPB 18/78 and 82) a new pollen genus, *Protoeusaccites* has been identified which shows the development of saccus with partial eusaccate condition — a transitional character-state from protosaccate to eusaccate condition in Late Permian.

The overall assessment of palynotaxa in bore-hole SPB-14 shows the dominance of striate bisaccates (*Faunipollenites, Crescentipollenites, Striatopodocarpites*) alongwith *Gondisporites* which indicates Late Permian affinity and could be equated with Raniganj Formation of Damodar Graben.

Ram-Awatar

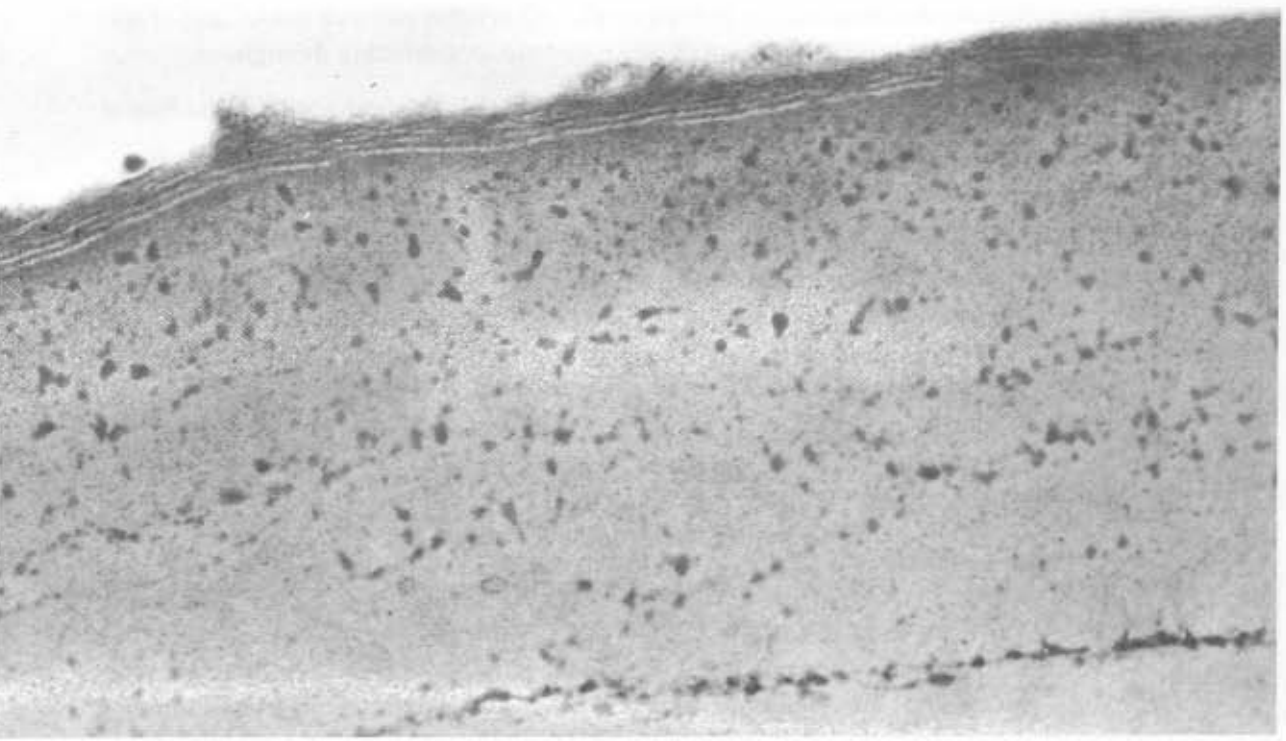
The age of the subsurface sediments below the Kamthi Formation in bore-hole IBSH-6 from Ib-River Coalfield has been determined. The palynoassemblage between 234.00-270.00 m is equivalent to the Raniganj palynozone. Photodocumentation is being done.

K.L. Meena

Programme 2.5 : **Morphological study of plant megafossils from Raniganj, Karanpura and Rajmahal coalfields and ultrastructure of megaspores, cuticles, seeds and *in situ* pollen/spores**

Objective : *To make extensive and exhaustive collections of leaf specimens of Gondwana gymnosperms, study their morphology, make cuticular preparations, establish relationship between morphography and epidermal features, objectively identify each species based on cuticles of extant gymnosperms, ultrastructure of in situ pollen/spores for fine resolution taxonomy and affinities*

Cuticles of Corystospermaceous pinnules recovered by bulk maceration of Late Triassic shale samples were processed for ultrastructure. The pinnules belong to three different types. Study of two types is almost complete, while cuticle of the third type has been embedded in resin.



Outer zone of the cuticular membrane in a Late Triassic corystospermaceous taxon showing a polylamellate layer at the leaf-air interspace (x 80,000).

In type 1, both the upper and lower cuticles exhibit two layers each, herein designated as layer A and layer B. The A layer is distinctly identifiable into an outer layer (the cuticle proper) and an inner layer (the cuticular layer). The B layer is the inner most layer present below the cuticular layer. All the layers of the cuticular membrane are not homogeneous structurally and chemically. In one species the outermost layer, i.e., the cuticle proper is a polylamellated layer made up of dark bands of electron dense areas alternating with the electron lucent area. The polylamellate layer comprises 5-6 lamellae which are compactly arranged. This layer (A1), at places is covered by the electron dense bodies. Earlier workers suggested that such bodies are osmiophilic granules which are highly lipophilic in nature. The cuticular layer (A2) seems to be amorphous which at places exhibits fine channel-like structures. These are the lamellated structures identified by the staining granules of lead citrate in position corresponding with those of the opaque lamellae. The B layer, the inner most and the thickest layer, seems to be spongy. The fibrillae are compactly arranged and oriented mainly parallel to the membrane surface and have a 'herring bone' appearance. At places this layer forms flanges or cuticular pegs between the walls of the adjacent epidermal cells.

In type 2, an entirely different number, thickness and demarcations of A1, A2 and B layers of the cuticle is seen. The A1 layer is amorphous with fine prochannels. The granular structures are stain particles. On the outer surface of the A1 layer are seen osmiophilic

granules which are discontinuously deposited. The A2 layer is electron dense and of uneven thickness. The B layer is made up of fine reticulate ultrastructure throughout.

H.K. Maheshwari & Usha Bajpai

Bulk maceration of shale samples from Karanpura and Chuperbhita coalfields, Bihar was done for recovery of dispersed microfossils. Most of the samples are unproductive; in a few samples some fragmentary cuticles were present. In one sample a ? sporangium has been found.

A large number of specimens of the leaf genus *Glossopteris* were cleared and photographed. Cuticles were also prepared from these specimens. Cellular outlines are usually not preserved in these cuticles.

H.K. Maheshwari & S.M. Singh

Programme 2.6 : Pattern of evolving palynofloras through Gondwana Sequence in Damodar Graben

Objective : To search for characters in dispersed spores and pollen useful for determining major changes in patterns of morphologies

Critical analysis of the published data on megaflora, mioflora and the associated geological information has been done to analyse palaeobiogeography at Carboniferous-Permian boundary as reflected in Early Permian palynoassemblages on Gondwanaland. This analysis has revealed that episodic glaciation in Late Carboniferous triggered the evolutionary shift in the existing *Lepidodendropsis* flora, which is evidenced by the astray records of *Glossopteris* leaf in Late Westphalian. Occurrence of a faintly striate disaccate pollen (*Pityosporites westphaliensis*) in this time span is significant to comment on its distant relationship with glossopterid group of plants.

Photodocumentation of characteristic species in selected samples (at 263.00, 252.00,

Playfordiaspora Maheshwari & Banerji emend. Vijaya 1995(x 1500)—an evidence of true saccus structure in Late Permian Raniganj Formation.

251.00, 248.00 m) of bore-hole PGD-2 has been completed. Distributional pattern of species of *Coptospora, Aequitriradites* and *Contignisporites* indicates Early Cretaceous palynocomposition in the Mesozoic sequence under study.

Detailed morphotaxonomic study of a monosaccate pollen-*Playfordiaspora* (in six samples of two bore-holes PGD-2 and RAD-11) at P/Tr transition on peninsular India, has revealed the eusaccate nature of saccus. This is the first observation of eusaccatism in saccate pollen at latest-Permian-Triassic level in widely separated palaeogeographical areas on Gondwanaland, Europe and America. Distribution of various species of this genus reveals it to be climatically controlled, as in northern hemisphere it had been recorded in subtropical region but in southern hemisphere it is found at higher latitude entering into cool temperate zone.

Vijaya

Programme 2.7 : **Composition, relationship and age of the megafossil flora of Rajmahal Formation**

Objective : *To study morphotaxonomy of fossils collected from various intertrappean beds*

: *To work out composition of flora in order to arrange different plant beds in a chronological sequence and to correlate with other coeval floras*

: *To reconstruct whole plant based on comparative studies of different plant organs*

A fruit cast resembling modern *Butea frondosa* from the intertrappean bed near Sonajori Village, Rajmahal Hills, Bihar.

A large number of chert blocks were cut into slices and slides prepared for analysing the megafloral composition of Sonajori locality. The assemblage so far investigated includes *Lycoxylon, Arauameylon, Araucarites*-cone, *Coniferocaulon, Pagiophyllum, Brachyphyllum, Mehtaia, Nipaniophyllum, Paradoxospermum, Pakurispermum, Sonajorispermum, Conites* spp. and an indeterminate fruit.

Morphotaxonomic investigation of assemblage at Murlipahar in Rajmahal is being done. The assemblage is dominated by cycadophytes and Filicales. Within cycadophytes, *Ptilophyllum* and *Otozamites* are encountered in the assemblage. Pteridophytes are represented by *Cladophlebis* and *Coniopteris*. This assemblage is correlated with the Neocomian fossil assemblage of Chunakhal locality, Rajmahal Basin.

Jayasri Banerji

Morphotaxonomic study of plant megafossils from Onthea has been carried out. The identified forms are : *Equisetites rajmahalense, Gleichenites* sp., *Todites indicus, Ptilophyllum cutchense, P. acutifolium, Pterophyllum* sp., *Taeniopteris spatulata, Elatocladus tenerrimus* and *Conites* sp. The Onthea flora on the whole is dominated by cycadophytes followed by pteridophytes. Conifers are rare in occurrence. The preliminary study of Onthea flora with the known fossil flora of other localities of Rajmahal Hills shows its close resemblance with the Chunakhal flora and suggests Early Cretaceous age.

Neeru Prakash

Programme 2.8 : **Palynological diversity and palaeoclimate through Gondwana sequence in Rajmahal Basin**

Objective : *To study selected horizons, mainly from bore-cores to fill the existing lacunae in the data for building a complete sequence*

: *To tag results with other data, such as megafloral and sedimentological information and geological set-up*

: *To determine age and palaeoclimatic condition as depicted by spore and pollen patterns*

The palynological studies of intertrappean sediments (45.00 to 163.00 m) in bore-hole RJNE-35 from the northern part of Rajmahal Basin have revealed the dominance of *Araucariasaccites/Podocarpidites*. The pteridophytic components are quantitatively poor but qualitatively diversified represented by *Cyathidites, Matonisporites, Ischyosporites, Cicatricosisporites* and *Contignisporites*. The hilate spores — *Aequitriradites* and *Cooksonites* are also recorded. So far no angiosperm pollen is found in this material. The composition reveals Early Cretaceous age and is correlated with the palynoflora recorded from intertrappean beds encountered in bore-hole RJNE-32.

Archana Tripathi

Programme 2.9 : **Organic petrographic evaluation of Permian coal seams**

from Rajmahal Basin, Bihar

Objective : *To assess the quality of coals for suitability in various industrial and domestic purposes with emphasis on coking and blending potentiality*

Qualitative study and quantitative estimation of macerals under fluorescence mode (blue light excitation) have been made on particulate coal pellets from bore-hole HRC-CM/107 of Hura Basin. Appreciably high amounts of hydrogen-rich macerals (liptinite and perhydrous vitrinite) have been recorded. The liptinite maceral group is chiefly constituted by sporinite and liptodetrinite. Cutinite, fluorinite, resinite, alginite (*Botryococcus* and Lamalginite) and exsudatinite are in subordinate amount. Sporinite showed wide range of preservational stages from well-preserved to highly degraded and fragmented. High amount of hydrogen-rich microconstituents in the coals renders them suitable for liquefaction.

Fifteen coal samples (out of 42) from bore-hole RCH-3 of Chuperbhita Coalfield have been re-estimated (under normal incident light) in terms of individual macerals to assess the Gelification Index and Tissue Preservation Index of coals. Biopetrological preparations of coal samples from Pachwara Coalfield were also made.

B.D. Singh & B.K. Misra

In the light of presence of fluorescing inertinite in the coals, a critical evaluation of published literature on the reactivities of vitrinite and inertinite in the Indian Gondwana coals during carbonization has been made. It revealed that there exists certain misconceptions about their identification and coking behaviour. The semifusinite-A or semivitrinite is nothing but pseudovitrinite, however, semivitrinite/pseudovitrinite as recognized by others is partly pseudovitrinite and partly transitory semifusinite. The fluorescing inertinite, in fact, comprises transitory semifusinite + certain fraction of semifusinite. They, probably, are variably reactive. The fluorescence exhibited by inertinite appears to be related with its genesis from partial oxidation of resin/bitumen impregnated cell walls of gymnospermous plants which served as source for the formation of Indian Permian coals.

B.K. Misra & B.D. Singh

Programme 2.10 : Palynology of the Gondwana sequence in Satpura Basin

Objective : *To study palynostratigraphy, biozonation, palaeoecology, palaeoenvironment, correlation of various strata in the central part of the basin*

Search for good specimens from the palynoassemblage recorded in the Almod beds is in progress. Striate bisaccate pollen are plentiful; the preservation is very poor.

Palynoassemblage from Tamia cliff shows nonstriate bisaccate : *Falcisporites, Satsangisaccites* in prominence, but striate bisaccate *Striatopodocarpites, Faunipollenites* are common. Taeniate bisaccates *Lunatisporites* is poor but few cavate *Playfordiaspora*

spores alongwith *Guttulapollenites* and *Corisaccites* pollen have been identified. This is the first record of palynoflora from Pachmarhi Formation.

Processing of seven samples from Tawanagar section has been completed, out of which two have yielded spores and pollen.

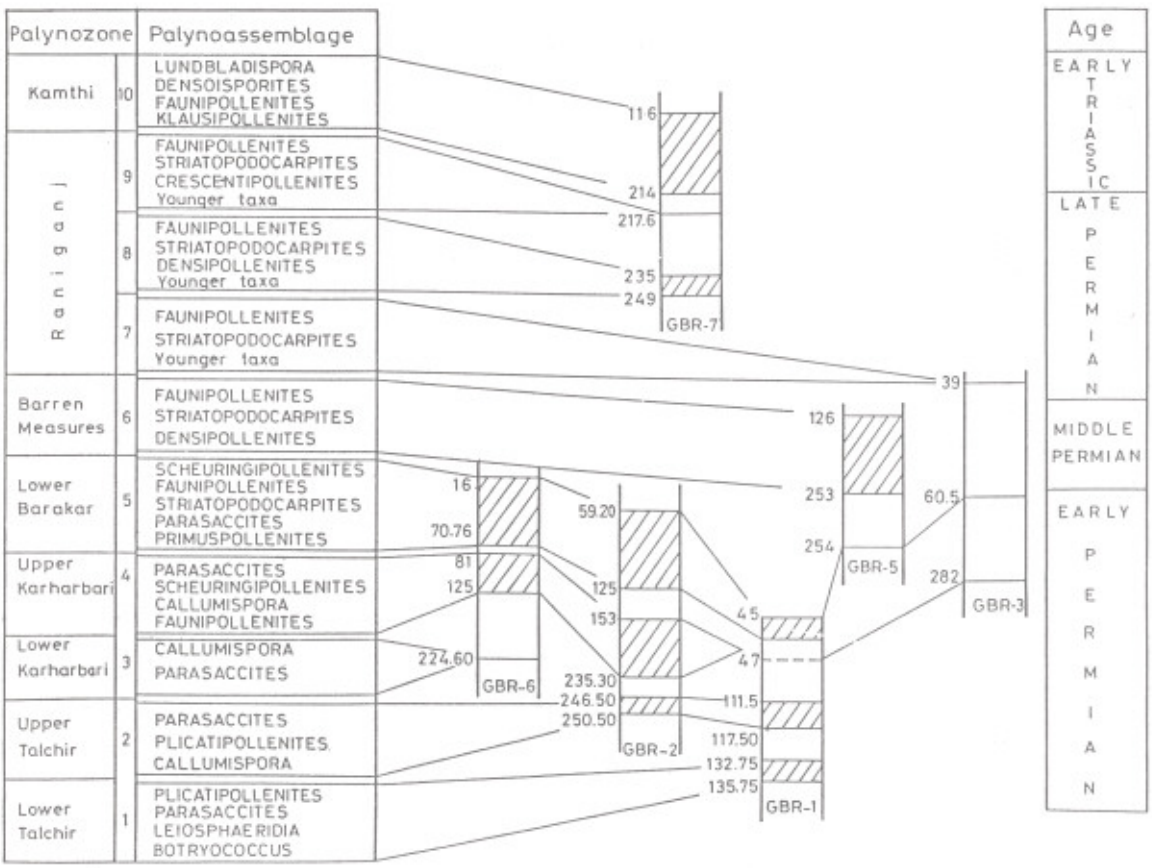
Pramod Kumar

Palynological study of bore-hole ANH-3 drilled through Denwa Formation from Anhoni area in Satpura Basin, Madhya Pradesh has been continued.

Pramod Kumar [with P.K. Raha, G.S.I., Nagpur]

Programme 2.11 : Palynofloral patterns and boundary demarcations in Gondwana sequence of Godavari Graben

Objective : To standardize palynoflora from different formations of Gondwana sequence



Palynological correlation of Permian-Triassic sediments from Budharam area, Godavari Graben, Andhra Pradesh.

: *To recognise biozones having stratigraphical significance*

: *To demarcate time boundaries with special reference to P/Tr boundary*

: *To decipher the nature and significance of evolution of various palynofloras*

Palynological study of 24 samples from Satrajpalli area (bore-hole GSP-9) reveals the presence of Barakar palynoflora at 114.00 to 167.00 m depth characterised by the dominance of *Scheuringipollenites* while Lower Raniganj palynoflora at 85.04 to 108.80 m is represented by the dominance of striate bisaccate, chiefly *Faunipollenites* and *Striatopodocarpites* and the presence of *Falcisporites, Crescentipollenites, Lunatisporites, Weylandites* and *Klausipollenites*.

Search, collection and consultation of literature for comparative study of Permian-Triassic palynoflora of India and Antarctica are continued.

Processing and study of samples from bore-holes GLP-6 (38 samples) and GLP-7 (30 samples) of Lakshmidevpet area are continued. Barakar palynoflora has been observed at 46.60 to 66.40 m depth in bore-hole GLP-7; Karharbari at 617.20 to 491.10 m and Barakar at 327.10 m in bore-hole GLP-6.

Restudy of five samples in bore-hole GAM-10 reveals the presence of Talchir palynoflora at 581.55 m depth.

Studies on bore-hole cores GBR-1,2,3,6 and 7 from Budharam area have been finalized. A complete sequence from Talchir to Kamthi formations (Early Triassic) has been recorded in this area and a palynological correlation of these bore-cores has been done.

Suresh C. Srivastava and Neerja Jha

Programme 2.12 : **Organic petrographic evaluation of coals from Godavari Graben**

Objective : *To assess the rank and quality of coal from Mailaram and other areas*

The maceral, microlithotype and reflectance studies of twenty-one coal samples from Koyagudem area have been completed. These coals in general are represented by vitrinite and fusinite macerals intimately associated with exinite and mineral matter. Cuticles, sporangia and resins have scanty distribution. Vitrite, inertite and trimacerite are the common microlithotypes recorded in these coals. The reflectance study has revealed that the coals attained reflectance (Ro max. in oil) value ranging from 0.57-1.3 per cent (normal range 0.57-0.86%), indicating high volatile bituminous C (sub-bituminous A) to high volatile bituminous A stages in rank. However, in some of the samples a sudden rise in the reflectance value has been recorded (0.96-to 1.3%) indicating that these coals have reached high volatile bituminous A to medium volatile bituminous stages. This sudden rise is prob-

ably because of the presence of a fault near the site of collection. A preliminary study regarding fluorescence characteristics of these coals has indicated the existence of closely packed sporinites.

Programme 2.13 : **Organic petrographic evaluation of coal seams from Talcher Coalfield**

Objective : *To assess coal characterisation in Talcher Coalfield*

The quantitative estimation of coal microconstituents has been carried out from the Lower and Upper workable seams of South Belanda, Bharatpur and Ananta quarries. Besides, the study of liptinitic macerals from the above seams have also been carried out under fluorescence mode (blue light excitation) and characteristic forms were photomicrographed. Seeds, sporangia, megaspores, resins, cuticles, algal matter and fragmented fluorescing material represent the characteristic forms of liptinitic fraction in the coals.

The high incidence of sporinite alongwith inertodetrinite, vitrodetrinite and mineral matter and characteristic textural pattern are indicative of the presence of cannel coals at distinct time levels of the Upper workable seam at Ananta Quarry. The thick-walled cutinites (crassicutinite) were also observed.

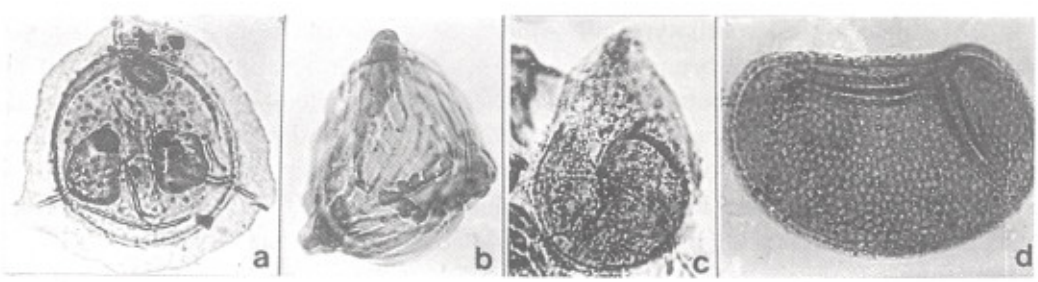
Anand-Prakash, Rakesh Saxena & Jyotsana Rai

Programme 2.14 : **Palynostratigraphy of recently explored subsurface Gondwana sequence in Tamil Nadu and Pondicherry (U.T.)**

Objective : *To establish palynological succession in the subsurface Gondwana sediments, their palyno-dating and correlation.*

The palynoflora of coal-bearing sequence in cores from bore-holes TC-1 and TC-2 in Kandamanglam and Marakkanam areas, Tamil Nadu are found to be rich in pteridophytic spores. The characteristic species present are *Appendicisporites distocarinatus, Crybelosporites stylosus, Microfoveolatosporis albertonensis, Schizosporis reticulatus, S. rugulatus, S. eocenicus, Balmeisporites* sp., *Triporoletes reticulatus, Coptospora kutchensis*, etc. The assemblage is assignable to the *Coptospora cauveriana* Zone of Aptian age. The findings add to our knowledge of Gondwana coal deposits on the East Coast of India.

R.S. Tiwari, Archana Tripathi & Vijaya



Characteristic Early Cretaceous palynotaxa- **a**, *Aequitriradites*; **b**, *Appendicisporites*; **c**, *Crybelosporites*; and **d**, *Microfoveolatisporis* from Upper Gondwana sediments, Tamil Nadu (all x 500).

Programme 2.15 : **Palynostratigraphy of Gondwana sequence in Tatapani-Ramkola Coalfield, Madhya Pradesh**

Objective : *To develop lithostratigraphic set up from various surface and subsurface sequences*

: *To reconstruct standard palynological succession, age determination and correlation with special reference to coal-bearing horizons*

: *To recognise range of stratigraphically significant taxa and evolutionary trends of various palynofloras*

: *To demarcate time boundaries with special reference to P/Tr boundary*

: *To document phytogeographic and palaeoenvironmental events*

Quantitative palynological investigations of bore-holes TRP-6, TRM-1, TRM-2 and TRS-12, have been completed. Bore-hole TRP-6 contains Talchir palynoflora (*Parasaccites-Plicatipollenites* assemblage) at the base and is succeeded by Lower Karharbari palynoflora (*Callumispora-Jayantisporites* assemblage) in the younger part of the bore-core.

Three palynoassemblage zones have been demarcated in bore-hole TRM-1. The oldest assemblage is represented by *Scheuringipollenites barakarensis* assemblage zone (Lower Barakar) and is succeeded by the dominance of striate bisaccate pollen, chiefly *Striatopodocarpites, Hindipollenites, Verticipollenites, Faunipollenites, Striatites*, etc. representing Upper Barakar. The youngest assemblage is represented by *Densipollenites indicus* and *Densipollenites invisus* in association with striate bisaccate pollen representing Kulti palynozone.

In bore-holes TRM-2 and TRS-12, the palynoassemblages compare with the *Scheuringipollenites barakarensis* assemblage zone representing Lower Barakar. The palynological reports of these bore-holes have been sent to the Coal Wing, Geological Survey of India.

Processing of samples collected from surface exposures is continued. Sediments from Uro Nala have yielded rich Talchir palynoflora dominated by radial monosaccates (*Plicatipollenites-Parasaccites* assemblage). Carbonaceous shale and coal samples from Banki River section have yielded Late Permian (Raniganj) palynoflora, having a dominance of striate bisaccates.

Suresh C. Srivastava & Ratan Kar

Programme 2.16 : **Palynological investigation of coal-bearing sequence in Deocha-Pachami area of Birbhum District, West Bengal**

Objective : *To study the morphological diversity of spores and pollen*

: *To find out palynostratigraphic relationships between the coal-bearing and associated strata from various sectors of this newly established coal sub-basin and to compare them with corresponding strata of other coal basins in India*

Spores and pollen recovered in the bore-hole DPD-15 have been referred to pteridophytic and gymnospermous affinities. The important genera, viz., *Cyathidites*, *Cicatricosisporites*, *Osmundacidites*, *Alisporites*, *Cycadopites*, *Callialasporites*, *Podocarpidites*, *Cuneatisporites*, *Araucariacites*, *Laricoidites* and *Podosporites* suggest an Early Cretaceous affinity. Further work is continued.

Maceration of thirteen samples from bore-hole DFD-15 was completed and found to be barren.

R.S. Tiwari, Vijaya & Jitendra Pandey

Programme 2.17 : **Evolutionary diversification of Cretaceous flora of Pranhita-Godavari Graben**

Objective : *To systematically study morphology, anatomy, ecology and related aspects of megafossils*

: *To detail out floristic diversification and observe evolutionary inter-relationships*

: *Taphonomic and cladistic analysis*

Collection of plant megafossils from various localities of the Gangapur Formation included mainly impressions and ill-preserved compressions of leaves, stem and reproductive parts. Two distinct floral assemblages were identified. Assemblage I is dominated by the genus *Elatocladus* associated with *Brachyphyllum*, *Pagiophyllum*, *Allocladus*, *Araucarites* and other unidentified reproductive structures. Assemblage II is characterized by *Equisetites*, *Rhizomopteris*, *Cladophlebis*, *Ptilophyllum*, *Pterophyllum* and other indeterminate leaf fossils.

A. Rajanikanth

PROJECT 3 : CENOZOIC PLANT BIOGEOGRAPHY OF PENINSULA INDIA

Programme 3.1 : **Floristics and plant megafossil biostratigraphy of the Deccan Intertrappean sediments**

Objective : *To study and understand the Deccan Intertrappean fossils*

: To determine their age for reconstruction of vegetational history and phytogeography of peninsular India

A few leaf-impressions from the Deccan Intertrappean sediments from Mohgaon

Kalan were cleared, photographed and studied. They have been tentatively identified with the leaves of Anacardiaceae and Sapindaceae.

N. Awasthi & Anita Dwivedi

Thin sections of fifty fossil wood specimens from Nawargaon in Wardha District, Maharashtra were cut and studied. Several genera have been identified, viz., *Ailanthus, Barringtonia, Canarium, Elaeocarpus, Euphoria, Homalium* and *Sterculia*. In addition, a gymnospermous wood and a palm root have also been found. This study reveals that similar flora of Deccan had a wide extension during Late Cretaceous-Early Tertiary Period.

N. Awasthi & E.G. Khare (Part time Ph.D. work)

Programme 3.2 : Studies on the Tertiary floras of western India

Objective : To build up floristic history and phytogeography of western India

Sixty petrified and carbonised woods from southern Gujarat were cut and studied. The genera identified are *Cynometra, Millettia-Pongamia* (Fabaceae), *Diospyros* (Ebenaceae), *Duabanga* (Sonneratiaceae), *Lagerstroemia* (Lythraceae) and *Terminalia* (Combretaceae). In additions, a wood belonging to family Rosaceae has been identified. A male inflorescence of *Nipa* palm alongwith palm leaves was identified and compared with rare living material available at the Royal Botanic Gardens, Kew. Spike-like inflorescences have been collected from the Palaeocene sediments of Barmer (Rajasthan) and Assam. A paper on fossil woods was finalized. Study on the occurrence of *Dipterocarpus* in Bikaner indicates the occurrence of moist tropical conditions in the western Rajasthan during Late Tertiary.

J.S. Guleria

Programme 3.3 : Palynostratigraphy and palaeofloristics of the Mesozoic-Tertiary sediments in Rajasthan Basin

Objective : To establish palynological succession in the Cretaceous-Tertiary sequences

: To deduce palaeoenvironment

Palynological studies on seventy-nine rock samples from five well sections (MK-207, MK-216, MJ-4, MJ-13 and MJ-15) drilled near Kapurdi and Jalipa, Barmer District were completed. Palynofloral assemblages recovered are represented by dinoflagellate cysts, fungal remains, pteridophytic spores and angiospermic pollen. Palynofloral resemblance between the present assemblage and that recorded from Matanomadh Formation, Barmer Sandstone, Akli lignite and Palana lignite of western India are striking. Forms common between the present assemblage and that of Matanomadh Formation of Kutch are: *Dandotiaspora dilata, D. telonata, Lygodiumsporites eocenicus, L. lakiensis, Neocouperipollis rarispinosus, Matanomadhiasulcites maximus, Tricolporopollis matano-*

madhensis and *Kielmeyerapollenites eocenicus*. Many palynotaxa recorded from Palana lignite, Barmer Sandstone and Akli lignite from Rajasthan are present in Kapurdi and Jalipa assemblages which indicate a Palaeocene-Eocene age.

Most of the palynotaxa from studied well sections are related with tropical-sub-tropical families, viz., Schizaeaceae, Arecaceae, Oleaceae, Caesalpiniaceae, Bombacaceae, Rubiaceae and Guttiferae and indicate the presence of low-land, fresh-water swamp, water edge and coastal elements in the assemblage.

S.K.M. Tripathi

Programme 3.4 : Neogene plant megafossils of West Coast

Objective : To study morphotaxonomy of plant megafossils; palaeofloristics, palaeoecology and palaeogeography

Sixty woods from Kerala Coast were sectioned and studied. Most of the woods were found to be duplicates of already known genera, such as *Anisoptera, Cassia, Cynometra, Diospyros, Dryobalanops, Gonystylus,* etc. One *Cynometra* type of wood with predominantly uniseriate rays has also been identified. This study indicates that almost similar climatic conditions prevailed in Kerala since Miocene.

Rashmi Srivastava

Programme 3.5 : Palynological investigation of the Tertiary sediments of Kerala Basin with reference to their biostratigraphy, palaeoecology and age

Objective : To study morphotaxonomy of spore-pollen from the measured sections of Quilon and Warkalli beds

: To establish palynostratigraphic zonation

: To determine their correlative value

: To determine the palaeoclimate and environment of deposition prevailing at the time of sedimentation

Morphotaxonomic study and identification of spore-pollen taxa recovered from Kundra clay mine sediments have been completed. The palynoflora consists of 30 genera and 42 species belonging to pteridophytic spores and angiospermous pollen. The latter register dominance over the former. Ecological analysis of the assemblage identifies several palaeoassociations of low-land, fresh water swamp and water edge, sandy beach and back-mangrove vegetation. The palynological assemblage depicts a wet semi-evergreen type of vegetation which had warm and humid tropical climate with heavy precipitation. The brackish water environment of deposition is indicated by back-mangrove elements and dinoflagellate cysts. Comparison of this assemblage with the known Indian Tertiary palynoassemblages

suggests Miocene age. A manuscript dealing with morphotaxonomy and data interpretation has been prepared. Processing of forty-three samples of Warkala (Warkalli Formation) has been completed.

M.R. Rao

Programme 3.6 : **Tertiary megafossils from Neyveli lignite, Tamil Nadu**

Objective : *To study morphotaxonomy of Tertiary megafossils from Neyveli lignite and relate them with extant plants*

: *To deduce palaeoenvironmental, palaeoecological and phytogeographical information*

Twenty carbonised woods from Neyveli lignite were sectioned and studied; fifteen of them were found to be the duplicates of already reported genera, viz., *Bouea, Diospyros, Gluta, Hopea* and *Parinari* and remaining were poorly preserved. More than 125 blocks of carbonised woods were prepared and studied. The study is still continued. Manuscript of a paper entitled "Evolutionary status of fossil wood assemblages of Neyveli lignite, Tamil Nadu and Warkala (Warkalli) bed, Kerala" was prepared.

Anil Agarwal

Programme 3.8 : **Organic petrological study of Rajasthan lignites**

Objective : *To carry out petrological evaluation of Rajasthan lignites*

: *To prepare basinal models showing deposition of lignite beds and their coalification trends*

Project suspended for the present because no fresh material could be collected.

Anand-Prakash & Rakesh Saxena

Programme 3.9 : **Organic petrology of Kutch lignites, Gujarat**

Objective : *To evaluate Panandhro lignite for various industrial uses*

: *To understand genesis of lignite and palaeoenvironmental conditions*

Quantitative estimation of Panandhro lignite from old mine section has been carried out under blue light excitation (fluorescence mode). The data generated reveal that the lignites of all the sections are more or less similar in respect of maceral composition. Huminite is the dominant maceral group (44-94%, fluorescing 3-47%, non-fluorescing 36-89%) followed by liptinite (5.6-56%) and inertinite (up to 4.4 %) groups. Among liptinites, resinite shows a wide range of variation (0.2-20%). However, the percentage ranges between 0.2-10%. Alginite (*Botryococcus*), though persistent, is not in recordable amount in old mine section. The lignites of old mine section contain a relatively lower proportion of fluorescing huminite.

B.K. Misra & Alpana Singh

Lignite samples from three bore-holes (NLE-27, 35 and 36) of the Neyveli lignite field have been assessed quantitatively under fluorescence mode (blue light excitation) to generate the required data on fluorescing and non-fluorescing macerals for comparative study. The studies indicate that the macerals of the huminite group are dominant followed by liptinite and inertinite.

Alpana Singh

Programme 3.10 : Palynostratigraphy of the Tertiary sediments of Gujarat

Objective : *To correlate Tertiary formations of Kutch with those in Broach and adjacent areas*

: *To decipher the palaeoecological condition of deposition*

: *To compare the fossil pollen with the living ones*

Palynoassemblage recovered from Matanomadh Formation is rich in angiosperm pollen. The assemblage contains 21 genera and 28 species. *Dandotiaspora dilata* occurs in good number. The recovered assemblage is different from the assemblage in a Nala section near Matanomadh Village. The latter assemblage is dominated by *Trilatiporites, Lakiapollis, Meliapollis* and *Neocouperipollis*, indicating an Early Eocene age.

J.P. Mandal

Palynofossils recovered from the samples of Rajpardi lignite, Broach District show the abundance of angiosperm pollen, especially the tricolporate and tetracolporate assigned to family Alangiaceae, followed by monocotyledonous pollen of Palmae. The other pollen assignable to family Bombacaceae, Labiatae, Anonaceae, etc. and fungal fruiting bodies of Microthyraceae are also common in the palynoassemblage. It is concluded that warm and humid tropical climate was prevalent during the time of deposition.

Madhav Kumar

Thirty samples collected from Nageswar near Dwarka were chemically processed but no sporomorphs could be recovered.

B.D. Mandaokar

Programme 3.11 : Palynological investigation of the Tertiary formations of Rajasthan (other than Kapurdi area)

Objective : *To build up the palynostratigraphy of different Tertiary formations*

: *To correlate different Tertiary formations of Rajasthan with those in Gujarat*

: *To infer the palaeoecological condition of deposition*

Three Early Eocene pollen genera, viz., *Piladiporocolpites, Psiladiporocolpites*

and *Retidiporocolpites* possessing different morphological characters, but all having a characteristic type of aperture called "Diporocolpis", were described from the bore-hole K12, drilled by MECL at Kuchaur-Benia area, Bikaner District. The "Diporocolpis" is proposed as a new type of aperture which is characterized by the presence of two equatorial pores connected by a colpus. In some genera, the margin of aperture is spinose while in others it is psilate. The exine is variously sculptured or structured.

Besides, hexacolpate pollen closely resembling the extant pollen of *Ocimum* were also recovered from the same bore-hole. The palynological assemblage indicates an Early Eocene age. Since this is the oldest record of fossil *Ocimum* pollen known so far, it is postulated that the genus *Ocimum* originated in India. The veneration and sanctity that *Ocimum* generates in the minds of people of India reflects its antiquity in India as demonstrated in this finding.

Some new spore pollen genera, e.g., *Pachymonoletasporites, Pluricolumellatepollis* and *Retitetradites* are also proposed from the same bore-hole.

R.K. Kar

PROJECT 4 : PHYTOPLANKTON BIOSTRATIGRAPHY OF MARINE SEDIMENTARIES OF INDIA

Programme 4.1 : Phytoplankton biostratigraphy of Cretaceous - Palaeogene sequences of South Shillong Plateau, Meghalaya with emphasis on time boundaries and palaeoceanography

Objective : *To document lithological succession and facies variations in outcrop areas*

: *To study dinocyst morphology and biostratigraphy and to document phytoplankton rich levels*

: *To integrate dinocyst, calcareous plankton and palaeontological data for stratigraphic precision*

: *To carry out palynofacies and organic petrographic studies*

: *To carry out oxygen isotope and geochemical studies across K/T boundary*

: *To attempt palaeoceanographic interpretations*

Photodocumentation, morphologic study and identification of Danian dinoflagellate cyst taxa have been carried out. Photodocumentation and identification of Late Palaeocene dinoflagellate cyst assemblage from Cherrapunji area were also completed.

K.P. Jain, Rahul Garg & Khowaja- Ateequzzaman

A draft on "Integrative bioevents at K/T boundary in Meghalaya" has been prepared.

Rahul Garg & K.P. Jain

Programme 4.2 : **Cretaceous phytoplankton biostratigraphy and palaeoceanographic set up of East Coast petroliferous basins**

Objective : *To document lithological succession in outcrop areas*

: *To study dinocyst morphology, taxonomy and biostratigraphy*

: *To integrate phytoplankton data with palaeontological and sedimentological data*

: *To carry out palynofacies study, document plankton-rich levels*

: *To carry out stable carbon isotope (C-13) and organic petrographic studies*

: *To attempt palaeoceanography modelling*

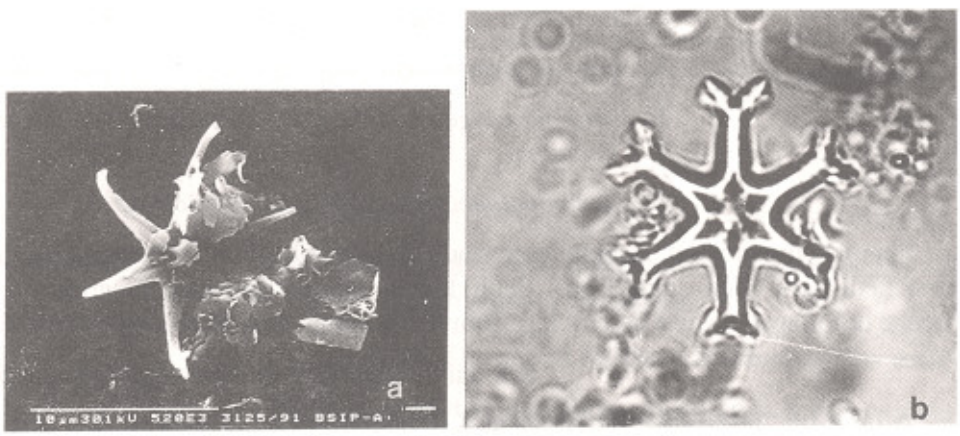
A manuscript on a new dinoflagellate cyst genus from the Upper Cretaceous of Cauvery Basin has been revised and submitted. A draft manuscript on dinoflagellate cyst biostratigraphy of Trichinopoly Formation has also been completed.

K.P. Jain, Khowaja-Ateequzzaman & Rahul Garg

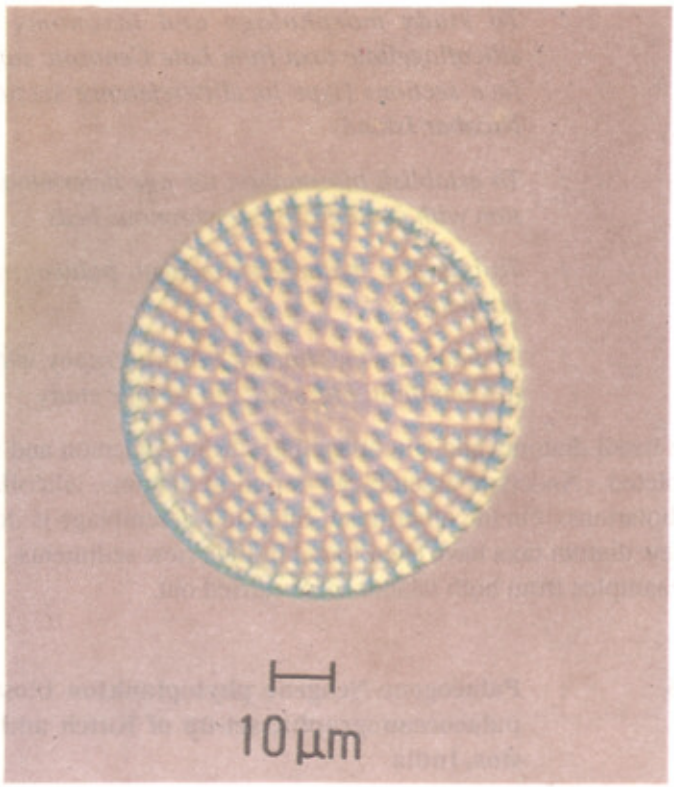
Programme 4.3 : **Neogene calcareous nannoplankton palaeoceanography of Andaman and Nicobar Islands**

Objective : *To compare Neogene calcareous nannoplankton assemblage of Andaman and Nicobar Islands with that known from nearshore and high latitude and to select cosmopolitan markers*

: *To integrate calcareous nannoplankton and planktonic fora-*



a, *Discoaster brouweri* Tan Sin Hok 1927; b, *Discoaster variabilis* Martini & Bramlette 1963 (x 2200) from Late Miocene of Neill Island, Andaman & Nicobar Islands.



Stictodiscus nankoorensis (Grunow) Pant–a diatom from Miocene sediments of Interview Island, Andaman & Nicobar Islands.

miniferal zonations to improve dating resolution

: *To record palaeoenvironmental events with special reference to Antarctica glaciation event based on plankton assemblage backed by stable isotope and organic data*

Early Miocene nannofossils in volcanogenic sediments of Lacum Point Section of Havelock Island, suggest assignment to nannofossil zone : *Helicosphaera ampliaperta* (NN 4) which is an important oil-bearing horizon in Southeast Asian basins. This also marks an event matching the opening of Andaman Sea. Based on nannofossil data of sections from Neill Islands and Car-Nicobar Island, the problem of demarcating Miocene/Pliocene boundary in Indian Ocean and Southeast Asian basins was recognised.

Photodocumentation of Neogene calcareous nannofossils from Archipelago group of sediments is being continued.

S.A. Zafar

Programme 4.4 : Late Cenozoic diatom biostratigraphy of Andaman and Nicobar Islands

Objective : *To study morphology and taxonomy of diatom and silicoflagellate taxa from Late Cenozoic surface and subsurface sections (type locality/reference sections) of Andaman Nicobar Islands*

: *To establish biozonation for age determination and correlation with geologically synchronous beds*

: *To interpret palaeoenvironment, palaeogeography and time boundaries*

: *To integrate the diatom biostratigraphy with the established foraminiferal biozones and isotope study*

Data on fossil diatoms and silicoflagellates from Anderson and Interview Islands have been completed. Anderson assemblage is rich in diatoms, silicoflagellates, sponge spicules and radiolarians. On the other hand, Interview assemblage is dominated by radiolarians. Very few diatom taxa have been found in Interview sediments. SEM and EDAX studies of some samples from both islands were carried out.

Anil Chandra

Programme 4.5 : **Palaeogene-Neogene phytoplankton biostratigraphy and palaeoceanographic set-up of Kutch and Saurashtra basins, India**

Objective : *To study dinoflagellate cyst morphology and biostratigraphy and to document phytoplankton rich levels*

: *To integrate dinoflagellate cyst, calcareous nannoplankton and palaeontological data for stratigraphic precision*

: *To document palaeoenvironmental events*

Literature on Tertiary geology of Kutch Basin was consulted and reference cards were prepared.

K.K. Pandey

Preparation of lithologs of the studied sections and compilation of field data have partly been carried out.

Rahul Garg, Khowaja-Ateequzzaman & K.K. Pandey

PROJECT 5 : PALAEOFLORISTIC DIVERSIFICATION IN THE HIMALAYA

Programme 5.1 : **Palaeozoic flora of Kashmir region : biozonation, affinities and biogeography**

Objective : *To make extensive collections of plant fossils from the peri-Gondwana stratigraphical sequences, their identification and*

comparison with Gondwana, Cathaysian and Angaran elements to trace their origin

Several good specimens of the genus *Kawaziophyllum* collected from the Dunpathri Member of Mamal Formation were sorted, cleaned and photographed. It has been observed that not a single leaf is preserved in a flat position, almost all are folded. The leaves have an incipient parallel venation. Cellulose acetate pulls were made from these specimens for the recovery of cuticles. No cuticle was recovered but the macerate did contain a few monosaccate, disaccate-nonstriate and disaccate-striate pollen. These pollen are identifiable up to generic level. The genera that have been identified include *Cordaitina, Potonieisporites, Densipollenites, Striomonosaccites, Scheuringipollenites, Cedripites, Protohaploxypinus, Striatites, Lahirites, Gondwanipollenites, Rhizomaspora* and *Schizopollis*.

On the basis of composition of the megaflora, the Mamal Formation has generally been equated with the Karharbari 'Formation' of Gondwana Supergroup of the peninsula. The composition of palynoflora from the Dunpathri Member, particularly the presence of the genus *Schizopollis* suggests that this member may be equivalent of the basal part of the Barakar Formation. Except for the presence of the genus *Cordaitina*, the palynoflora known so far is typically Gondwanan in composition.

H.K. Maheshwari, Usha Bajpai [& H.M. Kapoor]

Programme 5.2 : **Palynofloras of the Tethyan sediments of the Himalaya, their provenance and regional relationship**

Objective : *To search palynofossils in the well dated sequence of Palaeozoic and Mesozoic sediments of Niti (Spiti), Malla Johar (Kumaon) and Kashmir (Guryul ravine and Pahalgaon)*

Qualitative assessment of the palynoassemblages recovered from eight sections in Niti area, has been completed. They compare with the Late Permian and Early Triassic palynoassemblages of peninsular India and establishes correlation between the palynoassemblages from marine and continental sequences at Permian-Triassic transition.

R.S. Tiwari, Vijaya [& V.D. Mamgain & R.S. Misra, GSI]

Qualitative assessment of the spore-pollen taxa recovered from the five well-dated sections in Spiti area has been done. For the first time, Barakar, Upper Raniganj and Lower Panchet equivalent miofloras are identified in these sections, which exhibit close similarity with the known palynoassemblages from peninsular India.

R.S. Tiwari, Vijaya, Ram-Awatar [& T. Singh, WIHG]

Programme 5.3 : **Palynostratigraphic studies, evaluation of rank and properties of coal and associated sediments in eastern Himalaya**

Objective : *To correlate the palynoflora with petrography of coal and to compare with the known palynofloras from the peninsular Gondwana*

: *To reconstruct marine pathways, palaeoecology and palaeoenvironment during the deposition of the Permian sediments in Siang District*

Permian sediments, coal, carbonaceous shale, micaceous shales exposed in Ghish and Lish River sections in the Darjeeling District were analysed. One sample from Ghish River yielded palynofossils. The preservation, however, is poor.

Samples from Devonian and Permian sediments collected from Sethi Khola and Rigka Nala, Bhutan sent by GSI were processed. Coal balls from Sethi Khola yielded very poorly preserved palynofossils. Study of these fossils is continued.

Suresh C. Srivastava & A.P. Bhattacharyya

Two papers were finalized in collaboration with Wadia Institute of Himalayan Geology, Dehradun : "The nature of contact between Gondwana sediments and basement metamorphic rocks in Arunachal Himalaya" and "Organic petrology of Tipam coals (Arunachal Himalaya), their nature, composition, rank and depositional environment".

Anand-Prakash [with T. Singh, WIHG]

Programme 5.4 : **Palynological history of the Tertiary sediments of Jammu area**

Objective : *To study palynofossils from the Palaeocene- Miocene sediments*

: *To carry out palynozonation, age determination and correlation of the assemblage*

: *To develop information on phytogeography and understanding of the orogeny of Himalaya*

Several rich palynofloral associations have been studied from two measured stratigraphic sections of the Subathu succession (Eocene) in the Kalakot area. Ferruginous shales, dark grey shales, carbonaceous shales, coal seams and pyrite concretions are the common lithological features encountered in the Subathu Formation. The palynofloral assemblage consists of a variety of dinocysts, spore-pollen grains, fungal and algal remains. Three distinct palynological assemblage zones have been recognised, viz., *Homotryblium* sp. Assemblage Zone, *Cordosphaeridium* sp. Assemblage Zone and *Thalassiphora* sp. Assemblage Zone. These assemblage zones correlate with those established in the Kalka-Simla and Banethi-Bagthan areas of Himachal Pradesh. Palaeoecological and palaeoenvironmental analyses of the recorded palynoflora demonstrate that the dinocysts/spore-pollen ratios run in inverse proportion from the base to the top of succession. Palynofloral composition dominated by dinocysts confirms a shallow marine environment of deposition for the Subathu Formation.

Samir Sarkar

Programme 5.5 : **Palynostratigraphy of the Tertiary sediments of Kargil Basin, Ladakh Himalaya**

Objective : *To systematically study spores and pollen*

: *To establish palynozonation*

: *To reconstruct the past vegetation, environment of deposition and palaeogeography*

One hundred-fifty samples collected from the Indus Group exposed at Khalsi, Dras and Kargil areas were macerated. Dispersed organic matter yielding horizons have been identified from Khalsi area. Algal remains have been recovered from the lower part of Indus Group. Morphotaxonomic study is now being taken up.

R.K. Saxena & Samir Sarkar

Programme 5.6 : **Neogene Himalaya : floristics, evolutionary patterns and climate**

Objective : *To undertake extensive study of fossil plants from Neogene sediments of different regions of the Himalaya*

: *To build up the floral succession for interpreting palaeoecology, phytogeography and evolution of the Himalayan flora*

Sorted and cleared the leaf-impressions collected from the Kasauli sediments of Himachal Pradesh. A paper on the lea-impressions of *Bauhinia* from Kasauli was finalized.

N. Awasthi

Out of a rich collection of fossil plants from the Kasauli Formation, near Shiv Shakti Temple, Kasauli, five types of leaf -impressions have been identified with the leaves of the extant taxa, *Clinogyne dichotoma* (monocotyledon), *Garcinia speciosa, Gluta tavoyana, Combretum apetalum* and *Phyllanthus reticulatus* (dicotyledons). These are distributed in the Indo-Malayan region and suggest that the Kasauli flora flourished under tropical climate with better representation of evergreen elements. Occurrence of coastal plants, such as, *Garcinia speciosa* and *Gluta tavoyana* indicates persistence of the coastal environment in the area during deposition of the Kasauli sediments.

N. Awasthi [& Ritesh Arya, Chandigarh]

Plant fossils comprising leaves, fruits and seeds from Surai Khola, Arjun Khola and Rehar areas of western Nepal have been studied and descriptions of 35 leaf-impressions collected from Arjun Khola have been written. In addition, some more leaf-impressions have been identified. They are : *Amoora lawii, Anisoptera glabra, Cocculus trilobus, Diospyros dasyphylla, Ficus scandens, Ipomoea eriocarpa, Mallotus philippinense, Sabia paniculata* and *Vatica perapensis*. A manuscript entitled, "Further contribution to the Siwalik flora from Surai Khola sequence, western Nepal and palaeoecology and phytogeography of the region" was prepared. Based on the distribution patterns of the modern counterparts of megafossils, a low mesophytic tropical moist deciduous to evergreen forests in the area during Siwalik sedimentation has been envisaged.

N. Awasthi & Mahesh Prasad

A leaf-impression resembling modern *Anisoptera glabra* from Siwalik sediments of Arjun Khola, western Nepal.

Out of the sixty fossil woods sectioned and studied from Kalagarh, three have been found to be new showing affinities with the woods of Fabaceae, Euphorbiaceae and Myrtaceae. A draft paper on "Fossil wood of *Duabanga* from the Siwalik sediments of Sindhuli, Nepal" was prepared. Leaf-impressions from Haridwar, Kathgodam and Koilabas areas were also investigated. Three impressions from the Koilabas have been identified showing resemblance with *Lagerstroemia parviflora, Helicia erratica* and *Anisophylla apetala* belonging to Lythraceae, Proteaceae and Rhizophoraceae, respectively. The present

habit and habitat of the recorded taxa and the morphological characters of the fossil leaves indicated that the area enjoyed a tropical climate with plenty of rainfall during Mio-Pliocene times in contrast to the present day climate with reduced precipitation.

Mahesh Prasad

Programme 5.7 : **Palynology, palaeoecology and palaeogeography of the Tertiary sediments of Nepal Himalaya**

Objective : *To study palynofossils from the Mio-Pliocene sediments*

: *To carry out palynozonation and age determination of assemblages together with reflections on the past vegetation and environment of deposition*

Palynoflora from the Siwalik Group of rocks exposed in the Surai Khola and Arjun Khola areas have been studied. Several palynoassociations have been recognised in the Siwalik succession between 13 to 2 Ma. The data has been interpreted and plotted against a chronostratigraphic control. A standard successional palynofloral model from western Nepal has been prepared for comparative study. Progressive enrichment of Neogene palynofloras of Himalaya due to evolutionary changes and inflow/outflow of plant taxa from the adjoining areas is envisaged to have shaped the present day floras.

Samir Sarkar

PROJECT 6 : BIOSTRATIGRAPHY AND PALYNOFACIES OF PETROLIFEROUS BASINS OF EAST INDIA

Programme 6.1 : **Tertiary floral history of northeast India**

Objective : *To study morphotaxonomy of megafossils from the Palaeogene and Neogene sediments of Assam, Meghalaya and Arunachal Pradesh*

: *To reconstruct Tertiary floral history, palaeo-ecology and phytogeography*

Systematic descriptions of one hundred specimens comprising leaves, fruits and seeds from Makum Coalfield were completed. Draft of a paper entitled, "Evolution and diversification of angiosperms in Northeast India during Tertiary" was prepared. A paper on more than 20 taxa from Makum Coalfield was also finalized. Modern counterparts of the fossil taxa indicate a tropical climate with high precipitation. The presence of some coastal forms indicates near-shore deposition of the beds.

N. Awasthi & R.C. Mehrotra

Programme 6.2 : **Palynostratigraphy of sedimentary rocks in Therriaghat section and its correlation with Jaintia and Garo Hills sediments**

Objective : *To work out palynostratigraphy of different Tertiary formations*

: *To palynologically differentiate Langpar (Early Palaeocene), Langpar-Lakadong (Middle Palaeocene), Lakadong-Umalatodoh-Prang (Early-Middle Eocene), Prang-Kopili (Late Eocene) and Kopili-Barail (Early Oligocene) sediments*

: *To correlate the Therriaghat assemblages with those of Jaintia and Garo Hills*

The Late Cretaceous and Tertiary palynological assemblages recovered from Therriaghat and other localities were divided into several phytogeoprovinces and cenozones. The Senonian palynoflora of India were clubbed with Brazil and West African palynofloras as *Constantinisporis* phytoprovince characterized by the presence of *Constantinisporis, Victorisporis* and *Andreisporis*. The Danian to Middle Eocene palynofloras of India were placed under pantropical *Proxapertites operculatus* zone and this was further subdivided into *Acrostichumsporites meghalayensis* subzone, *Dandotiaspora dilata* subzone, *Kielmeyerapollenites syncolporatus* subzone, *Lakiapollis ovatus* subzone, *Tricolporopilites robustus* subzone and *Pellicieroipollis langenheimii* subzone. The Oligocene and Miocene palynofloras were placed under pantropical *Striatriletes susannae* zone and were divided into *Trisyncolpites ramanujamii* subzone and *Hibisceaepollenites robustispinosus* subzone. A comparison of Borneo, Caribbean and Atlantic Tertiary palynological assemblages with India reveals that the transatlantic palynological assemblages show closer similarity.

R.K. Kar

Important palynotaxa recovered from Bapung, Mukshay, Thangskai and Waliyncott of Meghalaya are : *Cyathidites minor, Dandotiaspora dilata, D. telonata, D. plicata, Lycopodiumsporites speciosus, L. umstwensis, Polypodiisporites repandus, Neocouperipollis kutchensis, N. wodehousei, Matanomadhiasulcites maximus, M. kutchensis, Spinizonocolpites echinatus, Proxapertites microreticulatus, P. assamicus, Lakiapollis ovatus, Retitribrevicolporites matanomadhensis, Triangulorites bellus, Trilatiporites kutchensis*, etc. The assemblage indicates a Late Palaeocene age for the sediments.

Manisha Nanda & R.K. Kar

Spores and pollen recovered from Bhalu Kurug, Meghalaya were photographed. The assemblage is dominated by the various species of *Lycopodiumsporites, Dandotiaspora, Matanomadhiasulcites, Proxapertites, Neocouperipollis, Spinizonocolpites, Tripilaorites, Triangulorites* and *Kielmeyerapollenites*. The assemblage indicates a Late Palaeocene age.

R.K. Kar & M. Chakraborty (Part-time Ph.D. work)

Programme 6.3 : **Palynostratigraphy of Tura Formation (Palaeocene), Garo Hills, Meghalaya**

Objective : *To establish significance of the palynoflora in biostratigraphic zonation, correlation and dating*

: *To study palynofloras recovered from selected sections in or-*

der to recognise their ecological importance and to trace evolutionary lineage

: *To deduce palaeoclimate and depositional environment prevalent at the time of deposition*

Palynofossils from rock samples collected along the road sections of William Nagar - Nongwalbibra were studied. The palynoassemblage includes fungi (5%) and pteridophytic spores (30%), while among the angiosperms, monocots form 20 per cent and the dicot taxa are represented by 40 per cent of the assemblage. Occurrence of *Laricoidites* is indicative of the sediments being younger in age than lower part of Palaeogene and is comparable to the assemblage recorded from the top seam in Rekmangiri area. The important palynotaxa recorded from the sediments comprise *Lycopodiumsporites speciosus, Cyathidites minor, Dictyophyllidites dulcis, Dandotiaspora telonata, D. dilata, Matanomadhiasulcites maximus, Droseridites major, Kielmeyerapollenites syncolporatus, Retitribrevicolporites rubra, Tricolpites* sp., *Psilastephanocolpites psilatus, Margocolporites sahnii, Palmidites plicatus, Spinizonocolpites echinatus, Proxapertites operculatus, Laricoidites magnus*, etc. For the detailed morphological studies SEM examination was also carried out.

K. Ambwani

Programme 6.4 : **Palynological investigation of the Tertiary sediments of Jaintia and Cachar Hills**

Objective : *To study morphotaxonomy and affinity of palynofossils*

: *To select ecologically and stratigraphically important palynotaxa for biostratigraphic zonation, correlation and dating*

: *To infer palaeoclimate and environment of deposition of sediments*

Disang assemblage recorded from Silchar-Haflong Road section was compared with the Palaeocene-Eocene flora of Meghalaya, Bengal Basin and Kutch Basin. Though few taxa, like *Palmidites, Spinizonocolpites, Striatriletes, Tricolporopilites* and *Pellicieroipollis* are common between the assemblages. Disang assemblage is poor in variety and number. Nevertheless, the assemblage is identical with Disang assemblage of Upper Assam.

J.P. Mandal

Programme 6.5 : **Palynological studies of Khasi (Late Cretaceous) and Garo (Late Tertiary) groups in the South-Shillong front, Meghalaya**

Objective : *To establish palynological zonation for correlation and dating of each unit of rocks*

: *To infer palaeoclimate and depositional environment*

: *To study extant pollen and spores for comparison with extinct ones*

Study and documentation of the palynotaxa recovered from the Late Cretaceous sediments in Khasi Hills were completed. The assemblage recovered is dominated by pteridophytic spores, followed by gymnospermic pollen. Angiospermic pollen, although poorly represented, are marked by the occurrence of Normapolles group of pollen. For the first time important megaspore genus *Arcellites* and *Paxillitriletes* were recorded. On the basis of palynology the sediments were correlated with the type section of Late Cretaceous units.

A rich palynological assemblage was documented from the Tertiary sediments of Garo Hills which is marked by the consistent occurrence of *Bombacacidites, Pellicieroipollis, Compositoipollenites, Meliapollis, Retistephanocolpites* and *Tricolpites*. The assemblage compares with the Barail Group of sediments of Assam and Meghalaya. Correlation of the sediments on the basis of palynotaxa was done. Spores related to fresh water ferns along with palm pollen in the Eocene sediments indicate occurrence of fresh-water swampy condition while in Miocene sediments pollen related to high altitude gymnosperms reflect the raised topography and initiation of cold climatic condition. The raised topography may be related to the first upliftment of the Himalayas in this part.

R.S. Singh

Programme 6.6 : **Palynostratigraphy of the Tertiary sediments of Mikir and North Cachar Hills, Assam**

Objective : *To select stratigraphically and ecologically important palynotaxa of North Cachar Hills*

: *To study ultrastructure of important palynofossils to trace their relation with pollen of extant taxa*

: *To reconstruct the environment of deposition and palaeoclimate during sedimentation*

The rock samples of Maibong Road and Lumding-Haflong Road sections show scanty representation of palynofossils. The qualitative and morphological observations of palynoassemblage recovered from Lumding-Haflong Road section indicate that spores of *Striatriletes* complex are dominant, followed by pollen of *Tricolporopollis*. The *Striatriletes* spores are also dominant in the assemblage from Maibong Road. The Permian saccate pollen are also found in these assemblages.

Madhav Kumar

Programme 6.7 : **Palynostratigraphy of Barail sediments in Upper Assam**

Objective : *To study Barail sediments in order to know their lithic characters, nature of contact and palynofossil content*

: *To study morphotaxonomy of the palynofossils*

: *To establish palynological zonation in the entire Barail sedimentary succession*

: *To study the botanical affinity of the various spore-pollen taxa*

Out of seventy-five samples collected from Dilli River section, 21 samples yielded spores and pollen. The assemblage shows the dominance of pteridophytic spores, viz., *Striatriletes, Lygodiumsporites, Dictyophyllidites, Crassoretitriletes, Polypodiaceaesporites* and *Polypodiisporites*. The angiospermic pollen are common and are represented by *Bombacacidites, Palaeomalvaceaepollis* and *Pellicieroipollis*. Some Permian striate bisaccate pollen, mostly represented by *Striatites, Lahirites* and *Striatopodocarpites* are also encountered in the assemblage.

B.D. Mandaokar

Programme 6.8 : **Palynostratigraphy of the Kopili Formation of Khasi and Jaintia Hills, Meghalaya**

Objective : *To establish palynological zones for correlation and dating*

: *To deduce palaeoclimate and depositional environment*

: *To carry out SEM studies of important palynofossils to trace evolutionary trends*

Forty-six samples of Kopili Formation from Jowai-Badarpur Road Section were macerated. In the assemblage, the pteridophytic spores are represented by *Polypodiisporites, Monolites, Polypodiaceaesporites, Striatriletes, Lygodiumsporites* and *Cyathidites*; the angiospermic pollen are represented by *Densiverrupollenites*. Fungal forms are represented by *Dyadosporonites, Phragmothyrites, Notothyrites*, etc. The study is continued.

G.K. Trivedi

Programme 6.10 : **Biodiagenesis of Tertiary coals from Nagaland and kerogen study from Tertiary sequence of Assam-Arakan Basin**

Objective : *To evaluate Tertiary coals from Nagaland and kerogen study from Tertiary sequence of Assam-Arakan Basin*

A set of nine coal samples with Ro max. 0.55 to 0.81 per cent has been selected for assessing alteration effect of fluorescence on their perhydrous (fluorescing) vitrinite from 49 samples of Garo and Jaintia Hills of Meghalaya. Fluorescence alteration behaviour of perhydrous vitrinite in these Palaeocene "abnormal" coals shows that their rank is related to the contents of primary and secondary bitumen. Relatively early generation of secondary bitumen in these coals than in normal humic coals is correlatable with their coking property as well as abnormal reflectance behaviour.

Another set of liptinite-rich samples has been selected for spectral fluorescence measurements on sporinite and alginite macerals. Spectral fluorescence behaviours of sporinite and alginite in these Tertiary coals and in coals from an Upper Permian seam reveal that Lambda max. and spectral Quotients (Q) of sporinite have relation with age, whereas those of alginite with rank. The plotting of Chromaticity Coefficients, calculated from the corresponding fluorescence colours, on Chromaticity Diagram of International Colourimetry System (DIN 6164 D 65.2°) has been found helpful in differentiating sporinite types and fluorescence colour.

B.K. Misra

Programme 6.11 : **Palynostratigraphy and correlation of Tertiary sediments of Meghalaya**

Objective : *To carry out morphotaxonomic study of recorded palynotaxa*

: *To determine stratigraphically significant palynotaxa and their application in zonation, correlation and dating*

: *To infer palaeoclimate and environment of deposition*

: *To trace botanical affinity and evolutionary lineages of studied palynotaxa*

Processing of 24 samples from the Oligocene-Lower Miocene sequences of Boldamgiri Formation of Adugiri-Purakhasia road section in Garo Hills was completed. Morphological studies of palynomorphs of this section have been taken up.

R.K. Saxena & M.R. Rao

Processing of 75 samples from Palaeocene-Eocene sequences of Nongwalbibra and Siju-Baghmara sections in Garo Hills was completed. Morphological studies of palynofossils from these sections have been taken up.

R.K. Saxena, S.K.M. Tripathi & Vandana Prasad

PROJECT 7 : RECONSTRUCTION OF QUATERNARY VEGETATIONAL PATTERNS

Programme 7.1 : **History of vegetation and climate in tropical montane forests in south India**

Objective : *To build up a complete palynofloral succession of the Shola forest/grassland in Annamalai Hills, Palni Hills and Silent Valley*

Twenty soil samples from Berijam Lake profile, Palni Hills, dating back to 20,000 yrs B.P. have been pollen analysed and one pollen diagram prepared. Three vegetational stages have been phased out in order to record all possible events and episodes which the vegetation has witnessed in time and space.

Phase I : (20,000-16,000 yrs B.P.) – It records the existence of grassland as it is evidenced by high frequency of Poaceae alongwith herbs and ferns depicting cold and dry climatic regime.

Phase II : (16,000-4,000 yrs B.P.) – It records emergence of such herbaceous taxa which are the associates of Shola forest on one hand and reduction of grasses on the other. This shift in the vegetation has revealed the climatic amelioration leading to warm and humid climate.

Phase III : (4,000 yrs B.P. till date) – It records coexistence of Shola forest and grasses under the increasing cold and decreasing humid climatic regime.

H.P. Gupta, S.K. Bera & Anjum Farooqui

Pollen morphology of the genera *Eucalyptus, Jambosa* and *Syzygium* (eight species of the family Myrtaceae); *Lonicera* and *Olea* (one species each Oleaceae); *Xanthophyllum* (one species Polygalaceae); *Zizyphus* (one species Rhamnaceae); *Carellia* (one species Rhizophoraceae); *Adina, Canthium, Coffea* and *Morinda* (five species Rubiaceae) has been studied.

H.A. Khan

Study of modern pollen taxa, viz., *Palaquium ellipticum, Rhodomyrtus tomentosa, Pavetta breviflora, Euonymus frigidus, E. crenulatus, Gordonia obtusa, Eurya acuminata, Rhododendron nilagiricum. Oldenlandia aspera, Ligustrum robustum, Evodia roxburghiana, Ilex doniana, I. whitiana, Sapota glabra, Viburnum cordifolium, Berberis* sp., *Strobilanthes cadatus, Impatiens* sp., *Ranunculus* sp., *Dodonaea viscosa, Heracleum nepalense, Polygonum plebejum, Polygala* sp., *Osbeckia capitata, Blumea membrancea, Artemisia parviflora, Crepis japonica, Cricus falconeri, Vernonia* sp., *Senecio* sp., *Gentiana tenella, Elaeocarpus ferrugineus, E. parviflora, Symplocos pendula, S. obtusa, Celastrus paniculata, Drosera* sp., *Dipsacus* sp., and *Chenopodium* sp. was taken up to get aquainted with various morphotypes of Shola forest.

Anjum Farooqui

Programme 7.2 : **Depositional environment and climate during the Quaternary Period in the Himalaya : a palynological approach**

Objective : *To build up a fine resolution climatic sequence of Quaternary Period in the Himalayan region*

Pollen analysis of four surface samples from Dewar Tal, Garhwal Himalaya has revealed the dominance of arboreals over non-arboreals. Amongst the arboreals *Pinus* followed by *Quercus* and *Alnus* are the major representatives, whereas *Salix, Myrica, Rhododendron, Acer, Bauhinia* together with shrubby elements of *Strobilanthes*, Rosaceae and Oleaceae are sporadic. The ground vegetation comprises mainly grasses, sedges, Cheno/Ams, Asteraceae, *Polygonum*, etc. Fern spores are quite frequent in most of the samples. The recent pollen spectra constructed from Dewar Tal show a close coherence with the modern vegetation composition in the region.

Pollen analysis of a 1.8 m deep soil profile from Dewar Tal has revealed the presence of chirpine forests in the region around 2,500 years B.P. The broad-leaved taxa, such as *Quercus, Alnus, Rhododendron,* etc. were scantily distributed around 2,000 years B.P. The mixed Chirpine-Oak forests got established as indicated by the increased frequencies of *Quercus, Alnus, Rhododendron* and shrubby elements of *Strobilanthes*, Oleaceae and Rosaceae. Thereafter, the decline in these forests and simultaneous improvement in grasses and other non-arboreals have been witnessed.

Chhaya Sharma & M.S. Chauhan

Pollen analysis of 24 samples from 1.5 m deep soil profile (DT-3) from Deoria Tal, Garhwal Himalaya has been carried out. Study reveals the dominance of non-arboreals over arboreals. Poaceae followed by Cyperaceae are major constituents. Asteraceae, Ranunculaceae, Cheno/Ams, Caryophyllaceae, Brassicaceae, Polygonaceae, Lamiaceae and Urticaceae, etc. are other associates of ground cover. Arboreals are poorly represented by *Pinus, Quercus, Alnus, Betula, Carpinus, Rhododendron, Picea, Abies, Ephedra, Ulmus, Celtis, Juglans,* Myrtaceae, *Symplocos*, *Juniperus* and Fabaceae. Fern spores are encountered in good number reflecting their origin from local source. The overall vegetation assemblage depicts that around 2,500 years B.P. the open mixed broad-leaved forest existed in the region.

Chhaya Sharma & Asha Gupta

Five aeropalynological samples from Chaurangi Khal, Garhwal Himalaya were pollen analysed . The study reveals the dominance of arboreals over non-arboreals. Arboreals show high frequency of *Pinus* followed by *Quercus*, *Carpinus, Betula, Alnus, Corylus, Ulmus, Celtis, Juglans* and *Rhododendron*. Non-arboreals are represented by Poaceae, Ranunculaceae, Cyperaceae, Cheno/Ams and Brassicaceae, etc. Fungal spores are encountered in good number while fern spores occur rarely. The composition of aerospora more or less corresponds with the surrounding vegetation in the region, except for the under-representation of fern spores which could be attributed to their restricted vertical transportation.

Asha Gupta & Chhaya Sharma

Programme 7.3 : History of mangrove vegetation in India

Objective : *To study palynostratigraphy and Dispersed Organic Matter analysis of the sediments from Chilka Lake in Mahanadi-Brahmani-Baitarini deltaic region in Orissa*

Five samples of 250 m deep profile at the depth between 51-55 m from Sadanandpur in Mahanadi Delta have been palynologically investigated. The assemblage showed the preponderance of Poaceae, Cyperaceae, Chenopodiaceae/Amaranthaceae, Urticaceae, *Typha, Lemna, Nymphoides, Potamogeton,* etc. The core-mangrove taxa such as *Rhizophora, Avicennia, Excoecaria, Heritiera* and peripheral mangroves were lowly present. The palynological investigation has revealed that during this phase the sea regressed leaving the relics of mangrove forest in Mahanadi Delta.

Eight samples of Dangmal profile collected from thickets of mangrove forest at Bhitarkanika, Baitarni Delta, Orissa have been palynologically investigated. The samples showed good assemblage of pollen grains, fungal spores, dinoflagellate cysts, microforaminifera, *Pediastrum*, fern spores and *Pseudoschizea*. The dominance of *Rhizophora, Sonneratia, Avicennia, Excoecaria,* etc. were recorded. The other peripheral mangroves and hinterland taxa encountered in varying frequencies are *Pandanus, Acacia, Aegialitis, Heritiera, Xylocarpus, Emblica, Xanthium, Brownlowia, Justicia, Casuarina,* Poaceae, Rubiaceae, Lythraceae, Myrtaceae, Fabaceae, Urticaceae, Chenopodiaceae/Amaranthaceae, etc. The study reflects the existence of mangrove throve as the area enjoyed consistent marine incursions.

H.P. Gupta & Asha Khandelwal

Nine samples numbering 166, 180, 184, 194, 197, 201, 206, 208, 210, 218 from 250 m deep profile from Sadanandpur were pollen analysed. The samples are rich both quantitatively and qualitatively. The important mangrove constituents are represented by the members of Rhizophoraceae, *Avicennia, Sonneratia, Excoecaria, Nypa* and *Brownlowia*. The study has revealed the existence of constant depths of sea water leading to luxuriant mangrove throve.

H.P. Gupta & R.R. Yadav

Programme 7.4 : **Dendrochronology of temperate and tropical trees and seasonality of cambium activity**

Objective : *To reconstruct climate (temperature and precipitation) from tree rings*

: *To study environmental factors determining the seasonality of cambium activity*

Ring widths of dated tree ring sequences of *Abies pindrow* collected from Dwali near Pindari glacier were measured. Tree growth has shown highly individualistic growth pattern which could be due to inter-tree competition and stand phase disturbances. Tree ring chronology further needs to be updated with more replication of samples from the area for climatic reconstruction.

Tree ring samples of teak (*Tectona grandis*) collected from Korzi, Andhra Pradesh were dated and ring widths measured. A master chronology (1872-1989 AD) was prepared from nine samples. Tree growth and climate relationship using response function analysis has shown very good correlation between tree growth and summer precipitation.

Fifteen tree core samples of spruce collected from Dodital in Uttarkashi were dated using Skeleton plot method. Trees have been found to be around 300 years in age. Tree core samples of deodar collected from different areas around Gangotri were also dated. Age of trees has been found to be around 500 years in Gangotri.

R.R. Yadav & Amalava Bhattacharyya

Programme 7.5 : **Plant remains from Pre- and Proto-Historic sites in northern and northwestern India**

Objective : *To study agricultural practices in context of different cultures in time and space*

: *To sketch the perspectives of ecological potential of contemporary agro-ecosystem and their contemplated further development*

: *To determine the interaction of pre-historic man with the floral wealth*

: *To reconstruct regional models of ecological conditions around the cultural settlements*

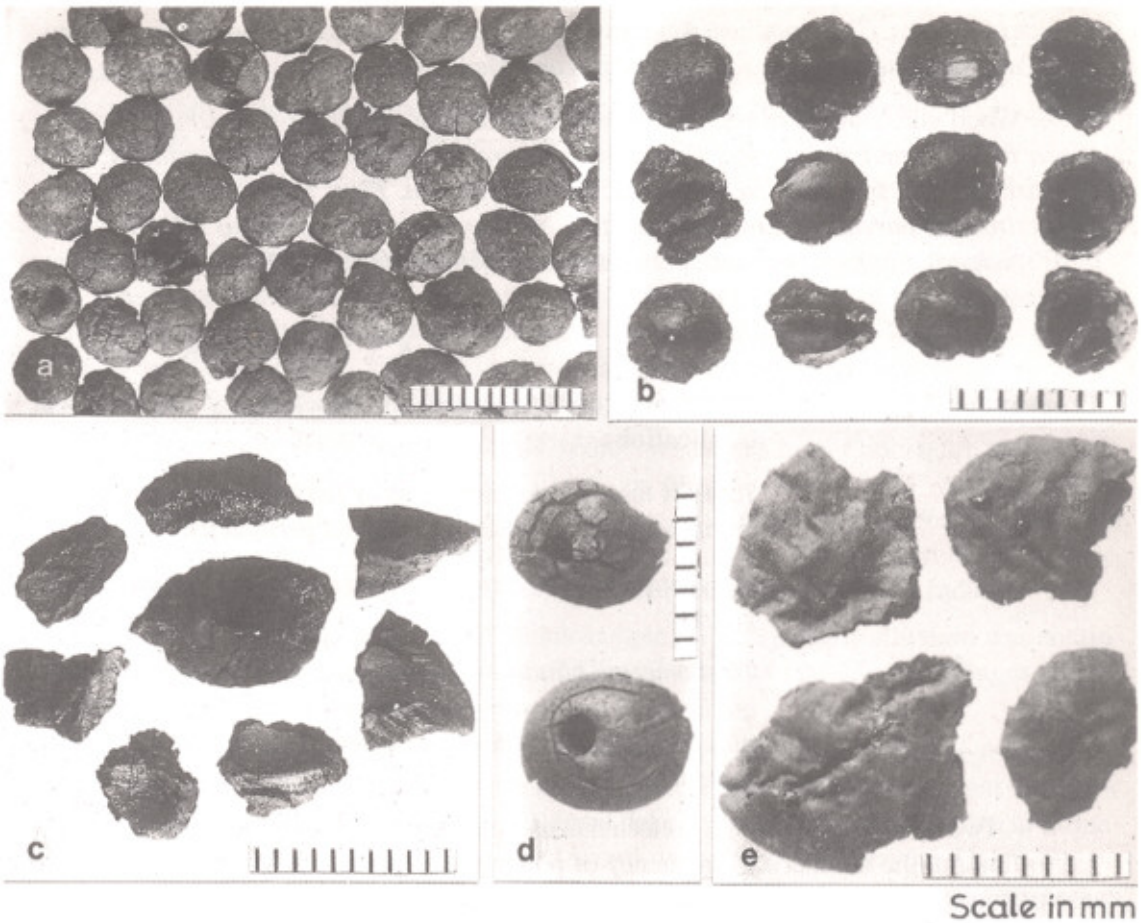
The plant remains recovered from Banawali, district Hissar, Haryana amply demonstrate a rich and varied plant economy of Pre-Harappan and Mature Harappan communities, from 2,750 to 2,000 B.C. Crop remains from Pre-Harappan period (2,750-2,500 B.C.) include hulled-barley (*Hordeum vulgare*), naked-barley (*H. vulgare* var. *nudum*), emmer-wheat (*Triticum dicoccum*), dwarf-wheat (*T. sphaerococcum*), bread-wheat (*T. aestivum*), club-wheat (*T. compactum*), jowar-millet (*Sorghum bicolor*), horse-gram (*Dolichos biflorus*), field-pea (*Pisum arvense*), lentil (*Lens culinaris*), chick-pea (*Cicer arietinum*), grass-pea (*Lathyrus sativus*), sesame or til (*Sesamum indicum*) and field-brassica (*Brassica juncea*). Associated seeds and fruits of weeds and other wild plants in the food grains belong to *Setaria* sp., *Ziziphus nummularia, Tamarindus indica* and *Trianthema triquetra.*

Among the finds from the Mature Harappan levels (2,500-2,000 B.C.), most of which are of the same kind as from Pre-Harappan levels, rice (*Oryza sativa*), green-gram (*Vigna radiata*), black-gram (*V. mungo*), fenugreek (*Trigonella foenum-graecum*) and date (*Phoenix* sp.) are new discoveries. Remains of weeds and wild taxa belong to *Vicia* sp., *Ficus religiosa, Trianthema triquetra, Ziziphus nummularia, Vetivaria zizanioides, Ipomoea* sp., *Dactyloctenium* sp., *Albizia* sp., *Solanum suratense* and some indeterminate grass caryopses.

From the same site discovery of a carbonised sample having components of herbal shampoo, still used in the present times, is first of its own kind in the world archaeological context to amply demonstrate the sense of hygiene and the understanding of chemical properties of plant products in the Pre-Harappan communities in India during 2,750-2,500 B.C. It contains the fruits of an indigenous wild soapnut or reetha (*Sapindus emarginatus*), a substitute for soap obtained from south India through trade and locally available fruits and seeds of Shikakai (*Acacia rugata*) and Anwala (*Emblica officinalis*) both of which are used as detergent for shampooing hair and to promote their growth.

Wood charcoals from Pre-Harappans and Mature Harappan levels belonging to *Prosopis* cf. *P. spicigera, Phoenix* sp., *Albizia lebbeck, Morus alba, Ziziphus* sp., *Ficus* cf. *glomerata* and *Azadirachta indica* have been found.

K.S. Saraswat



Carbonised remains of : **a, b,** fruits of *Sapindus emarginatus* (Reetha); **c**, endocarp pieces of *Emblica officinalis* (Anwala); **d**, seeds of *Acacia rugata* (Shikakai); and **e**, pod pieces of Shikakai from Pre-Harappan Culture (ca 2,750- 2,500 B.C.) at Banawali, Haryana.

Anatomical investigations of 12 wood charcoal samples from Lumbini, district Taulihava, Nepal, a site of Buddhist period dating between ca. 600 to 200 B.C., were carried out. Majority of the wood remains have been found to belong to *Shorea robusta*, thereby revealing the selective choice of the ancient settlers for this quality timber available locally in the Tarai and Bhabhar region. The other timbers exploited by them belong to the mixed deciduous forest associated with Sal, viz., *Terminalia tomentosa, Adina cordifolia, Gardenia turgia, Dalbergia* sp. and members of Anacardiaceae, Mimosaceae, Apocynaceae, Magnoliaceae, Meliaceae and Bombacaceae. The specific identifications are in progress.

Chanchala Srivastava

The remains of weeds and wild taxa from Kushana Culture at Sanghol (100-300 A.D.), district Ludhiana, Punjab include *Vicia hirsuta, V. sativa, Fimbristylis tetragona, Trigonella occulta, Argemone* cf. *mexicana, Lawsonia inermis, Rumex dentatus, Trianthema triquetra, Setaria glauca, Commelina benghalensis, Dactyloctenium aegyptiacum* and

species of *Datura, Chenopodium, Amaranthus, Polygonum, Solanum, Eleocharis, Cyperus, Poa, Panicum, Andropogon, Scleria, Scirpus* and *Medicago*.

Wood charcoals have been identified as belonging to *Acacia* sp., *Albizia lebbeck, Butea monosperma, Citrus* sp., *Calotropis procera, Capparis sepiaria/horrida, Cedrus deodara, Datura* sp., *Emblica officinalis, Feronia limonia, Ficus religiosa, F. glomerata, Lagerstroemia parviflora, Lowsonia inermis, Mitragyna parvifolia, Morus alba, Prosopis* cf. *P. spicigera, Ricinus communis, Tectona grandis, Vitis vinifera, Ziziphus* sp. and *Bambusa* sp.

A.K.S. Pokharia & K.S. Saraswat

Programme 7.6 : Aerospora of Lucknow : its biochemical and clinical implications

Objective : *To daily monitor the aerospora of Lucknow and surrounding areas for their seasonal and diurnal periodicity*

: *To identify aeroallergens by biochemical and clinical investigations*

: *To enumerate biota in the aerospora both quantity-wise and quality-wise employing both gravimetric and volumetric techniques in order to achieve precision in seasonal and diurnal periodicity*

Twenty-four soil samples collected from different parts of Lucknow city were studied to find out the number and frequency of pollen grains preserved in the sediments. On comparing with aerospora, the processes involved in dispersal, sedimentation and differential preservation of pollen grains can be assessed. Collected bulk pollen of several taxa responsible for pollen allergy, for their clinical and biochemical studies.

Asha Khandelwal

PROJECT 8 : GEOCHRONOMETRY OF INDIAN ROCKS

Programme 8.1 : Radiocarbon dating of Quaternary deposits and materials of archaeobotanical importance

Objective : *To date Quaternary sediment profiles, ocean sediment cores, coastal deposits and shell deposits and Kankar horizons in the Ganga plain*

: *To establish the Liquid Scintillation Counting method for C-14 dating*

A total of 81 samples were processed in the Radiocarbon lab. Of these, 48 samples were dated. Some of the results are as follows :

Sediment and peaty clay profiles (22 samples) from a number of localities in

Himachal Pradesh were dated. The age range covered by these profiles span entire Late Quaternary Period. The pollen analytical investigations in the sediment profile of Sithikhar swamp, Spiti Valley, Himachal Pradesh indicate cold-arid climate before 1,900 yrs but later the climate became colder as evidenced by decline in the frequencies of most plant taxa in younger sediments. The samples from Takche, Spiti Valley were found to be palynologically barren.

Charcoal samples (6) relating to archaeobotanical studies from the Harappan site in Dholavira, Kutch, Gujarat were dated. The calibrated C-14 ages of the samples lead to the inference that the Harappan Civilization was flourishing in this locality for a much longer period (2,660 to 1,950 B.C.) than at other sites excavated so far.

For a collaborative programme (with the Geology Department, Kumaon University) on neotectonic studies in Himalayas, sediment samples from Pithoragarh were dated. The ages of two samples differ widely 30,000 yrs in one case and 2,000 yrs in the other. Dating of systematically collected profile samples is in progress. Samples of peat from Nilgiris were dated for a collaboration programme with the Indian Institute of Science, Bangalore in continuation of earlier studies on palaeoclimate of southern India.

The C-14 dating of shell and kankar samples (8) in Gangetic alluvium was continued for understanding the development of alluvial deposits and climate changes in Holocene in the Indo-Gangetic Plain.

Five peat samples from West Bengal were dated on payment for Centre for Study of Man and Environment, Calcutta to reconstruct palaeoclimate and environment and their changes during the Quaternary of lower Bengal delta in a precise geochronological framework. Six samples of coral, sediment and wood were dated for Jadavpur University on payment for studies relating to past sea level and palaeoclimate. One charcoal sample was dated for Lumbini Development Trust, His Majesty's Government, Nepal from a site in Lord Buddha's birth place, Lumbini in Nepal.

Five samples of burnt wood, sediment and charcoal were dated as part of a programme relating to the investigations by NGRI of 1993 earth quake in Latoor, Maharashtra.

G. Rajagopalan

For the reconstruction of past trophic conditions around Didwana Lake, Rajasthan on the basis of elemental analysis, phosphorus concentrations (authigenic phosphorus passes to the sediments primarily through biotic cycling) at different depths of trial trench were measured. This is in addition to the measurements of elemental, organic and mineral contents carried out earlier in these sediments, which covers a time span of 8,100 yrs BP. Five samples were analysed for measuring authigenic phosphorus concentrations using Spectrophotometer. The concentrations range from 7,880-1,8250 ppm . Conclusions derived are in agreement with those on the basis of other elemental, organic and mineral content data.

G. Rajagopalan & B. Sekar

Programme 8.3 : Potassium-Argon dating of sedimentary and igneous rocks

Objective : *To date the glauconitic sandstone collected from Vindhyan deposits in Uttar Pradesh and Rajasthan*

: *To date the Deccan Trap samples and synthesize the data with fossil studies in collaboration with Cenophytic Department*

: *To develop data acquisition and reduction system*

Two glauconitic mineral separates were prepared, a new molybdenum crucible was made and new water tank and water line installed for the RF furnace. RF valves were tested. Magnetic shield for the turbomolecular pump was made and fixed. Work on the electronics of MS system continued. In view of high power interruption frequency, processing for UPS system initiated. Vacuum generation and residual gas spectra recording were continued. Work on instrument-maintenance was also carried out.

C.M. Nautiyal

PROJECT 9 : ANNOTATED ATLASES, CATALOGUES, MONOGRAPHS AND BOOKS AND RESEARCH PROGRAMMES *AD FINUM*

Programme 9.1 : Data bank for Palaeozoic-Mesozoic palynology, using expert system and compilation of catalogues, atlases and other palynological information

Objective : *To index and update new data into the existing data banks*

: *To develop data-base for distribution of stratigraphically important taxa*

: *To establish data-base for identification and retrieval of palynotaxa*

Updating of data bank on palynology of Indian Gondwana sediments and related aspects was continued.

Department of PGGP : Group Effort

A programme for retrieval of references has been developed. Through this programme according to the requirement the references can be retrieved in various combinations pertaining to author, area, basin, age and different subjects.

R.S. Tiwari, Archana Tripathi & R. Nandhgopal

The index of fossil spores and pollen in the Indian Permian sediments is being prepared. The marker key species for Talchir, Karharbari, Barakar, Kulti and Raniganj have been sorted out and the details have been listed.

R.S. Tiwari, Archana Tripathi, Vijaya & Ram-Awatar

Programme 9.2 : A catalogue of fossil dinoflagellates from India

Objective : *Morphological re-interpretation and documentation of published data*

Scanning of slides from Arthungal bore-hole, Kerala Coast (Rao, 1990) has been completed. The dinoflagellate cyst assemblage is poor. Presence of *Impagidinium* sp. (reported as *Thalassiphora* sp.) is noted.

K.P. Jain, Rahul Garg & Khowaja-Ateequzzaman

Programme 9.6 : **Patterns of leaf architecture and cuticle in some tropical dicotyledonous families**

Objective : *To study leaf architecture and cuticle of some tropical angiospermous families : Magnoliaceae, Anonaceae, Dilleniaceae, Combretaceae, Lauraceae, Myrtaceae and Fabaceae*

Leaves of *Anona reticulata* Linn., *Anona squamosa* Linn., *Polyalthia longifolia* (Sonner) Thw., *Polyalthia suberosa* Thw., and *Artabotrys uncinatus* (Lam.) Merr. in family Anonaceae and *Combretum roxburghii* Spreng., *Combretum comosum* of Combretaceae were collected, pressed and chemically processed. Slides of their cuticle and mounts of leaf venation were prepared and morphology, venation pattern and cuticlar features have been described.

D.C. Saini

Programme 9.7 : **Inventory of Type and Figured palaeobotanical specimens/ slides (megafossils) available with repository of BSIP-Museum**

Objective : *Publication of Inventory and a Guide Book to the BSIP Museum*

Compilation of data for Inventory Part III is under progress.

G.P. Srivastava (Co-ordinator) [Group Effort]

Programme 9.9 : **Cenozoic plant remains of Palamu, Bihar**

Objective : *To study morphotaxonomy of megafossils from the Neogene sediments of Mahuadanr Valley*

: *To reconstruct vegetational history, palaeoecology, phytogeography and depositional environment*

Description of four taxa (*Sterculia, Artocarpus, Croton* and of fossil Lauraceae) has been completed.

G.P. Srivastava

Programme 9.10 : **Siwalik flora of West Bengal**

Objective : *To study the plant megafossils from the Siwalik sediments exposed in various localities of Darjeeling District*

: *To build up the floristics for interpreting palaeoecology, phytogeography and evolutionary patterns of the Himalayan flora*

A number of leaf-impressions, collected from the Himalayan foot-hills near Oodlabari and Sevoke Road cutting section in Darjeeling District, have been identified with the modern taxa *Mitrephora macrophylla, Polyalthia simiarum, Milletia pachycarpa, Shorea buchananii, Phyllanthus hirstum, Swintonia floribunda, Lagerstroemia colletti* and *Dipterocarpus macrocarpus*. The occurrence of these elements in the Siwalik sediments indicates the prevalence of warm and excessive moist conditions in the area at the time of sedimentation.

J.S. Antal

Programme 9.11 : Collection of extant plant material from the foot-hills of Himalaya

Objective : *To enhance the collection of extant plant material and their preparations for development of Herbarium of the Institute as repository of the authentic plant specimens and samples*

: *To provide authentically identified extant plant material to the scientists as per their requirements*

: *Preparation of Inventory and Atlases of Herbarium holdings*

About 600 plant specimens and eighty samples of fruits and seeds have been collected from Allahabad, Raibareilly and Lucknow in Uttar Pradesh and Katni, Jabalpur, Seoni and Balaghat districts in Madhya Pradesh and their identification was completed.

Preparation of Inventory of Herbarium holdings (Carpothek and Xylarium) is under progress. Prepared about 2,000 cards of Xylarium for computer feeding. Physical verification of wood samples present in the Herbarium has been completed.

Herbarium has been shifted to the hall originally meant for it, repository has been re-arranged and exhibits are being displayed.

D.C. Saini (Co-ordinator) [Group Effort]

PROJECT 10 : APPLICATION OF GEOBOTANICAL ANALYSIS IN :

I. MINERAL PROSPECTING

II. RECONSTRUCTING THE HISTORY OF MODERN VEGETATION THROUGH CENOZOIC ERA

Objective : *To assess the extant plant communities for indication of minerals in the underlying strata*

: *To reconstruct the patterns of migration, extinction and diversification of Cenozoic floras in conjunction with the lineages of modern floras*

The plants, soil and rock samples collected from Malanjkhand copper mine and Ukwa Mangnese mine areas, both situated in the Balaghat District of Madhya Pradesh were cleared, dried and prepared for chemical analysis to find out any specific correlation between the mineral content of the rock and abundant/robust growth of plant species growing in the area.

Consulted relevant literature on geobotany and prepared a draft of a paper on the "Status of geobotany".

R.S. Tiwari (Co-ordinator)

J.S. Guleria, S.K. Bera, Madhav Kumar, D.C. Saini & B. Sekar

PROJECT 11 : PALAEOBIOCHEMISTRY OF PLANT FOSSILS, LIGNITE/ COAL, D.O.M. AND RELATED RECENT MATERIAL

Objective : *Extraction and identification of organic compounds from plant fossils, rocks, lignite, coal and related recent material*

: *Evaluation of extracted organic compounds (EOC) for the possible use as biomarkers and in identification of plant groups*

: *Possible structural changes in EOC (by diagenetic, catagenesis and metagenesis) through time for assessment of maturity*

: *Pair-wise comparison of correctly aligned proteins and nucleic acids (DNA & RNA) sequences to measure time*

: *Evaluation and assessment of organic compounds in lignite and coals*

: *Assessment of palaeoenvironmental and palaeo-depositional conditions*

Initial efforts were made to identify right type of material for study and to get trained in continuous solvent extraction procedure using Soxhlet apparatus. Efforts were made to understand sources of contamination and procedures to avoid them.

A collaborative venture to study carbon and oxygen isotopes of limestone and shale samples from Bhima Basin has been initiated with NGRI, Hyderabad.

It is also proposed to make efforts for extracting DNA (part of DNA which may be still preserved in fossils). This work is to be taken-up in collaboration with School of Environmental Sciences, Jawaharlal Nehru University, New Delhi.

Manoj Shukla

Sponsored Projects

S.P. I : **Holocene palynostratigraphy and palynoenvironment of Chilka Lake : An inter-disciplinary approach (DST NO. ES/44/019/90)**

Objective : *To build up data on palynology, sedimentology, C/N ratio and O^{18} isotope from in and around Chilka Lake for palaeoclimatic interpretation*

Palynological analysis of 50 soil samples from 250 m deep Sadanandpur profile in Mahanadi delta, dating back to > 40,000 yrs B.P. has revealed distinct transgressive and regressive phases, enabling the study of coastal evolution. Samples between the depths of 175-183 m and 241-250 m have revealed the preponderance of core-mangrove taxa such as *Rhizophora, Ceriops, Bruguiera, Xylocarpus, Heritiera, Nypa, Aegialitis, Excoecaria, Avicennia, Sonneratia*, etc. indicating the marine phase with constant depths of sea water. Samples between the depths of 168-174 m and 220-230 m have revealed deltaic environment with high discharge of sea water. Samples between 150-167 m depth proved to be palynologically barren.

The grain-size and mineralogical analysis of Sadanandpur profile have been completed. The location, geomorphological field map and litholog have been prepared. The palynotaxa have been documented. The micropalaeontological fossil remains, such as oolites, echinoderms and brachiopods have been observed. The preparation of pollen diagram is in progress.

Eight soil samples of 250 m deep Erbang profile, about 6 km away from the present seashore near Konark in Mahanadi delta, have been chemically processed and pollen analysed. Samples between the depths of 30-40 m have recorded pollen taxa indicating deltaic environment with high discharge of fresh water, i.e., marine regressive phase. However, samples between 95-101 m depth have revealed preponderance of marshy land pollen taxa, such as *Barringtonia,* triletes, monoletes, etc. signifying cessation of sea influence in this zone.

Pollen analysis of a 3.0 m deep profile from Chandrapur Village, south of Balugaon, Chilka Lake, Orissa have revealed the moderate presence of both core and peripheral mangrove taxa between 3.0-2.5 m depth. The rest of the profile has recorded poor occurrence of mangroves in the assemblage. The preparation of pollen diagram of Chandrapur profile is in progress.

H.P. Gupta & Deepak Kohli

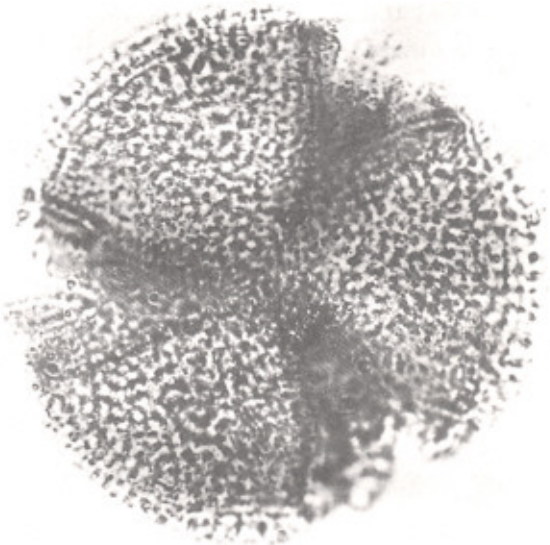
S.P. II : **Palaeogene floral diversity, biostratigraphy and palaeoenvironmental implications (DST NO. ES/44/037/93)**

Objective : *To document the palynological changes during Palaeogene*

: *To decipher the extinction and evolutionary pattern of the different palynotaxa*

: *To infer the palaeoecological condition of deposition*

Surface and subsurface samples collected from Tamil Nadu, Gujarat and Rajasthan were chemically processed. In Tamil Nadu, except the samples collected from Neyveli lignite and a bore-hole near Mannargudi, all other samples turned out to be barren. Surface



Trisyncolpites ramanujamii Kar from the subsurface Oligocene sediments, near Bhavnagar, Saurashtra, Gujarat (x 1000).

samples collected from Palana and Kolyat regions also turned out to be unproductive. However, bore-hole core samples (drilled by the MECL and the GSI) near Kuchaur Benia area in Bikaner District yielded spores and pollen grains. The Lower part of some of the bore-hole core (160-179 m) contains different species of *Dandotiaspora, Lycopodiumsporites, Matanomadhiasulcites, Proxapertites, Spinizonocolpites, Lakiapollis, Retitribrevicolporites, Kielmeyerapollenites*, etc. The palynological assemblage indicates a Late Palaeocene age which was not suspected earlier. All the slides of the productive samples were scanned and important taxa marked for photography.

R.K. Kar, Poonam Sharma & Luna

S.P. III : **Reconstruction of past climatic changes in eastern Himalayan region using tree-ring data (DST No. ES/44/018/90)**

Objective : *To understand past climatic changes especially temperature and precipitation during last 500 years based on tree-ring width proxy data*

Tree ring samples collected from the diversified forests in the eastern Himalayan region have been mounted in wooden frames. Surface of these cores were polished through different grades of sand paper to make tree ring features clearly visible under binocular stereozoom microscope. A large number of cores have been studied to trace out missing or double rings through Cross dating techniques. These studies reveal that among other conifers, viz., *Abies, Tsuga, Taxus baccata* and *Larix*, the endangered taxa growing in this region have been found to be most promising for dendroclimatic analysis because of clarity of their ring boundaries, and good cross dating within the same tree and different trees. However, problem was encountered in obtaining replicated samples of these trees as most of the old trees were found rotten inside.

Ring counts in the Skeleton Plots show that tree-age of *Larix griffithiana* ranges from 100-250 years, *Taxus baccata* 150-380 years, and 150-530 years in *Tsuga brunoniana*. Dating of these tree-ring sequences to the calendar year of their formation is in progress.

A. Bhattacharyya, R.R. Yadav & Vandana Chaudhary

S.P. IV : **Palaeobiological investigations across Archaeozoic-Early Proterozoic transition (DST NO. ESS/CA/A4-09/93)**

Objective : *To identify organic-walled microfossils, their syngenicity and biogenicity from Archaean and Early Proterozoic*

: *Identification of benthic and planktonic biota and their comparison with extant forms*

: *Significance of biota in metallogenesis*

: *Organosedimentary structures-stromatolite morphology, etc.*

: *Study of organic walled microfossils associated with stromatolites*

: *Significance of stromatolites in biostratigraphy, basin analysis, etc.*

Two sections in Noamundi-Barbil area, Orissa were identified which show good development of carbonate facies underlying the Iron-Manganese ore-bearing horizon. One section is near Bhadrasahi in the Kasia Mine and other at Nadidih about 10 km from the Kasia Mine area. The Kasia Mine area shows ca 80 m thick carbonate sequence with intercalated shales and black bedded cherts. The thickness of chert bands varies from a few mm to 2 m with colour varying from light grey to black. The lower part of the carbonate sequence is devoid of cyanobacterial mat horizon but the upper part shows excellent preservation of mat horizon. A few bands show development of *Stratifera* type mats but some also show columnar, non-branching stromatolites. The height of the stromatolite columns is up to few cms. The upper part is overlain by Hematite-Jasper-bearing horizon which is mined for iron and manganese ores. A lithostratigraphic succession is established for Kasia Mine area and entire 80 m thick carbonate sequence is divided into 5 informal units. The Nadidih section shows an exposure measuring a few meters only. A detailed sampling is done in both the areas for the study of stromatolites and microbiota. More than 100 thin sections were prepared and studied for the presence of microbiota.

For organic-walled microfossils each slide was scanned under the petrological microscope with 100 x objective. Majority of the slides are non-fossiliferous but some show poorly developed microfossils. However, in three slides fairly well developed microbiota has been recorded which shows following morphotypes :

(a) Solitary cells (1-6 μm size) with sheath encompassing individual cells. Some cells show ornamented outer wall also,

(b) spheroidal cells forming colonies,

(c) paired cells with diameter ranging between 1-5 μm,

(d) globular cells forming chains, individual cell with diameter 1-6 μm,

(e) dividing stages of cells, and

(f) cells with globular and marginal thickning, cell size ranging from 2-8 μm. These are being studied for their taxonomic assignment.

Twenty-seven large-sized samples of stromatolites were sliced for morphometric study. These are being studied for shape, size and microbiomineralization. None of the stromatolite forms show branching and generally are of small size measuring not more than a few cms. Some are also comparable with *Conophyton* type forms.

P.K. Maithy
S. Kumar (Geol. Dept., Lucknow Univ.)
Rupendra Babu & Sheenu Sharma

S.P. V : ***Aeroallergens* and human health : An aerobiological study (Ministry of Environment & Forest No. 42/14/94-RE dt. 30.03.94)**

Objective : *Monitoring of extramural and intramural environment of Lucknow, database acquisition of aeroallergens; diagnosis, treatment and control of allergic disorders*

Habit, habitat, frequency, distribution, mode of pollination and duration of flowering period of many plant taxa growing in and around Lucknow city were recorded. Herbarium sheets of about 150 plant taxa were prepared and their polleniferous material was also collected. Both temporary and permanent slides of 40 plant taxa were prepared. Besides, about 1,000 index cards of aerobiological literature were also prepared.

About 10 gm pure pollen of each plant of aeroallergenic importance, such as *Holoptelea integrifolia, Ricinus communis, Ailanthus excelsa, Morus alba, Pithecolobium dulce, Argemone mexicana* and *Putranjieva roxburghii* were collected.

Asha Khandelwal, Rashmi Tewary, Shantanu Chatterjee & Priti Agarwal

S.P. VI : **Palaeobiology and biostratigraphy of the Proterozoic sediments of the Indravati Group of Bastar District, Madhya Pradesh, India (SP [SR/SY/A- 16/93])**

Objective : *Documentation of palaeobiological remains in Indravati sediments*

: *Establishment of range of life forms and organo-sedimentary structures*

: *Integration of these records in biostratigraphic framework*

: *Interpretation of these data in terms of sequence stratigraphy and palaeoenvironment.*

A reconnoitre survey of the exposures of Indravati Group around Jagdalpur has been completed. Stromatolites are noticed only in Jagdalpur Limestone and Shale Formation and are present in the forms of carbonate build ups. Kanker Limestone Formation shows the presence of pyrite and carbonaceous nodules.

Mukund Sharma

Collaborative Projects/Work

Project I : **Precambrian-Cambrian boundary events (IGCP Project — 303)**

Carbonaceous macrofossils — *Chuaria* and *Tawuia* and their allied remains from the Halkal Formation, Bhima Group, Karnataka were studied. These beds were equated with Precambrian-Cambrian transition. The detailed study of carbonaceous macrofossil remains and associated organic-walled microfossils indicate that the beds of Halkal Formation are older than Pre Varanger glaciation, i.e., 700 Ma. The biological remains compare with the world wide assemblages found for the period 1000-900 Ma.

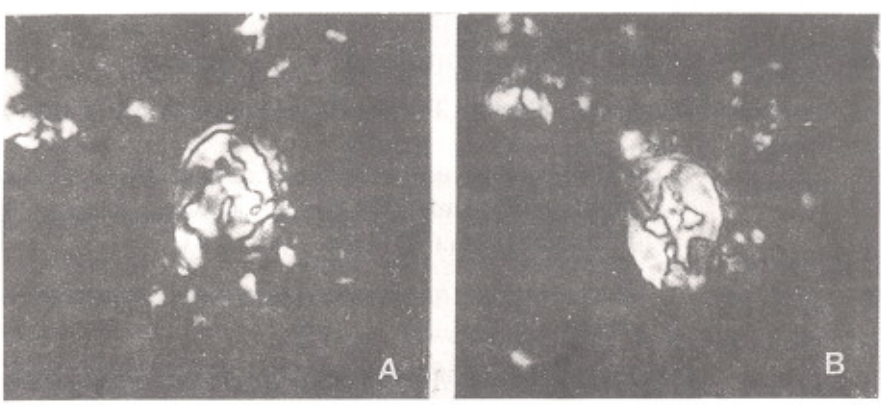
P.K. Maithy & Rupendra Babu

Project II : **Vegetational history, palaeoenvironment and climatic changes during Siwalik in west central Nepal**

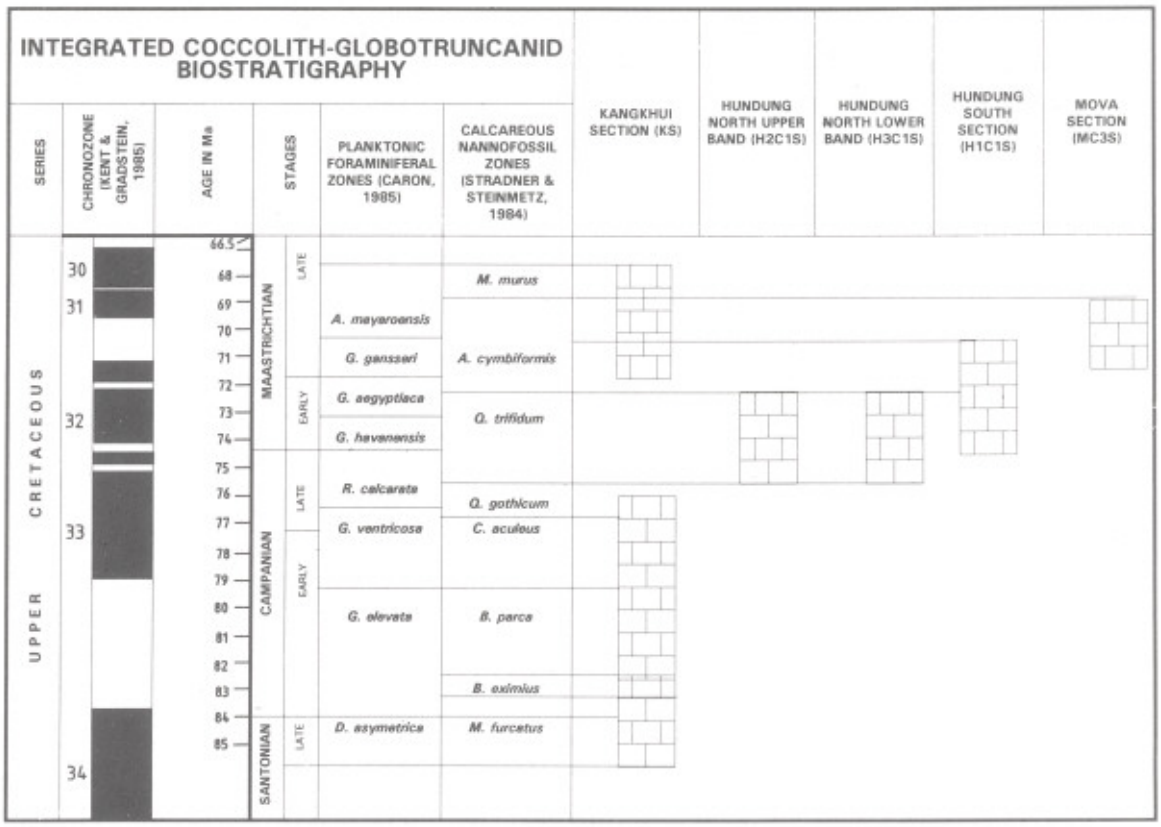
Prepared descriptions and photographs of some of the identified dicot leaf-impressions from Arung Khola and Binai Khola formations of Churia Group of Nepal.

N. Awasthi [& M. Konomatsu, Japan]

Project III : **Late Cretaceous calcareous nannofossil/planktonic fora-**



A, *Parhabdolithus embergeri* (Nöel 1958) Stradner 1963 (x 2200); B, *Eiffellithus eximius* (Stover 1966) Perch-Nielsen 1968 (x 2200) from Manipur, Earliest Campanian.



Integrated Coccolith-globotruncanid biostratigraphy of exotic blocks of pelagic limestones from ophiolite melange zone of Ukhrul, Manipur.

miniferal integrated biostratigraphy of Ukhrul Ophiolite complex, Manipur

A draft manuscript on Campanion-Maastrichtian coccolith/globotruncanid biostratigraphy of pelagic limestones from accretionary prism of Manipur, north-eastern India has been completed. Tectonostratigraphic frame-work of Manipur accretionary prism, based on the recovery of globotruncanid/coccolith species from low latitude pelagic facies of convergent plate margin, would serve as a type section for biostratigraphy and recognising Campanian/Maastrichtian boundary in the Indo-Pacific region.

S.A. Jafar [& C.H. Prithiraj & A. Sahni, Chandigarh]

Two profiles, one each from Lamayuru (Ladakh) and Bhowali (Kumaon) have been undertaken for Quaternary pollen analysis. Fourteen samples from Bhowali section were found devoid of spore/pollen contents.

Fifteen samples from more than 110 m Lamayuru section covering time span of Weichselian have been macerated for pollen analysis. Out of these, five samples have been found to be barren while others are represented mostly by *Picea* and *Abies* which were

carried there perhaps with upthermic winds. Local taxa, viz., Asteraceae, Poaceae, Chenopodiaceae, *Ephedra, Hippophae* and others are found low in all samples. Detailed pollen counting is in progress.

A. Bhattacharyya [& B.S. Kotlia, Nainital]

Work other than Programmes

Fourteen histograms showing per cent frequency of palynotaxa at generic level in different palyniferous horizons of the Jhuran and Bhuj formations, and a distribution plot of selected palynospecies were prepared for the final report on the ONGC funded project "Palynology of the Mesozoic sedimentaries of the Kutch Basin". Data available so far indicate that the Middle Member of the Jhuran Formation may not be older than Late Tithonian in age.

H.K. Maheshwari & B.N. Jana

The report of ONGC-BSIP's collaborative Project entitled "Palynology of the Mesozoic sediments of Kutch Basin" was finalized for submission.

In addition to the study of calcareous algae of Bagh beds, a study of the algal flora found in Sylhet Limestone Formation of Meghalaya was carried out. The assemblage contains *Lithothamnium, Distichoplax, Archaeolithothamnium*, etc.

B.N. Jana

Chemical processing of bore-hole samples (45) of Narakal, Turavur and Cherai of Ernakulam District provided by Central Ground Water Board, Trivandrum, Kerala were completed. Slides were prepared for the productive samples.

M.R. Rao

A rich pteridophytic spore assemblage has been recorded from the rock samples collected from Dharamshala Formation near Bilaspur, Himachal Pradesh.

Samir Sarkar

Extant pollen grains of the families Alangiaceae, Arecaceae, Araceae, Liliaceae, Bombacaceae, Euphorbiaceae and Rubiaceae were studied at French Institute, Pondicherry.

S.K.M. Tripathi

Scanning electron microscopical observations on few pollen were made which are commonly met in the Tertiary sediments of India. A new genus — *Piladiporopollenites* was instituted.

R.S. Singh

Pollen analysed two soil samples received from Professor (Ms) S. Sachi Devi, Department of Geography, Andhra University, Vishakhapatnam (Consultancy Service). The palynoassemblage of the sample from Bukkapatnam tank has revealed that there had been sea influence at the site from where the sample is collected. This feature is exemplified by the preponderance of *Sonneratia* pollen grains to the tune of 80 per cent of the total vegetation. The other sample revealed the absence of biota indicative of oxidising environment.

H.P. Gupta & Deepak Kohli

Pollen analysed five soil samples received from Indira Gandhi National Center for the Arts, Janpath, New Delhi (Consultancy Service). The studies indicated tropical moist environment wherein *Madhuca indica* and *Azadirachta indica* colonised forming a forest.

H.P. Gupta & S.K. Bera

A pollen diagram from 1.5 m deep profile from Andaman and Nicobar Islands dated back to 20,000 yrs B.P. was prepared. Three broad vegetational phases have been recognised depicting shifts in vegetation, viz., brackish water *Heritiera* forest-salt marshes - brackish water *Heritiera* forest.

Asha Khandelwal & H.P. Gupta

Pollen analysis of a one metre deep soil profile from Sithikhar Swamp, Spiti Valley, Himachal Pradesh has revealed that around 2,500 years B.P. this region had alpine scrub vegetation, chiefly constituted by grasses, sedges, Asteraceae together with *Juniperus, Ephedra, Betula*, etc. The overall vegetational assemblage reflects the prevalence of cold and dry climate in the region. Around 1,900 years B.P. the decline in the number and frequencies of most of the plant taxa indicates the deterioration of climate.

Pollen analysis of 4 samples each from a 2 meter deep Takche Trench (ST-I) and Takche Calcareous Tuffa (TCT) from Spiti Valley, Himachal Pradesh was carried out. All the samples were palynologically barren, except stray pollen of grasses, sedges and *Pinus*.

M.S. Chauhan & Chhaya Sharma

A report on pollen content of various surface samples in relation to the vegetation at Dokriani Glacier, Uttarkashi was prepared and submitted to DST's Annual Report.

S.K. Bera

A manuscript on "Trilatiporate pollen from Indian Palaeogene and Neogene sequences : Evolution, migration and continental drift" was finalized.

B.K. Misra & Alpana Singh [& C.G.K. Ramanujam, Hyderabad]

Compiled maceral data of certain Lower Gondwana coals from Son, Damodar, Rajmahal, Pench-Kanhan and Godavari basins under fluorescence mode for highlighting the application of biopetrological methods in ascertaining the suitability of coal seams for their liquefaction potential. Also collected relevant details about their chemical nature.

B.K. Misra & B.D. Singh

Consulted literature pertaining to the geology of coal and lignite and made index cards. Got aquainted with the sample preparation techniques and made few particulate lignite pellets from Panandhro and Kapurdi lignitefields. Learned the procedures relating to identification of macerals and microlithotypes and determination of coal rank by reflectivity measurements.

Shinjini Sarana

Sections of a few African fossil woods were cut and their preliminary examination was done.

A draft of a paper entitled "Fungal and vascular plant/animal interaction during the past" was prepared.

J.S. Guleria

Maceration of 20 samples of bore-hole DHR from Dudhi River Section, Bokaro Coalfield, Bihar was done and all the samples proved barren.

Jitendra Pandey

A draft report on Mesozoic palynology of Kutch (Part 1: Dinoflagellate cyst biostratigraphy) including surface and subsurface sections has been prepared.

K.P. Jain, Rahul Garg & Khowaja-Ateequzzaman

A manuscript highlighting the integrated dating potential of dinoflagellate cysts and ammonoids in Late Jurassic of Tethys Himalaya has been prepared.

Rahul Garg, K.P. Jain,
[Jai Krishna, BHU] & Khowaja-Ateequzzaman

A draft manuscript highlighting the validation and typification aspects of *Glossopteris* Brongniart has been prepared.

R.K. Kar & S.A. Jafar

A draft manuscript on the coccoliths of Late Miocene of Neill Island has been finalised.

S.A. Jafar & O.P. Singh

Papers/Reviews/Articles submitted

Ambwani, K. — Scanning Electron Microscope : Techniques and applications. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology,* B.S.I.P., Lucknow.

Anand-Prakash — Coals and lignites of India. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology,* B.S.I.P., Lucknow.

Anand-Prakash & Singh, A. — Fundamentals of organic petrology. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology,* B.S.I.P., Lucknow.

Arya, R. & Awasthi, N. — A new species of *Bauhinia* from the Kasauli Formation (Lower Miocene), Kasauli, Himachal Pradesh. *Geophytology.*

Awasthi, N. & Mehrotra, R.C. — Oligocene flora from the Makum Coalfield, Assam, India. *Palaeobotanist.*

Banerji, J. — Megafloral assemblages from two new localities of Rajmahal Formation. *Geophytology.*

Chandra, A. — First report of fossil diatoms from Neogene sediments of Andersons, Andaman and Nicobar Islands, India. *Curr. Sci.*

Chandra, A. — Book review : The Fossil Record 2 by M.J. Benton, 1993. *Palaeobotanist.*

Chandra, S. & Singh, K.J. — On *Euryphyllum* Feistmantel and its epidermal features. *Palaeobotanist.*

Chandra, S. & Singh, K.J. — Bryophytic remains from the Early Permian beds of India. *Palaeobotanist.*

Chauhan, M.S. — Modern pollen/vegetation relationship in the tropical deciduous Sal (*Shorea robusta*) forests in district Sidhi, Madhya Pradesh. *J. Palynol.*

Chauhan, M.S. & Sharma, C. — Late Holocene vegetation of Darjeeling (Jore-Pokhari), eastern Himalaya. *Palaeobotanist.*

Ghosh, A.K. & Maithy, P.K. — Porostromatae algae from the Cretaceous of Sendurai, Tiruchirapalli District, Tamil Nadu. *J. palaeont. Soc. India.*

Guleria, J.S. — Fossil leaf of *Terminalia* from the Rajpardi lignite mine, district Bharuch, Gujarat, India. *Geophytology.*

Gupta, H.P. & Kohli, D. — Jaiv Vikas Ki Kahani, Jeevashmon Ki Jubani, *Vigyan Garima Sindhu,* New Delhi (in Hindi).

Gupta, H.P. & Kohli, D. — Shyampaarni Vastutah Sanjeevani Booti. *Kendriya Sachivalaya*

Hindi Parishad , New Delhi (in Hindi).

Jafar, S.A. — Report on the Southeast Asia Neogene Nannoplankton Workshop, August 16-18, 1994, Kuala Lumpur. *In* : Shirley E. van Heck *et al.* (Editors) – *J. Nanno. Res.*, London.

Jana, B.N., Kumar, S. & Maithy, P.K. — Occurrence of *Actinoporella cretacica* Raineri from the Bagh beds, Dhar area, central India. *Curr. Sci.*

Kar, R.K. — Diporocolpis : Introducing a new type of aperture from the Early Eocene sediments of Rajasthan, India. *Palaeobotanist.*

Kar, R.K. — On the Indian origin of *Ocimum* (Lamiaceae) : A palynological approach. *Palaeobotanist.*

Kar, R.K. — Concepts, potential and prospects of palaeopalynology. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology,* B.S.I.P., Lucknow.

Kar, R.K. — Late Cretaceous and Tertiary palynological succession in India. *Palaeobotanist.*

Kar, R.K. — Some new spore-pollen genera from Early Tertiary sediments of Rajasthan. P.K.K. Nair Comm. Vol., *J. Palynol.*

Karpavichus, J., Yadav, R.R. & Karaitis, J. — Radial growth responses of pine (*Pinus sylvestris* L) and spruce (*Picea abies* L.) Karst, to climatic and geophytological factors. *Palaeobotanist.*

Khan, H.A. — Morphotaxonomical studies of *Furcraea* Vent. (Agavaceae) of India. *J. econ. tax. Bot.*

Khan, H.A. — Palynological study of some Indian Nymphaeaceae with reference to Silent Valley, Kerala (India). *J. Env. Resources.*

Khan, H.A. — Studies in pollen morphology of Indian Ranunculaceae. *J. Palynol.*

Khandelwal, A. — Pollen allergy : An "invisible" health hazard. *Times of India*, Lucknow.

Khandelwal, A. & Agarwal, P. — Allergic disorders and herbal remedies. *Proc. 7th Natn. Conf. Aerobiol.*, Gwalior.

Khowaja-Ateequzzaman & Garg, R. — *Jainiella*, a new dinoflagellate cyst genus from Upper Cretaceous of Cauvery Basin, India. *Palaeobotanist.*

Kohli, D., Pandey, P.S. & Gupta, H.P. — Floristic composition and phytosociological study of Samaspur wetland, Raebareli, U.P. *Geophytology.*

Kohli, D., Pandey, P.S., Gupta, H.P. & Khandelwal, A. — Algal flora and water pollution of Samaspur Lake, Raebareli, U.P. *Geophytology.*

Kumar, P. — Palynofossils from Pachmarhi Formation, Satpura Basin, Madhya Pradesh. *Geophytology.*

Kumar, P. — Some new palynotaxa from Chaugan Bed in Hoshangabad District, Madhya Pradesh. *J. palaeont. Soc. India.*

Kumar, P. — Palynofossils of Middle and Upper Gondwanas in Satpura Basin – Palaeoenvironmental significance. *Proc. natn. Sem. Environmental changes, its impact on flora & fauna*, Raigarh (M.P.).

Maithy, P.K., Babu, R., Kumar, G. & Mathur, V.K. — New cyanophycean remains from the Blaini (Terminal Neo-Proterozoic) sequence of Mussoorie Syncline, Lesser Himalaya, India. *Palaeobotanist.*

Mandal, J. — Palynofossils of the Barail sediments from Nagaland, their age and palaeoenvironment. *Palaeobotanist.*

Mandal, J., Chandra, A. & Kar, R.K. — Palynological findings from the mud volcanoes of Baratang Island (Andaman), India. *Geophytology.*

Mandaokar, B.D. — *Dangrisporites*, a new record from Tikak Parbat Formation (Oligocene of Dangrikumari, Dibrugarh District), Upper Assam, India. *Palaeobotanist.*

Mehrotra, R.C. & Awasthi, N. — Status of gymnosperms in the Tertiary flora of India. *Palaeobotanist.*

Misra, B.K. — Application of biopetrological studies in the utilization of coal and lignite. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology*, B.S.I.P., Lucknow.

Misra, B.K. & Singh, B.D. — Fluorescing inertinite macerals in Indian Gondwana coals with remarks on their terminology, genesis and coking potentiality. *Palaeobotanist.*

Prasad, M. — Siwalik flora from Koilabas area in the Nepal Himalaya and its palaeoenvironmental and phytogeographical significance. *J. Nepal geol. Soc., Kathmandu.*

Ram-Awatar — Palynozonation of Middle Pali Member in Sohagpur Coalfield, M.P., India. *Palaeobotanist.*

Rao, M.R. & Rajendran, C.P. — Palynological investigations of Tertiary lignite and associated sediments from Cannanore, Kerala Basin. *Palaeobotanist.*

Sarkar, S. — Palynostratigraphy and palaeoenvironment of the Subathu Formation (Eocene) of Lesser Himalaya, Himachal Pradesh, India. *Ecol. Geol. Helvetie*, Switzerland.

Saxena, R.K. — Palynology of Upper Siwalik sediments in north-western India. *Proc. Symp. Recent advances in geological studies of Northwest Himalaya and the foredeep*, G.S.I., Lucknow.

Saxena, R.K. — Morphology of angiosperm pollen. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology*, B.S.I.P., Lucknow.

Saxena, R.K. — Biostratigraphic zonation and correlation. *Coaliferous fuel resources of*

India : Parameters of studies in palynology and biopetrology, B.S.I.P., Lucknow.

Saxena, R.K. & Tripathi, S.K.M. — Observations on *Tricolporopollis* Dutta & Sah. *Geophytology.*

Sharma, C. & Gupta, A. — Vegetational history of Nachiketa Tal, Garhwal Himalaya, India. *J. Nepal geol. Soc.*, Kathmandu.

Singh, B.D. — Coal microconstituents and their classification. *Coaliferous fuel resources of India : Parameters of studies in palynology and biopetrology*, B.S.I.P., Lucknow.

Singh, O.P. & Jafar, S.A. — Late Miocene Discoasters from Sawai Bay Formation, Neill Island, Andaman Sea, India. *Palaeobotanist.*

Singh, T., Tiwari, R.S., Vijaya & Ram-Awatar — Stratigraphy, palaeontology and palynology of Carboniferous-Permian-Triassic succession in Spiti Valley. *J. palaeont. Soc. India.*

Srivastava, A.K. — Lower Permian plant fossils from Auranga Coalfield, Bihar. *Palaeobotanist.*

Srivastava, A.K. — Occurrence of *Vertebraria* axes in the Lower Gondwana beds of Auranga Coalfield, Bihar. *Palaeobotanist.*

Srivastava, C. — Man and plants : An archaeological perspective. *Proc. Young Archaeologists Meet*, Patna.

Srivastava, R. — Systematic anatomy of fossil woods in the Tertiary flora of India. *Proc. 3rd Pacific Regional Wood Anatomy Conf.*, Rotrua, New Zealand.

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Report to the Governing Body of Birbal Sahni Institute of Palaeobotany, Lucknow

We have audited the attached Balance Sheet of Birbal Sahni Institute of Palaeobotany, Lucknow, as at 31st March, 1995, and the Income and Expenditure Account and Receipts & Payment Account for the year then ended and report that subject to our comments as given in Annexure A to this Report :

In our opinion and to the best of our information and according to the explanations given to us the said accounts give a true and fair view :

(i) In the case of Balance Sheet of the state of affairs of the Institute as at 31st March, 1995,

(ii) In the case of Income and Expenditure Account, of the excess of income over expenditure for the year then ended, and

(iii) In the case of Receipts and Payment Account, of the receipts and payments of the Institute for the year then ended.

Place : Lucknow
Date : July 20, 1995

For **SINGH AGARWAL & ASSOCIATES**
Chartered Accountants
Sd/-
(Mukesh Kumar Agrawal)

Annexure 'A'

(Annexure to and forming part of the Audit Report for the Year ended 31st March, 1995)

Comments on Accounts of Birbal Sahni Institute of Palaeobotany, Lucknow for the year ended 31st March, 1995.

Accounts :

1. Accounts of various Projects tenable at the Institute have been maintained separately and do not form part of the Balance Sheet and Income and Expenditure Account and Receipt and Payment Account.

2. Accounts have been maintained on cash basis.

3. Verification of bank account reveals that various entries have been incorporated in the Bank Reconciliation Statement under the head "Credit without advice (C.W.A.)" and "Debit without advice (D.W.A.)" amounting to Rs. 28,936/- and Rs. 32,976/- respectively.

   As explained to us, the above entries are not at present traceable. But in our opinion, the same are verifiable provided proper communication is there between the various departments of the Institute.

4. Various advances were found pending recovery for an unduly long period. Efforts are to be made for speedy settlement of the same.

Change of Accounting policies :

5. During the year under audit, there has been a significant change in the accounting policies of the Institute. Advances on Revenue Account as on Balance Sheet date, which were hitherto shown in the Assets side of the B/s, have been charged to Income and Expenditure Account by debiting to the respective heads of Expenditure Account. Therefore, "Excess of Expenditure over Income" has been over estimated by that amount.

6. There had been a short deduction of Income Tax from the Salary of employees of the Institute. But, however, the same has been recovered from them in early next year. Proper care should be taken while deducting Income Tax to avoid any harsh action taken by the Income Tax Authorities.

7. During the year under audit, three vehicles costing Rs. 2,56,346.11 were disposed off at Rs. 1,17,705.00. Sale price, as stated above, has been shown in the "Income and Expenditure Account" of the year under the head "Misc. Income". However, original cost of the vehicles have been reduced from Assets and Capital Fund heads in the Balance Sheet. In our opinion, prior approval of

the Department, from whom grant for these vehicles were received, is necessary before considering it as Income.

General Provident Fund :

8. In the administration of withdrawals from GPF accounts, rules regarding withdrawal from the fund have not been complied with and innumerable employees have been allowed to withdraw more than what is permissible under the GPF rules. As explained to us, excess withdrawals have been allowed in the cases where necessity of the same had been preassessed by the Institute.

9. Rs. 45,245/- has been appropriated and transferred to G.P.F. Account by BSIP to fill up the gap between interest paid to employees fund and interest received on Investment. This figure has been clubbed with the head of Family Pension and Gratuity shown under the head of "PENSION & SUPERANNUATION" of Receipts and Payment Account.

Publications :

10. On scrutiny of record of the priced publication of Palaeobotany, it has been observed that during the last several years, the Institute had brought out publication on different subjects to sell out in the market. Stock position of these priced publication as on 31.03.95 is about Rs. 17.50 lacs apart from which Rs. 1.50 lacs is reserve stock, totalling stock of Rs. 19.00 lacs.

Further, we observed that because requirements of these priced publications had not been properly assessed by the Institute, the same are lying in stock which causes blockade of valuable fund, deterioration in quality and blockade of storage space, etc.

Library :

11. No physical verification was made during the year under audit. As explained to us, library stocks are being physically verified after 5 years, as per Central Government Rules.

Stores :

12. Fixed Assets Register has been maintained w.e.f. 1988 onwards and no record has been maintained regarding fixed assets acquired out of grants or otherwise before 1988.

According to informations and explanations furnished before us, no physical verification of fixed assets has been made.

No identification marks on the fixed assets have been made for efficient and proper verification thereof.

13. No depreciation on fixed assets has been charged, as per accounting policy of the Institute.

Suggestions :

14. Looking at the volume of transactions, it is being suggested, for better, efficient and correct presentation of accounts, the accounts books must be prepared on the basis of "Double Entry System" of accounting which is a commonly accepted accounting system.

15. Backlog in the maintenance of Fixed Assets Register must be updated at the earliest with the help of some technical personnel.

Replies to the comments raised by the Chartered Accountants on the Accounts of the Birbal Sahni Institute of Palaeobotany while conducting the Accounts for the year ending 31.03.1995.

1. No comments.
2. No comments.
3. Unreconciled balances have now been reconciled with Bank up to the month of June 1995 and latest position is annexed herewith. In this connection, however, it may be stated that bank reconciliation is mostly dependent upon the information and coopertion extended by the bank. Remark of Chartered Accountants about the unreconciled balances being untraceable is not correct.
4. Efforts are on to expedite the settlement of the advances. Latest position is annexed herewith.
5. Change of accounting system has been affected as per observation made by the Director of Audits, Scientific Departments, New Delhi.
6. Noted.
7. DST's approval already exists.
8. Contention of the Chartered Accountants is not correct as there has been no case where GPF rules were flouted.
9. No comments.
10. Efforts are being made to accelerate the sales of the priced publications.
11. No comments.
12. Noted.
13. No comments.
14. No comments.
15. Noted.

Sd/-
J C Singh
(Accounts Officer)

Sd/-
Suresh C. Bajpai
(Registrar)

Birbal Sahni Institute of

Balance Sheet as at

Liabilities	Amount Rs.	Amount Rs.
Capital Fund		
Balance as per last year's Balance Sheet	5,23,18,888.52	
Add: Govt. of India Grant	94,32,000.00	
Add: Miscellaneous Refund	4,953.00	
	6,17,55,841.52	
Less: Vehicles written off	2,56,346.11	6,14,99,495.41
Excess of Income over Expenditure	39,98,719.53	
Less: Excess of Expd. over Income 1994-95	8,95,210.25	31,03,509.28
Cost of land donated by U.P. Govt.		32,292.00
Founder's Donation		1,52,500.00
MGT Scheme (CSIR)		8,100.79
Coal Scheme (CSIR)		7,784.66
Palynological Scheme (CSIR)		5,207.87
UNESCO AID FUND		19,629.75
Burmah Oil Co., Donation		1,900.00
Rajasthan Scheme (Sponsored by Univ. Wisconsin)		23,009.15
C.D. Pant Memorial Fund		4,494.14
C.L. Katiyal Memorial Fund		7,901.76
Other Miscellaneous Donations		28,032.30
P.C. Bhandari Memorial Fund		8,077.95
A.C. Seward Memorial Fund		24,542.78
P.K. Srivastava Memorial Fund		6,820.81
Birbal Sahni Research Award Endowment		51,105.55
Prof. T.M. Harris Endowment		16,619.49
Gift in Kind		
Humboldt Foundation (West Germany)		75,000.00
General Provident Fund		
Liabilities & Provisions		1,34,70,530.50
Festival Advance		
Mrs Maya Devi & Mr Mahadev Prasad		120.00
Security (Capital)	26,483.90	
Security (Revenue) Plan	15,000.00	
Security (Revenue) Non-Plan	2,000.00	43,483.90
Group Linked Insurance Scheme		250.00

Palaeobotany, Lucknow

31st March, 1995

Assets	Amount Rs.	Amount Rs.
Land		
Donated by U.P. Government		32,292.00
Works & Buildings		
Out of Founder's Donation		50,000.00
As per last year's Balance Sheet	96,10,365.88	
Additions during the year	9,54,744.43	1,05,65,110.31
Research Apparatus & Equipments		
As per last year's Balance Sheet	2,06,43,131.46	
Additions during the year	20,65,425.50	2,27,08,556.96
Workshop Equipments		
As per last year's Balance Sheet	2,06,890.69	
Additions during the year	0.00	2,06,890.69
Office & Misc. Equipments		
As per last year's Balance Sheet	21,48,849.00	
Additions during the year	12,79,563.45	34,28,412.45
C-14 Radiometric Dating Equipments		
As per last year's Balance Sheet	54,49,692.66	
Additions during the year	4,309.00	54,54,001.66
Plant & Machinery		
As per last year's Balance Sheet	22,69,937.21	
Additions during the year	0.00	22,69,937.21
Apparatus & Equipments Donated		
M.G.T. Scheme (CSIR)	7,155.79	
Burmah Oil Co.	700.00	
Founder's Donation	2,500.00	
Coal Scheme (CSIR)	6,645.29	
Palynological Scheme (CSIR)	5,207.87	
Rajasthan Scheme (Sponsored by Univ. of Wisconsin)	22,029.45	
UNESCO Aid Equipment	19,629.75	
Humbolt Foundation	75,000.00	1,38,868.15
Vehicles		
As per last year's Balance Sheet	9,44,625.66	
Additions during the year	5,98,774.10	
	15,43,399.76	
Less: written off	2,56,346.11	12,87,053.65
Furniture & Fixture		
As per last year's Balance Sheet	23,39,407.08	
Additions during the year	4,44,178.90	27,83,585.98
Furniture & Fixture (Fixed)		
Burmah Oil Co.	1,200.00	
M.G.T. Scheme (C.S.I.R.)	945.00	

Liabilities	Amount Rs.	Amount Rs.

Total	7,85,90,408.09

For **Singh Agarwal & Associates**
Chartered Accountants
Sd/-
(Mukesh Kumar Agarwal)
Partner

Sd/-
J.C. Singh
(Accounts Officer)

Assets	Amount Rs.	Amount Rs.
Coal Scheme (C.S.I.R.)	1,139.37	
Rajasthan Scheme	979.70	4,264.07
Books & Journals		
As per last year's Balance Sheet	29,14,389.88	
Additions during the year	5,77,894.72	34,92,284.60
Founders Library Donated		50,000.00
Founders Fossil Collection		50,000.00
Maps & Toposheets		13,142.00
UNESCO Book Coupons		543.12
Investment (Donation)		
As per last year's Balance Sheet	1,35,600.00	
Additions during the year	0.00	1,35,600.00
Cash in Hand	92.00	
Balance in State Bank of India	63,67,041.05	
Savings Bank Account (SBI)	20,05,000.00	83,72,133.05
Unsettled Advances (Capital)		17,14,222.69
Security Money		
M/s Krishna & Co., Lucknow	3,000.00	
M/s Sardar Ji, Lucknow	5,000.00	
G.P.O., Lucknow	100.00	8,100.00
Loans & Advances		
House Building Advance	18,52,397.00	
Conveyance Advance	4,77,622.00	
Festival Advance	24,860.00	23,54,879.00
General Provident Fund		
Investment in 5 year's Time Deposit	12,00,000.00	
Special Deposit Scheme (S.B.I.)	1,06,05,000.00	
Advances	12,99,850.00	
With S.B.I. (Savings Bank)	3,65,680.50	1,34,70,530.50
Total		**7,85,90,408.09**

Sd/-
S.C. Bajpai
(Registrar)

Sd/-
Dr R.S. Tiwari
(Director)

Birbal Sahni Institute of

Income & Expenditure Account

Expenditure	Plan Rs.	Non-Plan Rs.	Total Rs.
To Academic Expenses			
Pay & Allowances of Academic Staff	1,43,594.00	67,31,441.00	68,75,035.00
Field Excursion	4,52,494.44	1,45,221.80	5,97,716.24
To Honorarium for Lecture			
Birbal Sahni Memorial Lecture	0.00	2,000.00	2,000.00
To International Programmes			
Deputation Abroad	2,53,278.80	1,90,000.00	4,43,278.80
To Expenses on Services Ancilliary to Research			
Pay & Allowances of Auxi. Technical Staff	2,49,481.00	20,67,123.00	23,16,604.00
Chemicals, Glasswares & Photogoods	3,14,848.55	3,93,456.15	7,08,304.70
Library Expenses	0.00	20,274.50	20,274.50
Maintenance of Apparatus Equipment & Workshop Machines	0.00	0.00	0.00
Museum Expenses	0.00	45,798.80	45,798.80
Herbarium Expenses	16,309.20	0.00	16,309.20
The Palaeobotanist	0.00	1,10,977.00	1,10,977.00
Annual Report	0.00	96,566.70	96,566.70
Gondwana Symposium	0.00	0.00	0.00
To Travelling & Other Allowances			
Governing Body	12,376.20	34,273.80	46,650.00
R.A.C./Selection Committees	1,692.00	58,318.00	60,010.00
T.A. to others	51,966.20	65,774.40	1,17,740.60
Attending Scientific Meetings & Conferences in India	0.00	48,463.10	48,463.10
Training to Staff	0.00	0.00	0.00
Reimbursement of Medical Expenses	27,440.65	1,28,473.10	1,55,913.75
Overtime Allowances	26,185.15	22,633.35	48,818.50
Leave Travel Concession	2,02,530.15	31,879.00	2,34,409.15
Reimbursement of Tution Fee	1,992.00	22,759.00	24,751.00
Ad-hoc Bonus	10,200.00	62,816.00	73,016.00
To Pensionary Expenses			
Superannuation Allowances & Pension	0.00	12,37,472.00	12,37,472.00
Pension Contribution	0.00	2,880.00	2,880.00
Leave Salary	0.00	18,601.00	18,601.00
To Administrative Expenses			
Pay & Allowances to Administrative Staff	2,20,380.00	22,42,959.90	24,63,339.90
Telephone & Trunk Call Charges	0.00	91,676.07	91,676.07
Postage Expenses	0.00	94,149.80	94,149.80
Advertisement Expenses	14,188.00	1,69,375.00	1,83,563.00
Assistance to Canteen	0.00	12,225.94	12,225.94
Hot & Cold Wather Charges	11,749.00	3,905.00	15,654.00
To General Expenses			

Palaeobotany, Lucknow

for the year ending 31st March, 1995

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Revenue Account			
By Grant from Govt. of India	40,68,000.00	1,45,00,000.00	85,68,000.00
By Grant from U.P. Government	0.00	5,000.00	5,000.00
By Sale Proceeds of Priced Publications			
The Palaeobotanist	0.00	2,01,728.50	2,01,728.50
Monographs	0.00	300.00	300.00
Symposium	0.00	110.00	110.00
Gondwana Symposium	0.00	1,830.00	1,830.00
Catalogue of Indian Fossil Plants	0.00	10,201.00	10,201.00
Seward Memorial Lecture	0.00	14.00	14.00
Birbal Sahni Memorial Lecture	0.00	14.00	14.00
Fourth I.P.C. Proceedings	0.00	400.00	400.00
Picture Post Cards	0.00	200.00	200.00
Aspects & Appraisal of Indian Palaeobotany	0.00	200.00	200.00
Misc. Receipts	407.00	1,82,841.55	1,83,248.55
V.S. Room Charges	0.00	42,600.00	42,600.00
Application Fee	0.00	914.00	914.00
Licence Fee	0.00	5,552.00	5,552.00
Telephone Receipt	0.00	0.00	0.00
Leave Salary	0.00	9,666.00	9,666.00
Pension Contribution	0.00	11,235.00	11,235.00
SEM Facilities	0.00	1,175.00	1,175.00
Electricity Receipts	0.00	660.25	660.25
Interest on Conveyance Advance	0.00	34,051.00	34,051.00
Interest on H.B.A.	0.00	13,956.00	13,956.00
Interest on Savings Bank Account/TDR	0.00	3,25,736.00	3,25,736.00
Consultancy Receipt	0.00	59,000.00	59,000.00
Excess of Expenditure over Income	5,50,137.07	3,45,073.18	8,95,210.25

Expenditure	Plan Rs.	Non-Plan Rs.	Total Rs.
Petrol & Mobil Oil	32,472.54	63,769.23	96,241.77
Electricity Charges	3,59,021.55	83,991.00	4,43,012.55
Electric Items	54,395.10	1,44,639.92	1,99,035.02
Municipal Taxes	0.00	34,723.50	34,723.50
Security & Sanitation	1,21,088.10	92,786.00	2,13,874.10
Insurance of Vehicle & Library	0.00	66,212.00	66,212.00
Consultancy Charges	0.00	13,500.00	13,500.00
Uniform to staff	26,597.50	25,728.60	52,326.10
Printing & Stationery	1,43,603.15	1,49,445.95	2,93,049.10
Hospitality Expenses	0.00	3365.65	3,365.65
Miscellaneous Expenses	4,65,786.03	3,57,460.73	8,23,246.76
Railway Freight & Carriage	0.00	4,468.50	4,468.50
To Maintenance Expenses			
Maintenance of Building	0.00	26,702.70	26,702.70
Maintenance of Garden	0.00	46,829.00	46,829.00
Maintenance of Vehicle	41,959.65	63,597.59	1,05,557.24
Maintenance of Equipment	3,59,126.17	1,87,447.10	5,46,573.27
Repair & Renewals	4,73,826.05	1,93,231.60	6,67,057.65
To Other Expenses			
Review Committee	3,07,364.89	0.00	3,07,364.89
Audit Fee	0.00	4,750.00	4,750.00
Legal Advice	0.00	38,315.00	38,315.00
Prof. Birbal Sahni Research Scholarship	1,72,498.00	0.00	1,72,498.00
Emeritus Scientist	48,000.00	0.00	48,000.00
Golden Jubilee Expenses	2,100.00	0.00	2,100.00
Total	**46,18,544.07**	**1,57,52,457.48**	**2,03,71,001.55**

For **Singh Agarwal & Associates**
Chartered Accountants
Sd/-
(Mukesh Kumar Agarwal)
Partner

Sd/-
J.C. Singh
(Accounts Officer)

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	**46,18,544.07**	**1,57,52,457.48**	**2,03,71,001.55**

Sd/-
S.C. Bajpai
(Registrar)

Sd/-
Dr R.S. Tiwari
(Director)

Birbal Sahni Institute of

Receipts and Payment Account

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
To Opening Balance :			
A. Bank Account			
I) Revenue	4,92,032.50	4,06,482.67	8,98,515.17
II) Capital	33,98,265.38	0.00	33,98,265.38
III) Group Insurance Scheme	0.00	250.00	250.00
IV) Deposit Account	15,000.00	2,000.00	17,000.00
V) Donation	0.00	499.73	499.73
VI) CDP Account	0.00	203.10	203.10
B. Cash Account			
Non-Plan Revenue	0.00	127.97	127.97
C. Savings Bank Account	5,000.00	0.00	5,000.00
To Govt. of India Grant			
Revenue	40,68,000.00	1,45,00,000.00	1,85,68,000.00
Capital	94,32,000.00	0.00	94,32,000.00
To Government of U.P. Grant for Revenue	0.00	5,000.00	5,000.00
To Receipts on Capital Accounts			
i) By Cancellation of Cheque (Library)	463.00	0.00	463.00
ii) Credit given by SBI On L/C 93/155	4,490.00	0.00	4,490.00
To Sale Proceeds of Publications:			
The Palaeobotanist	0.00	2,01,728.50	2,01,728.50
Monograph	0.00	300.00	300.00
Symposium	0.00	110.00	110.00
Catalogue	0.00	10,201.00	10,201.00
Aspects & Appraisal of Indian Palaeobotany	0.00	200.00	200.00
Seward Memorial Lecture	0.00	14.00	14.00
Birbal Sahni Memorial Lecture	0.00	14.00	14.00
Silver Jubilee Memorial Lecture	0.00	0.00	0.00
Gondwana Symposium	0.00	1,830.00	1,830.00
IV I.P.C. Proceedings	0.00	400.00	400.00
Picture Post Cards	0.00	200.00	200.00
To Administrative Receipts			
Income Tax	0.00	2,72,650.00	2,72,650.00
Insurance Premium Salary Savings Scheme	5,093.60	2,51,491.58	2,56,585.18
G.P.F. Subscription	66,510.00	27,96,712.00	28,63,222.00

Palaeobotany, Lucknow

for the year ending 31st March, 1995

Payment	Plan Rs.	Non-Plan Rs.	Total Rs.
By Capital Accounts			
Works and Buildings	11,05,000.43	0.00	11,05,000.43
Research Apparatus & Equipments	9,56,119.50	0.00	9,56,119.50
Equipments for Services Ancillary to Research	11,40,136.55	0.00	11,40,136.55
Library	6,30,453.06	0.00	6,30,453.06
Museum	37,108.60	0.00	37,108.60
Photography	3,00,000.00	0.00	3,00,000.00
C-14 Laboratory	3,966.00	0.00	3,966.00
Furniture & Fixture	3,86,281.55	0.00	3,86,281.55
Vehicles	5,98,774.10	0.00	5,98,774.10
Office/Misc. Equipments	78,140.60	0.00	78,140.60
Earnest Money	2,000.00	0.00	2,000.00
Pay & Allowances			
Pay (Academic)	58,619.00	29,98,787.00	30,57,406.00
Pay (Technical)	1,02,834.00	8,56,209.00	9,59,043.00
Pay (Administration)	91,965.00	9,19,290.90	10,11,255.90
D.A	2,83,771.00	49,38,641.00	52,22,412.00
C.C.A	11,277.00	1,53,827.00	1,65,104.00
H.R.A	49,482.00	9,72,640.00	10,22,122.00
Interim Relief	15,507.00	2,02,129.00	2,17,636.00
Overtime Allowance	26,185.15	22,633.35	48,818.50
Medical Reimbursement	20,106.65	1,26,473.10	1,46,579.75
Reimbursement of Tution Fee	1,992.00	22,759.00	24,751.00
Leave Travel Concession	1,81,225.15	31,879.00	2,13,104.15
Adhoc Bonus	10,200.00	62,816.00	73,016.00
By Travelling Allowance			
Governing Body Selection Committee & Meetings etc.	66,034.40	1,58,366.20	2,24,400.60
Field Excursion	3,24,697.20	1,27,021.80	4,51,719.00
Deputation Abroad	1,67,778.80	1,90,000.00	3,57,778.80
Attending Conferences & Meetings in India	0.00	43,013.10	43,013.10

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Recovery of GPF Advance	9,800.00	5,99,875.00	6,09,675.00
Recovery of BSIP Co-operative Credit Society	16,981.00	3,11,844.00	3,28,825.00
Group Insurance	6,765.00	1,43,715.00	1,50,480.00
Leave Salary	0.00	9,666.00	9,666.00
Application Fee	0.00	914.00	914.00
SEM Facility	0.00	1,175.00	1,175.00
Electricity Receipts	0.00	660.25	660.25
Guest Room Rent	0.00	42,600.00	42,600.00
Licence Fee	0.00	5,552.00	5,552.00
Consultancy Charges	0.00	59,000.00	59,000.00
To Misc. Receipts			
Misc. Receipt	407.00	1,82,841.55	1,83,248.55
Pensionary Charges	0.00	11,235.00	11,235.00
To Recoveries of Loans & Advances			
Festival Advance	0.00	43,780.00	43,780.00
Conveyance Advance	0.00	1,28,036.00	1,28,036.00
Interest on Conveyance Advance	0.00	34,051.00	34,051.00
House Building Advance	0.00	2,82,275.00	2,82,275.00
Interest on House Building Advance	0.00	13,956.00	13,956.00
To Deposit Account			
Security Deposit	5,000.00	5,000.00	10,000.00
To Donation & Endowments			
Interest on CDP Account	0.00	291.04	291.04
Interest on Donation Account	0.00	11,500.91	11,500.91
To Misc. Receipts on Capital Account			
Interest on TDR/S.B.	0.00	3,25,736.00	3,25,736.00
Interest on Savings Bank	0.00	0.00	0.00
To Group Insurance received from LIC	0.00	58,565.00	58,565.00
DST Project			
(Dr H.P. Gupta)			
Opening Balance	18,933.60	0.00	18,933.60
Grants from DST	70,000.00	0.00	70,000.00
DST Project			
(Dr A. Bhattacharyya)			
Opening Balance	1,10,000.00	0.00	1,10,000.00
Grants from DST	0.00	0.00	0.00

Payment	Plan Rs.	Non-Plan Rs.	Total Rs.
Golden Jubilee	2,100.00	0.00	2,100.00
By Maintenance of Property			
Buildings	0.00	26,702.70	26,702.70
Garden	0.00	46,829.00	46,829.00
Apparatus & Equipment	1,62,781.17	1,75,577.10	3,38,358.27
Vehicle	41,959.65	63,597.59	1,05,557.24
Repairs & Renewals	4,57,816.05	1,93,231.60	6,51,047.65
By Contingencies			
Telephone & Trunk Call Charges	0.00	91,676.07	91,676.07
Municipal Taxes	0.00	34,723.50	34,723.50
Postage	0.00	89,149.80	89,149.80
Advertisement	14,188.00	1,69,375.00	1,83,563.00
Hot & Cold Weather Charges	11,749.00	3,905.00	15,654.00
Petrol & Mobil Oil	32,472.54	63,769.23	96,241.77
Electricity Charges	3,59,021.55	83,991.00	4,43,012.55
Electric Items	54,395.10	1,44,639.92	1,99,035.02
Insurance of Vehicle & Library	0.00	39,714.00	39,714.00
Liveries to Sub. Staff	26,597.50	25,728.60	52,326.10
Printing & Stationery	1,43,603.15	1,49,445.95	2,93,049.10
Hospitality Expenses	0.00	3,365.65	3,365.65
Misc. Expenses	4,05,824.03	3,28,282.73	7,34,106.76
Chemical & Glassware	3,07,945.55	3,37,368.30	6,45,313.85
Assistance to Canteen	0.00	12,225.94	12,225.94
Library Expenses	0.00	8,328.50	8,328.50
Museum Expenses	16,309.20	45,798.80	62,108.00
Legal Advice	0.00	38,315.00	38,315.00
Medical Advice	0.00	0.00	0.00
Audit Fee	0.00	4,750.00	4,750.00
Railway Freight	0.00	3,968.50	3,968.50
Sanitation & Security Services	1,21,088.10	92,786.00	2,13,874.10
Consultancy Charges	0.00	13,500.00	13,500.00
Review Committee	3,07,364.89	0.00	3,07,364.89
By Publication			
The Palaeobotanist	0.00	1,10,977.00	1,10,977.00

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
DST Project			
(Dr R.K. Kar)			
Opening Balance	1,45,000.00	0.00	1,45,000.00
Grants from DST	0.00	0.00	0.00
DST Project			
(Dr P.K. Maithy)			
Opening Balance	1,25,000.00	0.00	1,25,000.00
Grants from DST	0.00	0.00	0.00
DST Project			
(Dr Mukund Sharma)			
Opening Balance	0.00	0.00	0.00
Grants from DST	60,000.00	0.00	60,000.00
Sponsored Project			
Dr (Mrs) Asha Khandelwal			
Opening Balance	0.00	0.00	0.00
Grants received	95,000.00	0.00	95,000.00

Payment	Plan Rs.	Non-Plan Rs.	Total Rs.
Annual Report	0.00	96,566.70	96,566.70
Gondwana Symposium	0.00	0.00	0.00
By Academic Expenses			
B.S. Memorial Lecture	0.00	2,000.00	2,000.00
B.S. Research Scholarship	1,72,498.00	0.00	1,72,498.00
S.M.L. out of Donation Account	0.00	500.00	500.00
Emeritus Scientist	48,000.00	0.00	48,000.00
By GPF Account			
GPF Subscription	66,510.00	27,96,712.00	28,63,222.00
Recovery of GPF Advance	9,800.00	5,99,875.00	6,09,675.00
By Miscellaneous			
Income Tax Remitted	0.00	2,72,650.00	2,72,650.00
G.S.I.	0.00	58,565.00	58,565.00
GSI Payment Recovered from staff	6,765.00	1,43,715.00	1,50,480.00
S.S. Insurance Premium Remitted	5,093.60	2,51,491.58	2,56,585.18
BSIP Co-operative Society	16,981.00	3,11,844.00	3,28,825.00
By Loans & Advances			
Festival	0.00	43,800.00	43,800.00
Conveyance	2,00,000.00	0.00	2,00,000.00
House Buildings	1,60,959.70	0.00	1,60,959.70
By Pension & Superannuation			
Pension, Family Pension and Gratuity	0.00	12,37,472.00	12,37,472.00
Leave Salary	0.00	18,601.00	18,601.00
Pension Contribution	0.00	2,880.00	2,880.00
By Deposit Account			
Refund of Security Money	5,000.00	5,000.00	10,000.00
DST Project			
Dr H.P. Gupta	63,232.70	0.00	63,232.70
Dr A. Bhattacharyya	1,01,222.50	0.00	1,01,222.50
Dr R.K. Kar	80,717.75	0.00	80,717.75
Dr P.K. Maithy	1,08,850.64	0.00	1,08,850.64
Dr Mukund Sharma	44,917.82	0.00	44,917.82
Dr (Mrs) Asha Khandelwal	59,219.50	0.00	59,219.50
Closing Balance (Bank)			

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	**1,81,49,741.08**	**2,07,22,683.30**	**3,88,72,424.38**

For **Singh Agarwal & Associates**
Chartered Accountants
Sd/-
(Mukesh Kumar Agarwal)
Partner

Sd/-
J.C. Singh
(Accounts Officer)

Payment	Plan Rs.	Non-Plan Rs.	Total Rs.
Revenue Account	1,02,091.97	6,38,466.31	7,40,558.28
Capital Account	55,97,237.99	0.00	55,97,237.99
Savings Bank Account	20,05,000.00	0.00	20,05,000.00
Deposit Account	15,000.00	2,000.00	17,000.00
BSIP Group Insurance	0.00	250.00	250.00
CDP Account	0.00	494.14	494.14
Donation Account	0.00	11,500.64	11,500.64
DST Projects			
Dr H.P. Gupta	25,700.90	0.00	25,700.90
Dr A. Bhattacharyya	8,777.50	0.00	8,777.50
Dr R.K. Kar	64,282.25	0.00	64,282.25
Dr P.K. Maithy	16,149.36	0.00	16,149.36
Dr Mukund Sharma	15,082.18	0.00	15,082.18
Dr (Mrs) Asha Khandelwal	35,780.50	0.00	35,780.50
Cash in Hand	0.00	92.00	92.00
Total	**1,81,49,741.08**	**2,07,22,683.30**	**3,88,72,424.38**

Sd/-
S.C. Bajpai
(Registrar)

Sd/-
Dr R.S. Tiwari
(Director)