ANNUAL REPORT

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BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY
LUCKNOW

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Foreword

THE Birbal Sahni Institute of Palaeobotany commemorates the name of its illustrious co-founder, Professor Birbal Sahni, an eminent scientist and a great son of modern India. Research activities of the Institute are primarily related to plant fossils spanning a time span of over 3 billion years. The beginning of life and its development are intrinsically fascinating chapters shrouded in mystery. These have been subjects of speculation since man started contemplation. In the bowls of the earth is preserved a bounty of treasures related to the successes and failures of experiments of the Nature on evolution and development of life forms. Scientific activities of the Institute are related to understand this legacy and to decode the development of life from a simple protein molecule to bacteria to lower plants-to the flowering plants. This decoding is Palaeobotany—the science of plant life through the ages. Remanants of bacteria, fungi, algae, different plant parts like roots, stems, leaves, fruiting bodies and the condensed bulks of whole forests (coal) tell us about past vegetations that grow no more. The task of the palaeobotanists is not only to identify and describe plant fossils but also to reconstruct the whole plants and vegetation, to work out the continuum of past events, to decipher the meaning and purpose of natural patterns, and to decode the past geography, ecology and climate.

Palaeobotanical investigations help to locate and explore for coal and hydrocarbon resources. Microscopic remains of past vegetation, viz., spores, pollen, phytoplankton and such others help interpret ancient environmental conditions favourable for organic matter accumulation and its transformation to fossil fuels. Fossil plants are viewed today not as static imprints or coalified relics of the past, but once living, dynamic entities.

Birbal Sahni Institute of Palaeobotany is devoted to fundamental as well as applied aspects of research on Palaeobotany. It has a commitment to develop relevant technology, scientific knowledge and expertise in the field of Palaeobotany. An integrated and multidisciplinary approach is adopted to cover both botanical and geological aspects and also to continuously update the state-of-the art to expand frontiers of knowledge.

The research activities are programmed as definitive projects which emphasize synergistic interaction within the Institute and collaboration with other organizations. The research activities are comprised in 16 Inter-Departmental Projects and seven Sponsored Projects.

Some of the landmark achievements made during the year under review are as follows :

Authentic remains of cyanobacteria have been discovered in the 2.9 billion years old manganese rich black cherts interbedded in Donimalai Formation of Sandur Schist Belt. Rod-shaped and coccoid eubacteria have been discovered attached to 2.6 billion years old syngenetic pyrite crystals from Kudremukh Iron Formation. It extends the antiquity of the family Siderocapsaceae from 2.0 to 2.6 billion years. The presence of

cyanobacterium *Scytonema* is taken as an evidence of photosynthetic activity during the Archaean Period. This work has been carried out in collaboration with the National Geophysical Research Institute, Hyderabad.

Study of morphological features of *Noeggerathiopsis* and *Gangamopteris* leaves from the basal Barakar Formation of Deogarh Coalfield, Bihar indicates a cool-temperate climate during Lower Permian. Spheroidal bacteria have been observed on some of the pyritized leaf fragments from Permian sediments of Arunachal Pradesh.

Megafloral study of Kota Formation indicates a Middle Jurassic or slightly younger age. Palaeofloristics of Gangapur Formation indicates an Early Cretaceous age. The genus *Culcitites* has been recorded for the first time in Indian Mesozoic.

The occurrence of *Antiaris*, *Duabanga*, *Dipterocarpus*, *Sindora* and *Sterculia* in the Namsang beds of Deomali indicates the existence of evergreen forests during Cenozoic. The occurrence of *Givotia* at the same time indicates that, atleast locally, most probably along the fringes, dry condition prevailed. Presence of *Canarium lurzonicum*, *Dryobalanops*, *Gonystylas*, and *Swintonia* in the Varkala beds of Kerala indicates a phytogeographical linkage of southern India and Malaysia during the Neogene. Petrified woods of the Shumar Formation, Rajasthan indicate a tropical humid climate with high rainfall. Occurrence of tropical African taxa *Khaya* and *Tetrapleura* in the Mio-Pliocene of Rajasthan is of phytogeographic significance.

A Talchir palynoflora has been found below the Athgarh Sandstone near Garh Haladia, Orissa. The striations in Permian saccate pollen are believed to act as germination gates or moisture regulators. Palynological studies show that though the Dubrajpur Formation in Rajmahal Basin includes Lower Triassic and Lower Cretaceous units, no characteristic Jurassic palynoflora has been recorded. Palynological investigation of the Mesozoic sediments of Kutch Basin shows that some of the sandstone-facies dominated beds, usually considered belonging to the Bhuj Formation, have *Callialasporites—Araucariacites* rich palynoassemblage as in the Jhuran Formation.

Quantitative assessment of microconstituents and rank determination of coals from a bore-hole in Bansloi Coalfield, Rajmahal Basin shows that these coals are of low rank, ranging from subbituminous B to high volatile bituminous C. Petrological study of Tertiary coals from Arunachal foot-hills indicates that these coals were formed by the burial of wood logs in niches in the flood plains of rivers in a sinking shallow basin.

Palynological investigations in Kerala Basin indicate that Eocene rocks were eroded and redeposited during the Miocene. Palynology of the Tikak Parbat Formation, Assam shows that the deposition of the sediments took place in brackish water, probably in a tropical to subtropical climate. In the Rokhia, Gajalia and Baramura bore-holes the presence of Permian and Mesozoic palynofossils is inversely proportional to the percentage of phytoplankton. This probably indicates a gradual regression of the sea. The occurrence of the Permian genus *Dulhuntyspora*, as a reworked fossil, in the Bhuban Formation shows an Australian connection during the Upper Permian times.

Dinocyst assemblages have been recorded from the Therria, Lakadong, Mahadek and Langpar formations exposed in Umshorengkew River, Assam Shelf. Occurrence of rare *Dinogymnium* in the upper part of Mahadek Formation is significant indicating a Maestrichtian age. Based on nannoplankton studies a model has been prepared for the recognition of a Bartonian transgressive event in Kutch.

Pollen analysis of a Holocene profile from Rewalsar, Himachal Pradesh shows a phenomenal change from arboreal to nonarboreal vegetation suggesting pastoral and arable activities of man. Pollen analysis of a profile from Chilka Lake, Orissa covering a time span of 1,500 years, has revealed the dominance of non-arboreals. The mixed assemblage of mangrove and upland taxa indicates fresh water and sea water intermixing in the open Chilka Lagoon.

Fission-track dating of one gabbrro sample (1,320+68 million years) indicates the presence of Vindhyan equivalent rocks under the Ganga alluvium.

New data has been collected on the use of herbal drugs in northern India during *circa* 600-200 B.C. From Khairadih in Ballia District of Uttar Pradesh, remains of anwala, grape, jaiphal and bel have been found. Anwala and sandal have been found at Narhan in Gorakhpur District. All these plants are valued in modern Ayurveda. The evidence of Nutmeg shows a maritime connection of ancient India with the Far-East.

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RESEARCH

Inter-Departmental Projects

Project I.D.1 : **Palaeobiology of Pre-cambrian-Cambrian sediments of India**

Objective : *Search for Pre-cambrian biota and tie-up with radiometric dates based on glauconite. Establishment of envolutionary chronology*

Subproject I.D.1.1 : **Palaeobiology and stratigraphy of Vindhyan sediments in Son Valley and Rajasthan**

Objective : *Search for the evidence of Vindhyan life and its role in mineralisation*

Biota, body and trace fossils have been recorded from the Rohtas Limestone and Ghurma Shale of Chopan. The body fossils identified are *Tawuia*, *Chuaria*, *Longfengsahnia* and *Sekwia*. The biota indicates a diversified megascopic life belonging to eucaryotes during the Mid-Proterozoic (1000 Ma). Trace fossils indicate movements of worms.

Biota in the carbonaceous shales of Semri Group of Chopan, comprises oscillatoriacean algae. Calcareous and dolomitic limestones contain acritarchs and algae. Microbiota from the Pellet Limestone facies of Chitrakoot comprises only acritarchs. The biota of clastic facies in Satna-Maihar area (Rohtas to Maihar Sandstone formations) is dominated by planktonic acritarchs whereas the cherty facies is dominated by algae.

Baicalica is the commonest stromatolite in the Lower Bhander Limestone of Satna. Microbiota in between laminations is filamentous. Heterocyst-like structures have been observed.

P. K. Maithy, Rupendra Babu and Kalyan L. Meena

Subproject I.D.1.2 : **Biological remains from Pre-cambrian Sequence of Kumaon and Garhwal Himalaya**

Objective : *To decipher evolution and diversification of life forms during the Precambrian*

Deoban Limestone Formation is extensively developed in Deoban mountain (30°45'' 77°45''). It is characterised by siliciclastic-carbonate sequence with profuse development of collumnar stromatolite. Stratified bedded black cherts and lenses of cherts in Deoban limestone show extensive development of microbiota. Petrographic thin sections of these stromatolites were examined for the presence of microbiota. Some of the collumnar stro-

matolites having cherty dolomitic layer show presence of crumpled organic matter. Purely dolomitic limestones do not show presence of any organic matter. The study shows that the structural remains of microbiota responsible for the formation of stromatolites have not been preserved in Deoban stromatolites.

Manoj Shukla and V. C. Tewari (WIHG)

Subproject I.D.1.3 : Palaeobiology' sedimentology and dating of Vindhyan sediments in Rohtas area with special reference to mineralisation and stratigraphy

(DST financed project 5(4)/83-STP-III)

Objective : *To study the Vindhyan biology, sedimentary structures and to date the Vindhyan rocks*

Field mapping of the Vindhyans sequence was completed. Sedimentary structures, viz., current laminations, ripple marks, mud cracks, tool marks, load casts, rain drops have been studied in detail to decipher the current direction in the basin. Petrological description of different rocks types and study of heavy mineral suites have been completed. Megascopic Petalonamae has been recorded. The microbiota shows dominance of acritarchs. *Asperia*, *Stratifera* and *Irregularia* have been recorded. The final report is under preparation.

P. K. Maithy, Kedar Narain and Amar Sarkar

Subproject I.D.1.4. : Fission Track dating of glauconitic deposits from the Vindhyan sediments

Objective : *Dating and correlation of Vindhyan sediments in Son Valley and Rajasthan*

Three profiles of Lower Vindhyan glauconitic sandstone deposits exposed at Bullai Jalashai, Susnai and Son-Pump house, Chopan, Son Valley have been dated. The F-T ages for the 2 m profile from Bullai Jalashai range from 1,290 to 1,300 ma; for the 3 m profile for Son-Pump house from 1270 to 1300 ma and for the 12 m profile at Susnai hillock from 1154 to 1190 ma. Since the F-T ages do not vary much for individual profile, the average value is obtained as 1295 ma for Bullai Jalashai, 1285 ma for Son Valley house and 1172 ma for Susnai Hillock. The F-T ages for these profiles show that all these deposits belong to Kheinjua Formation of Lower Vindhyan (Semri) Group. The bed at the base of Bullai Jalashai Hillock has given the oldest age, i. e. 1298 ± 261 ma. It indicates that there is a glauconitic sandstone bed overlying Porcellanite Formation at Son Valley area. This oldest F-T age corresponds to the F-T age of lower glauconitic limestone bed sandstone at Sangrampur Hillock, Chitrakut, Banda Distict. At Son namely: Salkhan Valley area pellet is not present at 1120-1200 ma age bracket. F-T dating of six profiles, viz., Newari, Susnai, Bullai Jalashai, Son-Pump house and Machchhar-

mara section indicates that these glauconitic sandstone units represent condensed deposition.

Total sixteen glauconite samples from Lower Vindhyan deposits at Videsin Hillock (six samples), Biahara Hillock (six samples) and Lakshman Pahari (four samples), Chitrakut have been dated. At Videsin base rock granite is not exposed. The pellet limestone unit overlies the lower glauconitic sandstone bed and its F-T age is 1130±270 ma. The glauconitic limestone unit overlies base rock at Lakshman Pahari and its F-T age is 1195± 265 ma. The F-T age of glauconitic sandstone ranges from 1096 to 1120 ma. Biahara is the highest hillock (Lower Vindhyan deposit 20 m) studied so far. There the granitic breccia shows the oldest age 1315±290 ma. The overlying pellet limestone unit gives F-T age of 1210±265 ma. F-T dating study on the six profiles at Chitrakut has indicated that the pellet limestone bed was deposited synchronously at all places and hence can be taken as the marker bed for the area.

G. Rajagopalan and A. P. Srivastava

Project I.D.2. : **Floral palynostratigraphy of coal and associated sediments of Gondwana grabens and their genesis**

Subproject I.D.2.1. : **Morphotaxonomy, floristics and biostratigraphy of Lower Gondwana plants in Son Valley**

Objective : *Comparative morphology and floristics*

Identification, photography and descriptions of plant megafossils collected from Umaria, Pali and Anuppur and photography and descriptions of fossils from Nidpur area were partly completed. Samples were analysed for seeds and other vegetative and fertile organs but none of the samples were found to be productive.

Shaila Chandra, A. K. Srivastava and Kamal J. Singh

Subproject I.D.2.2. : **Palynostratigraphy of the Gondwana sediments in Son Valley**

Objective : *Morphotaxonomy, correlation and age determination*

The Nidpur area of Son Basin is very important as far as biostratigraphy and dating is concerned. Samples representing various horizons have been palynologically analysed to achieve this goal.

R. S. Tiwari and Ram Awatar

Subproject I.D.2.3. : Classification of coal types, rank determination and investigation of sediments

Objective : *Genesis and characterization of coal types*

Twenty five coal samples from Umaria Coalfield and 4 samples from Korar Coalfield have been processed. Biopetrographic assessment revealed that, in general, these coals are rich in fusible constituents (vitrinite). However, occasional non-fusible (inertinite) rich bands also occur in the coal seems. Umaria coals are low rank (high volatile bituminous stage) and unlike other peninsular Gondwana coals are characterized by the presence of early diagenetic pyrite, indicating brackish water influence.

G. K. B. Navale and B. D. Singh

Subproject I.D.2.5. : Comparative morphology and floristics of Lower Gondwana plants in Damodar and Rajmahal grabens and their significance in evolution and stratigraphy

Objective : *Floristics, compilation of fossil floras, stratigraphy and evolution*

The Saharjuri Outlier is one of the three coal-bearing areas in Deograh Coalfield, Bihar. There have been doubts about the age and stratigraphical position of the coal beds. Floristics, age and stratigraphical position of the fossiliferous band in Chitra Mine Area have been worked out. The plant megafossil assemblage shows the presence of *Gangamopteris maheshwarii* sp. nov., *G. obovata* Carruthers, *Glossopteris decipiens* Feistmantel, *G. deogarhensis* sp. nov., *G. linearis* Feistmantel, *Noeggerathiopsis bihariense* sp. nov., *N. conspicua* Lele & Makada, *N. saharjuriense* sp. nov., *Vertebraria indica* Royle, *Cordaicarpus* sp., and *Samaropsis* sp. The overall composition of the assemblage is characteristic of basal Barakar Sequence. The spore-pollen found attached to the cuticles of some of the above species are also comparable to basal Barakar palynotaxa. These include *Cannanoropollis, Parasaccites, Apiculatisporis, Tiwariasporis, Scheuringipollenites, Goudwanipollenites*, etc. The assemblage has a close similarity with some of the known assemblages from Karharbari "Formation"/"Stage" (*Noeggerathiopsis-Gangamopteris* Assemblage Zone).

Usha Bajpai

Characteristic plant fossil assemblage showing Karharbari affinity have been recorded from the Barakar Formation of Raniganj Coalfield, West Bengal. The plant fossils include *Gangamopteris, Euryphyllum, Rubidgea* and *Noeggerathiopsis* along with *Glossopteris. Palaeovittaria*, so far known only from the Raniganj Formation, has now been discovered in the Barakar Formation. Typical *Cordaites* leaves with interstitial veins have also been found. Scutum attached on *Glossopteris* leaves and a new fern frond have also been investigated. The frond is sterile, pinnate, pinnae having neuropteroid base and pecopteroid veins. *Glossopteris* species comprise *communis, indica, stenoneura, browniana, nimishea, angustifolia, fusa* and *karanpuraensis. Gondwanophyton indicum* has also been described.

A. K. Srivastava

The controversy about the taxonomic status of foliage shoot of *Trizygia speciosa* Royle vis-a-vis the genus *Sphenophyllum* Brongniart still remain unresolved. The genera are apparently similar, except for the Trizygoid leaf whorls in the former. The two genera cannot be compared at the level of anatomy of the axes or organisation of the fertile shoot as this information is not available for *Trizygia*. Hence the venation pattern of *Trizygia speciosa* was analysed as a parameter to solve the problem. Same study now needs to be done for *Sphenophyllum* species. The parameters chosen for analysis include length, width and area-indices of leaves and number of vein dichotomies, ultimates and dichotomy levels.

Hari K. Maheshwari, V. K. Singh and Usha Bajpai

The plant megafossil assemblage of the roof shales of second top coal seam from Lalmatia Incline Colliery, Hura Coalfield, Rajmahal Hills comprises *Glossopteris communis*, *G. linearis*, *G. damudica*, *G. ampla*, *G. browniana*, *G. stricta*, *Vertebraria indica*, *Eretmonia* type scale and *Arberiella* type sporangia.

Hari K. Maheshwari and V. K. Singh

A new taxon *Bengalia raniganjensis* gen. et sp. nov. has been established for an articulate axis from the roof shale of Nega Coal, Raniganj Coalfield. The taxon closely resembles the Barakar form *Lelstotheca* but differs in having linear-lanceolate leaves with mucronate apices in clusters of about 18 in each whorl. Leaves are free throughout and apparently do not form a sheath or a disc.

Hari K. Maheshwari, V. K. Singh and Usha Bajpai

Subproject I.D.2.6. : Comparative morphology, floristics and biostratigraphy of Lower Gondwana plants in Mahanadi and Pranhita-Godavari grabens

Objective : *Floristics and compilation of fossil floras, phytogeography and evolution*

Completed work on a new gymnosperm leaf *Surangephyllum*, a ginkgoalean leaf *Handapaphyllum*, a new fertile taxon *Maria indica* and *Glossopteris* species from Handapa, Orissa. Fossil woods from Chandrapur and Sironcha districts were processed and studied.

Shaila Chandra and K. J. Singh

Subproject I.D.2.7. : Comparative morphology of Lower Gondwana megaspores

A new species of the megaspore genus *Ancorisporites* Pant & Mishra has been found in basal Barakar (Karharbari) Formation of Hutar Coalfield. A synthesis of available

data and a chart showing the stratigraphical distribution of Lower Gondwana megaspores are under preparation.

Hari K. Maheshwari and Rajni Tewari

Subproject I.D.2.8. : Mesozoic flora from the Satpura Graben

Objective : *Morphotaxonomy, relationship and evolutionary linkages*

Numerous leafy twigs of *Brachyphyllum*, *Pagiophyllum* and *Elatocladus* have been studied from Sehora. A number of cuticular mounts of leaves have been prepared and studied under Scanning Electron Microscope. The taxa are characterized by small leaves, thick cuticle and sunken stomata.

Sukh Dev and Neeru Pandya

Subproject I.D.2.9. : Mesozoic flora from the Mahanadi and Pranhita-Godavari grabens

Objective : *Systematic study of floral succession and biostratigraphical implications*

The report on "The Gangapur Formation : Plant life and stratigraphy" has been finalized. The Gangapur flora is dominated by conifers, followed by cycadophytes and pteridophytes. Pteridosperms are very rare, represented by a new species of *Pachypteris*. Two new species, one each of *Dictyozamites* and *Pagiophyllum* have also been recorded. This floral assemblage resembles Jabalpur Assemblage from Sehora beds. The flora is probably subtropical. In view of the present megafloral findings and other evidences the Gangapur Formation is dated as Early Lower Cretaceous.

Sukh Dev and A. Rajanikanth

Studies on the fossil flora from the Kota Formation have been completed. The assemblage as a whole is dominated by conifers and pteridophytes. Cycadophytes and ginkgoales are very poorly represented. The fossil wood genera *Araucarioxylon*, *Podocarpoxylon*, *Taxaceoxylon* and *Cupressioxylon* are common to the Rajmahal flora. In view of the available palaeobotanical data and other evidences the Kota Formation is considered Middle Jurassic or slightly younger in age.

A. Rajanikanth and Sukh Dev

A number of plant fossils from Golapalli Sandstone belonging to the genera *Cladophlebis*, *Taeniopteris*, *Ptilophyllum*, *Williamsonia*, *Pachypteris*, *Elatocladus*, *Pagiophyllum*, *Brachyphyllum* and *Araucarites* have been studied.

Sukh Dev and Neeru Pandya

Subproject I.D. 2.10 : Fossil flora of Rajmahal Formation

Objective : *Morphotaxonomy, floral succession and age determination*

Gleichenia gleichenoides, Cladophlebis indica, Sphenopteris sp., *Ptylophyllum acutifolium* and *P. cutchensis* have been documented and studied. The genus *Culcitites* has been recorded.

Jayasri Banerji

Subproject I.D.2.11. : Reconstruction of the Pentoxylon plant

Objective : *Anatomical investigation of Pentoxylon stem, Nipaniophyllum leaf, Sahnia pollen organ and Carnoconites seed-cone for establishing organic relationship*

Sections of small chert blocks from Nipania have been examined. Besides, the presence of already known plant remains, a few *Araucarioxylon* stems have also been found for the first time from Nipania.

Shyam C. Srivastava

Subproject I.D.2.12. : Palynostratigraphy of Gondwana Sequence in Rajmahal Basin

Objective : *Palynostratigraphy, biozonation and correlation of coal-bearing horizons*

Attempts to understand conventional Dubrajpur Formation lithologically, megafloristically and palynologically have revealed that palynology is an effective tool for dating of such sedimentary deposits where animal fossils are not on record and megafossils are not well presented in the whole sequence. Results of palynological studies suggest that this formation includes Late Triassic and Early Cretaceous sediments. It is a time transgressive unit. The Lower and Upper limits of Dubrajpur Formation are derived to be as Lower Triassic and Lower Cretaceous, respectively. A comparative study of palynoflora and megaflora assemblages from Dubrajpur and Rajmahal sediments suggests that the volcanic activities of this basin are not coeval. No typical Jurassic palynoflora has been recorded in the Dubrajpur Formation.

Palynological investigations of Bore-hole RJNE-8 and RJNE-16 (drilled in the northern extension (NE) of the Basin) reveal presence of an assemblage which is correlated with palynoflora of Upper Raniganj. Appearance of elements like *Lundbladispora, Densoisporites, Lunatisporities, Goubinispora* and *Pretricolpipollenites* indicates closing phase of Late Permian palynoflora. These results extend the presence of Upper Permian sediments from Barahat up to 5 km south of this village along Godda Pirpainti Road in Rajmahal Basin. The identification of Raniganj palynoflora in Rajmahal Basin is of a stratigraphical significance.

Archana Tripathi

For further correlation and dating of sediments in this area samples from Bore-hole RJNE-32 and RJNE-35 are being chemically processed for the recovery of palynomorphs. The material is rich in spores and pollen. The palynological investigation of BH RJNE-32 at 381.50 m depth reveals the presence of palynoflora of Raniganj age having *Striatopodocarpites-Crescentipollenites* assemblage. The palynological composition from the same bore-hole at 195 m depth suggests Early Cretaceous age due to presence of taxa : *Aegnitriradites*, *Coptospora* and *Cooksonites*. The dating of Upper Permian and Cretaceous strata is possible through these studies.

R. S. Tiwari and Archana Tripathi

Subproject I.D.2.13. : Palynostratigraphy of Gondwana Sequence in Damodar Graben

Objective : *Palynological dating, palynostratigraphy and biozonation*

The eastern extension of Raniganj Coalfield up to Panagarh is a new area for palynodating, correlation and basin configuration in this area. The bore-hole PGD-2 (Panagarh) has been undertaken for palynological analysis as a master bore-hole for the area. The samples are being processed and first survey of yielding material has revealed the presence of Raniganj Formation in the bore-hole at 607.00 m level. The precise P/T boundary is being sought in this bore-hole.

Vijaya

Sequel to the study of newly identified for coal-bearing beds in the eastern most part of the Raniganj Coalfield, the subsurface samples in bore hole RAD-8 have yielded encouraging results. The palynofloral changes at the close of Raniganj Formation and at the advent of Panchet Formation (270 to 205 m) have been identified. These results corroborate with other similar studies recently done in the area. Finer calibrations are in progress.

R. S. Tiwari, Vijaya and Kindu L. Meena

Subproject I.D.2.14. : Palynostratigraphy of Gondwana Sequence in Godavari Graben

Objective : *Palynostratigraphy, biozonation and correlation of coal-bearing horizons*

Palynological succession in bore-hole GRK 24 and GRK 25 from Ramkrishnapuram area indicates the occurrence of Talchir to Middle Kamthi palynofloras. The palynofossils of the Talchir Formation contain predominance of Leiosphaerids indicating marine influence during their deposition. The sediments accosted in bore-holes GSP 1 from Satrajpalli, GLP 1 and GLP 2 from Lachmeedevpet and GBR 1 and GBR 2 from Bubharam area have yielded Barakar palynoflora.

Palynological data of Kamthi Formation in Godavari Graben have been compiled and five distinct palynozones have been identified which are comparable with the known Upper Permian palynofloras. Seven new species of pollen taxa have been distinguished in Kamthi sediments.

A complete succession of palynofloras from Talchir to Middle member of the Kamthi Formation in Godavari Graben has been established.

Suresh C. Srivastava and Neerja Jha

Palynological succession of Lower Gondwana sequence in bore-hole GM-4 from Manuguru area of Godavari Graben has been analysed. Three distinct palynological assemblages have been demarcated, which are as : 1—*Faunipollenites* + *Striatopodocarpites*, 2—*Striatopodiaceaepites* + *Corisaccites* + *Guttulapollenites*, 3—*Striatopodocarpites* + *Densipollenites*. The first assemblage is comparable to the Lower Kamthi palynoflora, while the other two are comparable to the Middle Kamthi palynoflora known from Ramagundam and Ramkrishnapuram areas. They represent the Upper Permian palynofloral sequence in Godavari Graben. There the age of Middle Kamthi is indicated to be Late Permian.

Neerja Jha

Subproject I.D.2.15. : Palynostratigraphy of Palaeozoic and Mesozoic sediments in Mahanadi Basin

Objective : *Palynostratigraphy and biozonation*

The Infra-Athgarh sedimentary deposits observed at Garh Haladia, West of Bhubaneshwar in Mahanadi Basin comprising Khaki-green needle shales contain a palynoflora which is characterised by the presence of radial monosaccate pollen, *Plicatipollenites* together with alete taxa *Foveofusa*. Besides, few chitinozoa-like black organic bodies of unknown origin are also recorded. On the basis of these fossils an earlier Talchir age is assigned to these sediments. The presence of Talchir sediments in Garh Haladia area extends the occurrence of Lower Gondwana sediments along the east coast of peninsular India up to south of Bhubaneshwar. These Talchir shales are directly overlain by Athgarh Sandstone. Thus the time gap between earliest Permian and Late Mesozoic is not represented by sediments in this area.

R. S. Tiwari and Archana Tripathi

Subproject I.D.2.16. : Palynology of the Gondwana Sequence in Satpura Basin

Objective : *Palynostratigraphy, biozonation and correlation of coal-bearing horizons*

The sediments exposed in Haresdewar Nala section south of Pachmarhi in Satpura Basin contain dominance of striate-disaccate pollen grains chiefly represented by *Striato-*

podocarpites and *Faunipollenites*. In addition, *Corisaccites*, *Guttulapollenites* and *Densipollenites* are also represented in subdominance. The assemblage is comparable to those described from the Bijori Formation exposed on the western margin of Satpura Basin.

Suresh C. Srivastava

Subproject I.D.2.17. : Critical assessment of coals from Damodar and Rajmahal Graben

Objective : *Classification of coals and assessment of their quality*

Quantitative assessments of microconstituents and rank determination on all the 43 coal samples (bore-core RCH-3) from Chuperbhita Coalfield of Rajmahal Graben have been completed. The data show that these coals are of low rank, ranging from subbituminous B to high volatile bituminous C stages and contain high to moderate amount of reactive constituents (vitrinite) whereas non-reactive components (inertinite) are occasionally dominant. These coals are poor in liptinites (micro/megaspores).

G. K. B. Navale and B. D. Singh

Subproject I.D.2.18. : Evaluation and rank assessment of coal seams of Pathakhera Coalfield, Satpura Graben

Objective : *Coal seams characterisation*

The data processing of maceral, microlithotype and reflectance studies of all the 30 Lower Gondwana coal samples from Pathakhera Coalfield, Satpura Graben has been completed. The report on the biopetrological study of Pathakhera coals is being finalized.

Anand Prakash and O. S. Sarate

Subproject I.D.2.19. : Palynostratigraphic studies of Palaeozoic sediments in West Siang District, Arunachal Pradesh

Objective : *Palynostratigraphy*

The palynological assemblage recovered from the coal balls is rich in radial monosaccate pollen grains represented by *Parasaccites*. *Callumispora* represents the subdominance. This assemblage is comparable to the Lower Permian assemblages recovered from the associated coal and shales.

Suresh C. Srivastava

Subproject I.D.2.20. : Palynostratigraphic studies, evaluation, rank and properties of coals and associated sediments in eastern Himalaya

Objective — *Palynological study of coal and associated sediments and petrographic evaluation of coal*

A number of samples from East Siang, East Kameng and Lower Subansiri districts in Arunachal Pradesh and from Sikkim have been processed. The yield of palynofossils is poor. Morphographic study of palynofossils has been done. Quantitative analysis of the productive samples shows that the assemblage is comparable to those of Lower Permian ones. Further collections have also been made.

Suresh C. Srivastava, Anand Prakash and A. P. Bhattacharya

Petrological study of coals occuring in the form of small lenses, thin streaks and pockets in the Tertiary sediments forming the foot-hills of Arunachal Himalaya has been carried out in detail from Siang, Subansiri and Kameng areas. The coals are almost exclusively composed of vitrinite/huminite microconstituent with some fraction of inorganic mineral matter. Well preserved cellular structures exhibiting various stages of degradation of plant matter are characteristic features of the vitrinite/huminite maceral group. Reflectance of vitrinites in oil ranges between 0.3 to 1.5 per cent, in general, which indicates that these coals are of lignito-bituminous type in rank. The exclusive dominance of vitrinite/huminite maceral group also indicates that these coals were formed by the burial of wood logs in shallow niches of flood plains of the rivers in a sinking basin under shallow water depositional environment.

The nature, stratigraphic set up and relation of Gondwana sediments with Miri Group of rocks in the North and Upper Tertiary sediments in the south have been studied in detail from Siang in the light of sedimentation, tectonic frame work and palaeoenvironmental condition during Lower Permian.

Anand Prakash

Project I.D.3. : Floristics, palynostratigraphy and organic petrology of Indian lignites and associated sediments

Objective : *Comparative morphology of mega-and microfossils and microstructure of lignites, correlation, genesis and depositional environment*

Subproject I.D.3.1. : Tertiary plant megafossils from Kerala Basin

Objective : *Morphotaxonomy, palaeoecology, phytogeography and evolution of modern trees of Western Ghats*

A large number of carbonised woods from Varkala and Payangadi have been studied. Some of them have been identified with the woods of extant genera *Canarium, C.*

luzonicum, *Hopea*, *Anisoptera*, *Hydnocarpus* and *Afzelia-Intsia*. These taxa are the representatives of tropical evergreen forest and a few of them are still surviving in the Western Ghats. However, *Canarium luzonicum* is a Malayan element, occuring in the evergreen forests of Philippines. This together with other Malayasian elements, viz., *Dryobalanops*, *Gonystylus*, *Swintonia* reported earlier from this area, have provided evidence of the phytogeographical linkage of Malaysia with India during the Neogene.

N. Awasthi and Rashmi Srivastava

Subproject I.D.3.2. : Biodiagenetic investigation of Panandhro Lignite (Kutch) and dispersed organic matter in associated sediments

Objective : *Characterisation of lignites and quality assessment*

Both the upper and the lower lignite seams (52 lignites and non-lignite samples) from Panandhro Lignite Field, Kutch contain mainly attrital lignite type-degraded type. However, the middle and bottom parts of the upper, top and middle parts of the lower seams are of *woody type* with well preserved tissue structures. They contain fair amount of liptinite maceral (resinite, suberite, cutinite, exsudatinite, etc.). The seams are characterised by high incidence of argillaceous matter and frequent pyrite and calcite concretions. Iron-oxide is only occasionally common. The seams have attained rank of hard lignite/sub-bituminous C stage.

Very low reflecting 'grey' huminite having optical properties unlike that of the normal huminites was also identified. The differences in optical properties of the 'grey' and normal huminites are significant in relation to physico-chemical properties of the coals.

B. K. Misra and G. K. B. Navale

Subproject I.D.3.3. : Palynological study of the West Coast lignites

Objective : *Morphotaxonomy of spores/pollen, biostratigraphy and correlation with Cauvery Basin lignites*

Completed processing of rock samples collected from the Ratnagiri beds of Ratnagiri and Sindhu Durg districts of Maharashtra and scanned the slides. Study of the palynoflora is being done.

R. K. Saxena

Palynofossils recovered from the Meenkunnu Section of Cannanore area are referred to 36 genera and 38 species. Some of the important taxa are : *Crassoretitriletes*, *Neyvelisporites*, *Quilonipollenites*, *Lakiapollis*, *Meliapollis*, *Retitrescolpites*, *Malvacearumpollis*, *Ctenolophonidites* and *Crotonoidaepollenites*.

Some of the angiosperms pollen are : *Quilonipollenites*, *Lakiapollis*, *Retistephanocolpites*, *Polycolpites*, *Proteacidites*, *Margocolporites*, *Ctenolophonidites*, *Triorites*, *Compenipollis*, *Palmidites*, *Retynilonapites* and *Malvacearumpollis*. *Cheilanthoidspora*, *Laevigatosporites*, *Lygodiumsporites*, *Crassoretitriletes* and *Striatriletes* are some of the important Pteridophytic spores. The detailed study is in progress.

M. R. Rao

Subproject I.D.3.4. : Studies of dispersed organic matter from the Kerala sediments

Objective : *Characterisation of organic matter and study of depositional environment*

Dispersed organic matter studies of 48 lignite samples collected from Nichahom, Budapathri, Badusungi, Varnar, Pakharopora and Ningal Nala sections of Karewa Sequence, Kashmir Valley show that woody tissues, spores and pollen, algal filaments, unidentified organic matter and some sporangial remains form the main constituents of the total organic matter. The fungal action has also been observed on some plant tissues which indicates subaerial exposure of the vegetal matter in the basin.

Anand Prakash and O. S. Sarate

Subproject I.D.3.5. : Biodiagenesis of lignite and associated sediments of Cuddalore Formation

Objective : *Classification and correlation of lignite and associated sediments*

The maturation studies on the samples from the third mine area of Neyveli Lignite Field, Tamil Nadu, suggest that the lignite had reached sub-bituminous-C coal stage or an intermediate stage between soft and hard brown coal stages (German standard).

Reports of the palynological, organic matter and maturation studies have been finalized. The work reveals that floristically the third mine area more or less compares with the first and second mines excepting some newly identified forms. However, quality/rank of the lignite seam deteriorates in the third mine area, i.e. towards south of the deposit.

G. K. B. Navale and Alpana Singh

Subproject I.D.3.6. : Palynological investigation of subsurface and surface Tertiary sediments of Kerala

Objective : *To date the subsurface and surface Tertiary sediments of Kerala*

Exposures of Tertiary sediments in Kerala from Kundara, Tonakkal, Padappakara, Edavai, Varkala, Paravur, Payangadi, Cannanore and some sections of the bore-

hole core drilled at Ambalapuzha were correlated on the basis of palynofossils. These sections exhibit more or less homogeneous representation of spore-pollen genera with some minor variations perhaps due to local factors. In some of the sections, e.g. in Tonakkal, Varkala and Paravur the fungal elements are dominant whereas in Payangadi and Kundara, the angiospermic pollen are well represented. However, common palynofossils present in all the sections include *Polypodiaceaesporites*, *Lygodiumporites*, *Striatriletes*, *Polypodiisporites*, *Tricolpites*, *Retitrescolpites*, *Polyporites*, *Ctenolophonidites* and *Quilonipollenites*.

The occurrence of older Tertiary pollen genera, e.g. *Couperipollis*, *Lakiapollis*, *Retitribrevicolporites*, *Meliapollis*, *Retistephanocolpites*, *Triangulorites* and *Pseudonothofagidites* in these sections point out that the Eocene rocks were eroded and redeposited during Miocene.

R. K. Kar, P. K. Raha and C. P. Rajendran

Project I.D.4. : **Floristics, palynostratigraphy and biodiagenesis of sedimentary sequence of petroliferous Assam-Arakan Basin**

Subproject I.D.4.1. : **Tertiary vegetational history of Assam Shelf**

Objective : *Morphotaxonomy of fossil woods and leaves, palaeoenvironment and evolution of flora*

Identification of some fossil woods as *Dipterocarpus*, *Dialium* and *Givotia* from the Namsang beds near Deomali has been done. Presence of *Givotia* along with a number of tropical evergreen deciduous elements in the Namsang beds is significant from the phytogeographic point of view as one of its species, viz., *G. rottleriformis*, with which the fossil wood is closely comparable, now occurs in dry forests on the Western Ghats and on the hills of Deccan (Mysore and Karnataka) and also in dry region of Sri Lanka.

N. Awasthi

Subproject I.D.4.2. : **Palynostratigraphy (spore-pollen) of the Upper Cretaceous-Palaeocene Sequence in Assam Shelf**

Objective : *To establish palynostratigraphic zones of Upper Cretaceous-Palaeocene Sequence in Assam Shelf*

Forty spore-pollen genera comprising 45 species were identified in the coal exposed around Garo Hills. Eight genera and seven species belong to fungi, 20 genera and 25 species to pteridophytes and 12 genera and 13 species to angiosperms. The pteridophytic spores are mostly represented by *Dandotiaspora dilata*, *D. telonata*, *Lycopodiumsporites parvireticulatus*, *Cyathidites minor*, *Lygodiumsporites lakiensis*, *Todisporites kutchensis* and *Polypodiaceaesporites chatterjii*. The common angiospermic species in the assemblage are : *Palmaepollenites kutchensis*, *Couperipollis achinatus*, *Matanomadhiasulcites maximus*, *Pellicieroipollis*

langenheimii, *Lakiapollis ovatus*, *Retitribrevicolporites matanomadhensis*, *Polybrevicolporites cephalus*, *Meliapollis ramanujamii* and *Pseudonothofagidites kutchensis*.

The assemblage is quite similar to that of Latryngkew coal of Lakadong Formation (Palaeocene) of Cherrapunji, Meghalaya.

K. Ambwani

Lycopodiumsporites speciosus Cenozone and *Kielmeyerapollenites syncolporatus* Cenozone have been identifted in the Langrin Coalfield. The characteristic species of *L. speciosus* Cenozone are : *Lycopodiumsporites umstewensis*, *Dandotiaspora dilata*, *D. telonata*, *Cyathidites minor*, *Todisporites major*, *Lygodiumsporites*, *lakiensis*, *Spinizonocolpites echinatus*, *Proxapertites crassimurus*, *P. microreticulatus*, *Matanomadhiasulcites maximus*, *Couperipollis achinatus*, *C. kutchensis*, *Tricolpites reticulatus*, *Lakiapollis ovatus*, *Retitribrevicolporites matanomadhensis* and *Araucariacites australis*.

K. syncolporatus Cenozone has the following species in good percentage : *L. specious*, *Dandotiaspora dilata*, *D. telonata*, *Polypodiisporites repandus*, *P. umstewensis*, *Palmaepollenites ovatus*, *Palmidites plicatus*, *P. kutchensis*, *Triangularites triradiatus*, *Psilastephanocolporites psilatus*, *Retistephanocolpites* and *Polymargocolporities*.

R. S. Singh

Palynology of Thanji Nath coal seams, Meghalaya was completed. The assemblage consists of 35 genera and 64 species. 12 genera and 27 species belong to pteridophytes, 20 genera and 39 species to angiosperms and 3 genera and 3 species to fungi.

The assemblage has the abundance of Palm pollen which are generally represented by *Couperipollis kutchensis*, *C. achinatus*, *Spinizonocolpites echinatus* and *Proxapertites microreticulatus*. Other common species are: *Lygodiumsporites lakiensis*, *L. specious*, *Dandotiaspora dilata*, *D. telonata*, *Todisporites major*, *Polypodiisporites repandus*, *Polypodiaceaesporites chatterji*, *Proxapertites crassimurus*, *Lakiapollis ovatus*, *Retitribrevicolporites matanomadhensis*, *Margocolporites sahnii*, *Meliapollis navalei*, *Triangulorites bellus*, *T. inferious*, *Psilastephanocolporites psilatus*, *Polymargocolporites mawlensis* and *Kielmeyerapollenites eocenicus*.

Jagannath P. Mandal

Palynological investigation of two coal seams of Lakadong Formation (Palaeocene) exposed at Jarain, Meghalaya was completed. The assemblage comprises 33 genera and 49 species; pteridophytes are represented by 9 genera and 14 species, angiosperms by 21 genera and 31 species, gymnosperms by 1 genus and 2 species and fungi by 2 genera and 2 species.

The assemblage is divided into two cenozones : *Psilastephanocolporites psilatus* Cenozone and *Matanomadhiasulcites maximus* Cenozone. In *P. psilatus* Cenozone, *Lygodiumsporites lakiensis*, *Dandotiaspora dilata*, *Proxapertites crassimurus*, *Tricolpites reticulatus*, *Retitribrevicolporites rubra* and *Kielmeyerapollenites syncolporatus* are also found in good numbers. In *M. maximus* Cenozone, the above mentioned species are also more or less found but *Proxapertites emendatus* is restricted to this Cenozone.

It was observed that the palynological assemblage recovered from the Jarain colliery closely resembles the Laitryngkew assemblage.

Couperipollis Venkatachala & Kar was studied in detail. As the type species would not be located in the original slide and material, the name *Couperipollis* has been replaced with a new name—*Neocouperipollis* to accommodate monocolpate, spinose forms found in Palaeocene-Eocene sediments of India.

R. K. Kar and Madhav Kumar

Palynostratigraphy of Kopili Formation (Upper Eocene) exposed on Jowai-Badarpur Road Section at 136 km between Lumshnong and Sonapur, Meghalaya was completed. The assemblage comprises 82 genera and 108 species, of which algae are represented by 5 genera and 4 species; fungi by 9 genera and 5 species, probable bryophytes by 2 genera and 2 species, pteridophytes by 26 genera and 49 species, gymnosperms by 3 genera and 6 species, angiosperms by 16 genera and 18 species. Besides, Palaeozoic and Mesozoic reworked forms are represented by 26 genera and 24 species.

The assemblage is dominated by pteridophytic spores, particularly by *Striatriletes susannae*. Only one Cenozone, viz., *Striatriletes susannae* is proposed for this assemblage.

An attempt has been made to relate palynofossils with the extant families. The pteridophytic spores are probably related to Adiantaceae, Cyatheaceae, Hymenophyllaceae, Lycopodiaceae, Marattiaceae, Matoniaceaae, Osmundaceae, Parkeriaceae, Polypodiaceae, Selaginellaceae and Schizaeaceae. The gymnospermic pollen show affinities with those of Podocarpaceae, Araucariaceae and Pinaceae. Angiospermic pollen are represented by Araceae, Potamogetonaceae, Alangiaceae, Anacardiaceae, Cruciferae, Fabaceae and Theaceae.

R. K. Kar and G. K. Trivedi

Palynostratigraphical investigation of Ledo colliery, Tikak Parbat Formation (Upper Oligocene), Assam was completed. The assemblage comprises 109 genera and 180 species. Amongst them algae is represented by 2 genera and 2 species, fungi by 8 genera and 5 identifiable species, pteridophytes by 26 genera and 68 species, gymnosperms by 6 genera and 9 species and angiosperms by 26 genera and 34 species. Palaeocene-Eocene reworked forms in the assemblage are presented by 27 genera and 40 species of them pteridophytes are represented by 9 genera and 17 species and angiosperms by 18 genera and 23 species. Mesozoic reworked microfossils belong to 6 genera and 2 species, pteridophytes contri-

bute 4 genera and 6 species and the gymnosperms 2 genera and 4 species. Palaeozoic miospores belong to 12 genera and 12 species.

The pteridophytic spores are dominant in the assemblage. In the bottom seam the fungal elements are abundant but their percentage dwindles in the upper part. Gymnospermous pollen start appearing in the middle and gradually incresase in numbers. On the basis of frequency of different spore-pollen species, the assemblage is divided into three cenozone, viz., *Schizeaoisporites crassimurus* Cenozone, *Meyeripollis nahorkotensis* Cenozone and *Osmundacidites wellmanni* Cenozone. The deposition of the sediments took place in brackish water condition probably in tropical to subtropical climate.

R. K. Kar and B. D. Mandaokar

Subproject I.D.4.3. : Cretaceous Tertiary phytoplankton biostratigraphy of Assam Shelf

Objective : *Dinoflagellate taxonomy and identification of index taxa, biozonation, age determination and correlation of sedimentary sequences, precise demarcation of time boundaries and palaeoenvironmental and palaeogeographical interpretations*

Chemical processing of the samples and scanning of slides from Umshorengkew River Section have been carried out. A poor dinocyst assemblage recovered from Therria Formation and Lakadong Limestone contains rare forms of *Cordosphaeridium*, *Tityrosphaeridum* and *Operculodinium* only. A moderately rich dinocyst flora was obtained for the first time from Mahadek and Langpar formations from different stratigraphic levels. Occurrence of rare *Dinogymnium* in the upper part of Mahadek Formation is significant indicating Maestrichtian age. Characteristic taxa recovered from the lower part of Langpar Formation include *Cyclapophysis*, *Membranophoridium*, *Apteodinium*, *Fibrocysta*, *Ceratiopsis*, *Xenicodinium* and *Codoniella*.

K. P. Jain and Rahul Garg

A critical evaluation of the published dinocyst record, backed by restudy of type slides from Palaeocene of Khasi-Jaintia Hills, Meghalaya has been done indicating possible potential of dinoflagellate cysts in Palaeocene biostratigraphy of this area.

Rahul Garg

Subproject I.D.4.4. : Biodiagenesis of Tertiary coals in Assam

Objective : *Organic matter classification and maturation level*

Coal pellets from Jaintia and Garo hills, Meghalaya were thoroughly re-examined to ascertain causative factors responsible for the genesis of the very low reflecting 'grey'

vitrinite/huminite. Apparently both calcite and pyrite are responsible for the genesis of the 'grey' vitrinite/huminite. In addition to this, partially to fully degraded resinite-'amorphous' type was also found *in situ*. Its presence has been confirmed in Kutch lignite too. The understanding of the degradational process would help in ascertaining its influence on biodiagenesis of organic matter.

B. K. Misra

Subproject I.D.4.5. : Detailed palynological studies of Tipam-Surma units, Girujan Clay and Namsang Sandastone/Clay from the subsurface of Rokhia

Objective : *Precise dating of Namsang/Girujan, Tipam and Surma stratigraphic units and their zonation*

Palynological investigation of Rokhia bore hole-core no. 1, Gajalia 1 and Baramura 2, was completed. The assemblage consists of 115 genera and 165 species; amongst them 25 genera and 34 species are reworked Palaeozoic and Mesozoic forms. Stratigraphically important palynotaxa were marked.

The presence of Permian and Mesozoic palynofossils is inversely proportional to the percentage of phytoplankton. This probably indicates that with the gradual disappearance of sea, the erosion of the older rocks was evidenced due to instability of the land. The assemblage has been divided into 3 palynological cenozones : the lower *Aplanosporites robustus* Cenozone, the middle *Striatriletes susannae* Cenozone and the upper *Pinuspollenites crestus* Cenozone.

As *Aplanosporites robustus* Cenozone of Rokhia 1 closely resembles *A. robustus* Cenozone of Maniyara Fort Formation (Upper Oligocene) of Kutch, the lower part of Rokhia 1 has been assigned an Upper Oligocene age.

It has been inferred that the basin was deep to begin with and the marine condition prevailed. Gradually the basin transformed into an alluvial plain which is interpreted on the basis of spores of *Ceratopteris*. Upland vegetation represented by gymnosperms gained prominence later.

R. K. Kar

Subproject I.D.4.6. : Palynological studies of the Barail Sequence in the type area with special reference to Kopili-Barail and Barail-Surma transition

Objective : *Palynological zonation and dating of Barail sediments*

Palynostratigraphic work on the Barail sediments exposed on 'Silchar-Halflong Road Section was completed. The Disang assemblage consists of 26 genera and 28 species;

amongst them triletes are represented by 7 genera and 10 species, monoletes by 2 genera and 4 species, gymnosperms by 6 genera and 4 species and fungi by 5 genera and 5 species. Besides, there are also some phytoplanktons. The assemblage was placed into *Striatriletes microverrucosus* Cenozone.

Laisong palynological assemblage comprises 30 genera and 28 identifiable species; of them triletes are represented by 14 genera and 16 species, monoletes by 2 genera and 3 species, angiosperms by 4 genera and 2 identifiable species, fungi by 4 genera and 2 species and phytoplankton by 3 genera and 2 species. Besides, there are 6 genera and 4 species of reworked palynofossils. *Osmundacidites wellmanii* Cenozone was proposed for this assemblage.

Jenam assemblage has 49 genera and 42 identifiable species; amongst them triletes are represented by 16 genera and 14 species, monoletes by 4 genera and 7 species, gymnosperms by 8 genera and 8 species, angiosperms by 12 genera and 9 species, fungi by 8 genera and 3 species. Besides, there are also few dinoflagellates. The assemblage was divisible into (i) *Malayaeaspora costata* Cenozone, (ii) *Polypodiaceaesporites tertiarus* Cenozone, and (iii) *Striatriletes susannae* Cenozone in ascending order.

Renji assemblage has 47 genera and 52 species, of them triletes are 17 genera and 22 species, monoletes 5 genera and 6 species, gymnosperms 12 genera and 13 species, angiosperms 8 genera and 6 species and fungi 4 genera and 3 species. In addition, there are also few phytoplankton species. The assemblage was placed in *Cyathidites minor* Cenozone.

Bhuban assemblage has a good number of Palaeozoic and Mesozoic reworked pollen. *Dulhuntyispora* is one of the Palaeozoic reworked spores which is found in Bhuban as well as in Laisong. This genus was known so far only from Australia. Its occurrence as reworked fossil in the Tertiary sediments of India has got a bearing on the plate tectonics. Typical Bhuban assemblage was designated as *Pinuspollenites crestus* Cenozone.

Renji and Bhuban formations are easily demarcated by the proportionate occurrence of gymnospermous pollen grains. *Pinuspollenites crestus* and *Podocarpidites khasiensis* are present in both the formations, but in Bhuban their representation is maximum. Besides, *Striatriletes microverrucosus* and *Cyathidites minor* considerably dwindle in Bhuban and the dinoflagellates increase in numbers.

R. K. Kar

Subproject I.D.4.7. : Cretaceous-Tertiary diatom biostratigraphy of Assam Shelf

Objective : *Morphotaxonomy and identification of marker suites of diatoms*

Thirty rock samples collected from the Reong Therria Section and Umshorengkew River Section of Meghalaya were chemically processed for diatoms but they all proved to be barren.

Anil Chandra

Project I.D.5. : **Fossil flora, palaeogeography, palaeoecology and palynostratigraphy of Cauvery, Palar, Krishna-Godavari, Bengal and Andaman basins**

Objective : *Morphotaxonomy, biozonation, correlation, biostratigraphy, palaeoecology and phytogeography*

Subproject I.D.5.1. : **Floral succession in the Mesozoic sediments of Cauvery and Palar basins**

Objective : *Morphotaxonomy and floristics*

Detailed investigations including photodocumentation of plant fossils from Terani beds of Sivaganga Formation have been completed. Two new species, one each of *Sphenopteris* and *Brachyphyllum* have been recorded. A general comparison of Sivaganga flora with others shows that it is probably Upper Jurassic or slightly younger in age.

Sukh Dev and A. Rajanikanth

Subproject I.D.5.2. : **Palynostratigraphy of the Gondwana sediments of Palar Basin**

Objective : *Palynological zonation and age determination*

Morphography of spores and pollen in Sriperumbudur Formation has been completed. The palynoflora is characterised by the dominance of *Araucariacites* and *Callialasporites*.

Suresh C. Srivastava

Subproject I.D.5.3. : **Phytoplankton biostratigraphy of Cretaceous Tertiary Sequence of Cauvery and Palar basins**

Objective : *Identification of phytoplankton taxa, biozonation, age determination of palaeoenvironments of sedimentary sequences*

Detailed morphotaxonomy of 22 genera and 36 species of dinoflagellate cysts recovered from Trichinopoly Limestone exposed near Tappy, Kunnam, Kullakanatam and Chittali area in Cauvery Basin has been finalized. Out of them three genera and 10 species are new. Two genera, *Cyclonephelium* and *Palaeostomocystis* have been amended and two new combinations are proposed.

A group of essentially similar genera having lenticular cysts and apical archaeopyles, viz., *Adnatosphaeridium*, *Aptea*, *Areoligera*, *Baticasphaera*, *Canningia*, *Canninginopsis*, *Chiropteridium*, *Chytroeisphaeridia*, *Cyclonephelium*, *Emmetrocysta*, *Endoceratium*, *Glaphyrocysta*,

Hystrichosphaerina, *Kallosphaeridium*, *Membranophoridium*, *Odontochitina*, *Parvalodinium*, *Pesudoceratium*, *Sentusidinium* and *Systematophora* is studied. Several taxonomic reinterpretations are proposed and a key to identify these genera has been prepared.

K. P. Jain and Khowaja Ateequazzaman

Subproject I.D.5.4. : Tertiary megafossils of Cauvery Basin and their comparison with extant plants

Objective : *Comparative morphology of petrified and carbonised woods and leaves and palaeoecology*

Identification of a carbonised wood as *Bouea* of Anacardiaceae from Neyveli has been confirmed. Six leaf-impressions from the same lignite deposits have been tentatively identified with the extant genera: *Exoecaria*, *Machilus*, *Tecoma*, *Melodinus* and *Randia*.

Anil Agarwal

Subproject I.D.5.5. : Palynology of the Cuddalore Formation

Objective : *Palynoflora of various lignites and asscociated sediments contained in Cuddalore Sandstone, age determination, and correlation with West Coast lignites*

Processing of 148 samples from four shallow wells drilled by ONGC in Thanjavur District, Tamil Nadu has been completed. The samples are devoid of spores/pollen but some of the samples yielded microseeds. Investigation of these specimens is underway.

R. K. Saxena

Subproject I.D.5.6. : Fossil calcareous algae from Cauvery Basin

Objective : *Morphotaxonomy of calcareous algae and their significance as rock builders*

Available fossil algal material (limestone) kept in the Museum was sorted and suitable limestones of Uttatur Formation, Cauvery Basin were selected for study. In all, 20 thin sections were examined and members of Solenoporaceae and Dasycladaceae were observed.

A. Rajanikanth

Subproject I.D.5.7. : Floristics of Neogene sediments in Bihar and Bengal

Objective : *Vegetational history of the Neogene period*

Morphotaxonomy of leaf-impressions and petrified woods assignable to 25 extant genera of angiosperms from the Late Cenozoic sediments of Palamau District, Bihar has been completed.

M. B. Bande and G. P. Srivastava

Subproject I.D.5.8. : Cenozoic diatom biostratigraphy of the Andaman and Nicobar Island

Objective : *Morphotaxonomy, biostratigraphy, palaeogeography and palaeoecology of the Cenozoic diatoms to resolve the precise biostratigraphic framework for Cenozoic sedimentary formations of the area*

Ten samples from Middle Andaman were chemically processed. Two of them were found to be productive. Morphotaxonomy of these diatoms is in progress.

Anil Chandra

Project I.D.6. : Palynostratigraphy and fossil floras of sedimentary basins in Gujarat, Rajasthan and Narmada Valley

Objective : *Morphology, palynostratigraphy, biozonation and palaeoenvironments*

Subproject I.D.6.1. : Studies of Tertiary plants from Jaisalmer and Cambay basins

Objective : *To build up vegetational history*

About 75 petrified woods from the Shumar Formation near Jaisalmer were studied. They have been identified with 14 extant genera of dicotyledons, out of which *Bauhinia*, *Cordia*, *Khaya*, *Lagerstroemia*, *Ormosia*, *Pterocarpus*, *Sindora* and *Tetrapleura* are being reported for the first time from this area. These taxa indicate tropical humid climate with higher amount of rainfall at the time of their deposition. Occurrence of the tropical African genera, viz., *Khaya* and *Tetrapleura* in the Mio-Pliocene sediments of Rajasthan is of great phytogeographic significance.

Two carbonised woods from the Rajpardi Lignite mine, Gujarat have been identified as *Terminalia* and *Sonneratia*. The presence of *Sonneratia* is indicative of near shore deposition of the lignite during the Eocene.

J. S. Guleria

Subproject I.D.6.2. : Palynology of the Mesozoic sediments of Kutch Basin

Objective : *Palynostratigraphy, biozonation and palaeoenvironment*

Scanning of all palynological slides from Lakhpat and Suthri wells has been completed. Photomicrography of spores and pollen from Banni and Nirona wells has also been completed. Bar diagram, range charts and locality maps are being plotted. The palynological investigation shows that some of the sandstone facies dominated beds usually considered belonging to the Bhuj Formation have an *Araucariacites-Callialasporites* rich mioflora as in the Jhuran Formation.

H. K. Maheshwari and B. N. Jana

Subproject I.D.6.3. : Nannoplankton morphology and biostratigraphy of Mesozoic Tertiary sediments of Kutch and Jaisalmer basins

Objective : *Nannoplankton morphotaxonomy, biozonation of marine sequences, determination of chronostratigraphic boundaries and interpretation of palaeoenvironment*

Detailed account of nannoplankton employing light and scanning electron microscope was completed on measured sections of Harudi and Fulra Limestone formations of Kutch Basin. A model was proposed for the recognition of a Bartonian transgressive event for the sedimentaries overlying the Deccan Traps and terminating with the deposition of Fulra Limestone Formation; earlier concepts backed by critical evaluation of published records for the occurrence of Palaeocene, Early Eocene and Lutetian in Kutch Basin were rejected. Datable nannoplankton of low diversity were discovered in Maniara Fort (Oligocene) and Vinjhan Shale (Miocene) of Kutch Basin. Preliminary nannoplankton study on Mesozoic units of Jaisalmer Basin revealed datable assemblage in Kuldhar Member of Jaisalmer Formation.

S. A. Jafar and Jyotsana Rai

Subproject I.D.6.0. : Palynology of Mesozoic deposits in Narmada and Saurashtra basins

Objective : *Palynostratigraphy, biozonation and correlation*

Palynology of Jabalpur Formation at Pat-Baba Ridge, Madhya Pradesh indicates that the mioflora has the prominence of trisaccate pollen grain *Podosporites tripakshi* followed by pteridophytic spores *Cyathidites* and *Callispora*. The assemblage is comparable with Lower Cretaceous mioflora of western Australia.

Pramod Kumar

Project I.D. 7. : Palynostratigraphy and organic petrology of the Tertiary sediments of Himalaya

Objective : *Biozonation, age determination and palaeoecological interpretation*

Subproject I.D.7.1. : Palynostratigraphy of the Lower Tertiary sediments of Simla Hills and adjoining areas

Objective : *Biozonation, age determination and palaeoecological interpretation*

The palynoflora of the Subathu Formation (Eocene) in the Benethi-Bagthan area of Himachal Pradesh consists of 59 genera and 115 species. Dinoflagellate cysts and pteridophytic spores constitute an important part of the Subathu assemblage. Qualitative and quantitative data analyses permit the establishment of five palynological assemblage zones. Lateral extent of these palynozones is traceable as far as in the Kalakot area (Jammu and Kashmir). Palynological data indicates that the Subathu Formation was deposited under shallow marine condition. A subtropical climate is postulated during the Subathu sedimentation.

Samir Sarkar and H. P. Singh

Subproject I.D.7.2. : Palynostratigraphy of Tertiary sediments of Arunachal Pradesh

Objective : *Morphotaxonomy, biozonation, correlation and palaeoecology*

Morphotaxonomic studies on the palynofossils recovered from the Tertiary sediments of West Siang, Subansiri and Kameng districts of Arunachal Pradesh have been completed. Palynological assemblage consists of pteridophytic spores, gymnospermous and angiospermous pollen grains together with fungal remains. Poor recovery of palynofossils precludes the formal institution of palynozones. Some of the important palynotaxa studied are : *Collospermumpollis*, *Collumisphaera*, *Lakiapollis*, *Graminidites*, *Lygodiumsporites* and *Striatriletes*. This preliminary study of the assemblage postulates the occurrence of Eocene sediments in Arunachal Pradesh.

S. K. M. Tripathi

Project I.D. 8. : Palaeobotany and palynology of Tethyan Himalaya

Objective : *Morphotaxonomy, biostratigraphy and age determination*

Subproject I.D.8.1. : Palaeophytic vegetational history of Pre Tethyan realm

Objective : *Morphotaxonomy, floristics, biostratigraphy and age determination*

Permian 'Gondwana' of Arunachal Pradesh and Sikkim were investigated. Following megafossils have been identified: Equisetalean axes *Phyllotheca griesbachii*, *Glossopteris*

stenoneura, *G. communis*, *G. leptoneura*, *G. syaldiensis* and *Vertebraria indica*. The overall assemblage is too meagre for a meaningful age determination. However, *G. leptoneura* and *G. syaldiensis* have so far not been reported from sediments older than the Raniganj Formaton. Some of the leaf fragments are pyritised and spheroid bacteria have been observed over them under the Scanning Electron Microscope.

Usha Bajpai

Subproject I.D.8.2. : Palynostratigraphic studies of Palaeozoic and Mesozoic sediments in western Himalaya

Objective : *Morphotaxonomy, correlation and dating of sediments*

Palynostratigraphical results from Kalapani Limestone Sequence of Malla Johar area have been compiled. Samples from Dogadda area, Himalayan region proved barren of spores.

Collection and compilation of available palynological data in the areas of circum-Tethys region has been done. The Tethyan flora indicates more Indian Gondwanic affinity rather than the non-Gondwanic one.

R. S. Tiwari and Vijaya

Subproject I.D.8.3. : Palynostratigraphy of Tethyan Sequence in Niti area of Kumaon Himalaya

Objective : *Palynostratigraphy, dating and correlation of Tethyan sediments*

Further maceration of samples from Niti area, Tethyan Himalaya is in process.

R. S. Tiwari

Project I.D.9. : Reconstruction of Quaternary vegetation and climatic pattern

Objective : *Palynostratigraphy, palaeoenvironment and palaeoclimate*

Subproject I.D.9.1. : History of vegetation and climate in the subtropical, temperate and alpine belts of Himachal Pradesh and Uttar Pradesh

Objective : *Palaeofloristics and palaeoenvironments of Quaternary period through palynological studies*

Pollen analysis of a 7 m deep Holocene profile from Rewalsar in Himachal Pradesh has revealed two fold vegetation pattern. The subtropical Chirpine-Oak woods are apro-

crates. The codominant arboreal taxa recorded therein are indicative of relatively warm temperate climate. Thereafter, an abrupt decline in the arboreals and subsequent succession by herbs is noted. This phenomenal change in the pattern of vegetation from arboreal to nonarboreal suggests pastoral and arable activities of man in the landscape.

One meter deep profile collected from below water in Ram Tal (lake), Nainital has been analysed. The study indicates a typical subtropical chirpine-oak forest. A faster rate of deposition of the sediments is assumed from the pattern of vegetation.

Eight surface samples in and around Sat Tal area were investigated to understand the interplay of pollen and spores and precise interpretation of the profiles.

Pollen morphological study of 60 taxa distributed in Kumaon Himalaya was done in detail.

Chhaya Sharma and M. S. Chauhan

Subproject I.D.9.2. : History of vegetation and climates in tropical montane forests in Kerala

Objective : *Palynological investigation to build up a complete floral succession in forests of Anamalai Hills and Silent Valley*

A catalogue comprising distribution, habit and habitat of the floral elements within the Shola Forest and outskirt of the Shola Forest in Tamil Nadu and Kerala has been prepared.

Twenty eight modern surface samples collected on way from Kadamparai to Arumparai, Anamalai Hills revealed a good pollen frequency of arboreal taxa. The study has further envisaged that so long the samples from within the shola forest ever studied, they were rich in tree taxa. But the samples away from the shola forest are rich in grasses and hardly few tree pollen of trees could be encountered. This feature of modern samples has been properly utilized in the reconstruction of palaeovegetation from the profiles in the area.

One profile from Schichalli in Anamalai Hills has been pollen analysed. The study has revealed the predominant grasses suggesting the vast stretches open grasslands.

When the profile assemblages were evaluated in the light of modern sediments, then it could be possible to think of the existence of shola forest in the near vicinity. Hence the face value interpretation of pollen diagrams could not be relied upon the modern surface samples study.

H. P. Gupta and S. K. Bera

Five surface samples from Silent Valley have been pollen analysed and a good number of arboreal and non-arboreal taxa have been recovered.

H. P. Gupta and H. A. Khan

Project I.D.10. : History of mangrove vegetation in India

Objective : *Reconstruction of Holocene Mangrove vegetation and to understand the ecosystem, causes of deterioration of Mangroves in time and space and their impact on environment*

A map depicting the distribution of Mangrove in India, a chart showing the production, protection and prospects of Indian Mangroves in time and space, a semidiagramatic overview of estuarine complex with special reference to Mahanadi Delta have been prepared. 3-D pictures of Chilka Lake in Mahanadi Delta is in the process of completion.

Pollen analysis of a profile from Chilka Lake, covering a time span of 1,500 yrs has revealed the dominance of non-arboreals. The characteristic mangrove taxa encountered are: *Sonneratia, Avicennia, Bruguiera, Ceriops*, etc. Upland taxa, e.g. *Lumnitzera, Terminalia, Emblica, Glochidion* have also been recorded. Microforams and an animal cyst, *Concentricystis* are quite common. Microscopic remains like nucleus of *Chara/Nitella*, seeds of Chenopodiaceae, Cyperaceae, *Rubus*, etc. have also been recorded. The mixed assemblage of mangrove and upland taxa suggests fresh water and sea water intermixing in the open Chilka Langoon.

H. P. Gupta and Asha Khandelwal

Pollen analysis of a 3.0 m deep profile from Paradip in Mahanadi Delta records the occurrence of pollen grains of both coastal vegetation and hinterland tropical forest as detailed in the Chilka profile.

The reworked bisaccate Palaeozoic spores have also been recorded in the profile. Surface samples from Bautra Kud area in Orissa were palynologically investigated and recorded various pollen taxa of mangrove and upland vegetation. The pollen assemblage of modern sediments could be used as a check parameter for the correct interpretation of pollen assemblage of the pollen diagrams from the profiles.

H. P. Gupta and R. R. Yadav

Seventy-five taxa of mangrove and upland vegetation in Mahanadi Delta were investigated and a pollen-key was prepared.

Asha Khandelwal and R. R. Yadav

Project I.D.11. : Geochronology of Indian rocks

Subproject I.D.11.1. : Radiocarbon dating of carbonaceous material

Objective : *To investigate the rate of sedimentation; subsidence of Ganga plain, rate of sedimentation in Indian Ocean and chronology of vegetational changes in the Himalayan region*

A total of 85 samples including anthracite background and NBS oxalic acid (contemporary radiocarbon standard) were processed. Dates for 68 samples have been calculated.

Two profiles of kankar deposit from Kanpur and Fatehgarh have been dated. The C-14 ages of kankar from depths >50 meter show a plateau at 35,000 yrs. The age vs depth relationship for both the profiles is linear up to a depth of 50 m giving an average subsidence/sedimentation rate of 1.7 mm per year.

Deep sea sediment cores collected from two localities (SK-185, 10° N 71° 51.5′ E and SK-186, 0°2′ N 68°31′ E) in the Arabian Sea have been dated using the carbonate fraction. The C-14 ages for the core SK-185 indicate a break in the sedimentation rate at the depth of 30 cm corresponding to 11,000 yrs. The calcium carbonate analysis of the core samples also indicates a change in the content at this depth. The start of deglaciation has been dated to 11,000 yrs B. P. on the basis of O_2 isotopic data and corresponds to calcium carbonate change in sedimentation rate data on this core. The C-14 age data on core SK-186 has not indicated the characteristics seen in core SK-185. In core SK-186 the sedimentation rate is fairly uniform at 2 cm/1,000 yr.

Radiocarbon dates of shale deposit around Payyanur, North Kerala lead to the conclusion that the Flandrian sea level-rise at this locality was felt about 4,500 yrs B.P.

Lake sediments from Balugaon, Orissa have indicated that the deposit is 1,400 yrs old, but the sediments from Paradip are much younger (450 yrs B.P.).

G. Rajagopalan

Subproject I.D.11.2. : Fission Track dating of rock samples

Objective : *Dating of rocks and minerals by Fission Track method*

The glauconite samples given by PRL have been F-T dated. Of those, two samples from Crimea, Russia have given quite younger F-T ages (19 ± 3 Ma & 18 ± 2 Ma respectively) compared to the expected values (Cretaceous age). The third sample from Langpar-Mahadek Section, Meghalaya has given the age of (64 ± 16 Ma) which compares well with the stratigraphic age (C-T boundary). The results are being campared with trace elements studies.

One gabbro rock sample from Ganga Valley has been processed for F-T dating. Approximtely 10 grains of apatite mineral were separated using Isodynamic Magnetic Separator. After counting the fission tracks on the surface of fossil and induced apatite grains, the F-T age (1320 $\pm$ 68 Ma) has been obtained. It indicates the presence of rocks contemporary to Vindhyans under the Ganga alluvium.

The etching of fission tracks on the induced surface of collophane had been tried in various concentration of HCl, HNO_3, H_2SO_4, etc. but no proper track revealation had been possible. More etchants are being tried.

G. Rajagopalan and A. P. Srivastava

Subproject I.D.11.3. : Setting up of K-Ar dating laboratory

Objective : *To establish the K-Ar dating laboratory*

The assembling of the Argon extraction and purification system has been completed to a large extent. A number of glass and metal components have been fabricated in house for trapping and gettering of argon. The ultra high vacuum (UHV) components as well as analyser have been assembled on a single syndanio-top table. A diffstak (combined rotary and diffusion pump) pumping unit and an ion-pump have been joined to the system. Using diffstak alone, vacuum in the range of 10-7mb has been obtained in the whole assembly including the analyser part of the extraction-purification system and the ion pump in dynamic mode. Pirani gauge and ion gauge have been connected for high vacuum measurement in the system. This level of vacuum is an order of magnitude improvement over the previous level and has been attained by repeated baking and sustained leak hunting. The new assembly of the analyser, with the additional coupling and a valve, is aimed at improving sensitivity of mass spectrometer. The coupling is being tested for use in static analysis. The flame photometric potassium determination has been carried out routinely and several useful standards have been collected for the purpose.

G. Rajagopalan and C. M. Nautiyal

Project I.D.12. : Environmental and depositional studies in modern sediments

Subproject I.D.12.1. : Study of Kerala mud-banks and estuaries to develop a suitable analogue to understand ancient sediments

Objective : *To understand the depositional environment of mud-bank and to develop a profile of palynological suites in marginal areas*

About 50 samples from the Vemband Lake and Kerala mudbank were macerated. All the samples are rich in spores, pollen grains and phytoplankton. Pollen slides of

the living taxa were studied to identify spores and pollen grains. It was found that littoral forest elements are more common in the assemblage than the montane ones.

B. S. Venkatachala, R. K. Kar, M. Kumar, C. K. Rajendran, T. R. Ramachandran and A. S. K. Nair

Subproject I.D.12.3. : Diatom biostratigraphy of the core samples from D. S. D. P. (Site 218)

Objective : *Morphotaxonomy, palaeogeography and palaeoecology of the Cenozoic diatoms*

Fifty-two core samples from the Bengal Fan were chemically analysed for the recovery of diatoms. Technique has been modified to clean the diatom frustules. Low concentration of sodium pyrophosphate was found to be useful in removing the clay particles. Out of 15 productive samples, only a few are rich in diatom frustules. Morphotaxonomical studies reveal the predominance of centric diatoms over the pennate ones. Some of the important taxa are *Coscinodiscus*, *Hemidiscus*, *Thalassiosira* and *Actinocyclus*.

Anil Chandra

Project I.D.13. : Atlases of stratigraphically and ecologically significant Indian fossil taxa and fossil floras

Subproject I.D.13.1. : Catalogue of stratigraphically significant palynofossils in the Indian Gondwana sediments

Objective : *Cataloguing of stratigraphically significant palynofossils*

To circumscribe the limits of species in four pollen genera, viz., *Callumispora*, *Parasaccites*, *Crucisaccites* and *Faunipollenites*, the type specimens have been studied in detail. These type specimens and other similar specimens have been photomicrographed and assessment for this delimitation of various species has been done.

R. S. Tiwari, Suresh C. Srivastava, Archana Tripathi and Vijaya

Subproject I.D.13.2. : Software development for morphotaxonomy and palynostratigraphy

Objective : *To update data bank on palynology of Gondwana related sediments and to develop software for morphography of taxa and palynostratigraphy*

The reference cards of new literature on palynology and related aspects have been prepared to update the data bank. To develop the software for morphotaxonomy the data

concerning broader categories of Potonié classification for sporae dispersae is being sorted out in terms of morphographic variables. The points for generic retrieval have been identified for trilete group and similar attempts are being done for other group of sporae dispersae.

R. S. Tiwari, Suresh C. Srivastava, Archana Tripathi, Vijaya, B. N. Jana, Neerja Jha, Ram Awatar, K. L. Meena, A. P. Bhattacharya and G. Rajagopalan

Subproject I.D.13.3. : An atlas of Tertiary palynofossils

Objective : *To catalogue stratigraphically significant palynofossils*

About 300 index cards of spore pollen species recorded from the different Tertiary localities of Kutch, Assam, Meghalaya, Palana, Neyveli, Varkala, Quillon, Cauvery Basin, etc. have been prepared

B. S. Venkatachala, R. K. Kar, R. S. Singh, Asha Gupta, Alpana Singh and G. K. Trivedi

Subproject I.D.13.4. : An atlas of Jurassic-Cretaceous plants of India

Objective : *To prepare a catalogue of Indian Jurassic-Cretaceous plants*

Morphotaxonomic studies on *Equisetites*, *Hausmannia*, *Matonidium*, *Phlebopteris* and *Cladophlebis* species from Kutch have been caried out. Illustrations showing the morphology have also been prepared.

Sukh Dev

Project I.D.14. : Deccan Intertrappean Flora

Objective : *Critical reinvestigation of the flora to trace the phylogeny and evolution of angiosperms, phytogeography and ecology of Tertiary Deccan flora*

An analysis of the Deccan Intertrappean flora and its stratigraphic implications has been done.

M. B. Bande, Anil Chandra and B. S. Venkatachala

A fossil wood of *Ailanthus* has been identified from Mandla District and the woods assigned to the genus *Ailanthoxylon* have been reviewed. Critical observation on *Polyalthioxylon parapaniense* described from Parapani, Mandla District has been made based on the material collected from Ghughua.

An araucarian seed-scale has been studied from Mohgaon Kalan.

R. C. Mehrotra

Project I.D.15. : **Siwalik flora and its stratigraphical implications**

Objective : *Floral composition of the Siwalik Group, palaeoecology and phytogeography of the Himalayan foot-hills during the period*

Subproject I.D.15.1. : **Siwalik plant megafossils**

Objective : *Comparative morphology, floristics, palaeoecology and phytogeography*

Ten leaf-impressions from the Lower Siwalik beds near Tanakpur, Nainital District have been identified as *Diospyros*, *Mimusops*, *Erythrina*, *Terminalia*, *Cordia*, *Litsea*, *Cryptocarya*, *Mallotus*, *Trewia* and *Ficus*.

Identification and photodocumentation of ten different types of leaves from North Bengal have been completed.

N. Awasthi and J. S. Antal

Leaf-impressions collected from Mahendra Raj Marg, Surai Khola, Nepal were studied in detail and photographed. They have been identified with 27 extant taxa belonging to both monocots and dicots. This assemblage includes a number of tropical evergreen elements which are quite significant for the assessment of palaeoclimate and phytogeography of the Himalayan foot-hills.

N. Awasthi and Mahesh Prasad

Subproject I.D.15.2. : **Studies of plant fossils from Siwalik sediments around Jwalamukhi-Ranital, Himachal Pradesh**

Two leaf-impressions from the Lower Siwalik beds near Balugoloa have been studied. They have been identified as *Fissistigma* and *Terminalia* (Combretaceae).

R. N. Lakhanpal

Subproject I.D.15.3. : **Palynological study of the Siwalik sediments from Surai Khola area, Nepal**

Objective : *Systematic palynology, biozonation and palaeoecology*

Palynological investigations of the Siwalik samples from Surai Khola area of Nepal have been partly carried out. A rich palynological assemblage has been recovered.

Morphotaxonomical study of palynotaxa is underway. A number of palaeoassociations of taxa have been identified from various stratigraphic levels indicating an interplay of evergreen vegetational pattern during Siwalik times in the area of study. Preliminary palynological data demonstrates the existence of fresh water swamps.

Samir Sarkar

Project I.D.16. : Plant remains from pre-and protohistoric sites in India

Objective : *Plant economy of ancient India*

Subproject I.D.16.1. : History of economic crops and other plants from pre- and protohistoric sites

Objective : *To trace palaeobotanical history of crops and other plants*

Remains of some medicinal plants recovered from excavations at Khairadih and Narhan on the bank of Ghaghra River in Ballia and Gorakhpur districts respectively have thrown fresh light on the use of herbal drugs in northern India during 600-200 B.C. Khairadih finds comprise fruit remains of *Phyllanthus emblica, Terminalia chebula* and *Buchnania lanzan*, a broken grape seed (*Vitis vinifera*), kernel of Jaiphal (*Myristica fragrans*) and wood charcoal of *Aegle marmelos*. *P. emblica* and *Santalum album* were found at Narhan. All the plants are valued in current Ayurvedic system of medicine. Grape seed, sandalwood and nutmeg were recovered from far beyond the confines of northern India. Possibly, the currants and raisins were obtained from north-west Indian subcontinent. Sandalwood bears ample testimony of reciprocity, exchange and trade of ancient cultures in northern India with those of southern India. Nutmeg is native of Moluccas, northern Celebes, Sangih Islands and North and West Sumatra. The evidence of nutmeg depicts maritime connections of ancient India with far-eastern and southeastern countries.

K. S. Saraswat, D. C. Saini and N. K. Sharma

Remains of carbonised seeds and fruits recovered from Black and Red Ware and Black-slipped Ware Cultures at Narhan in Gorakhpur District, throw light on an advanced agriculture practiced by the ancient settlers at this site during (ca. 1,000-600 B.C.). The cereal remains are : *Oryza sativa, Triticum sphaerococcum, T. compactum* and *T. aestivum*. *Pisum sativum, Vararvense, Vigna radiata, Cicer arietinum* and *Lathyrus sativum* have been identified as pulse crops. The seeds of *Lathyrus aphaca* and *Vicia sativa*, which are usually weeds in winter crops, have also been found. The remains of oilseed-crops comprise *Brassica juncea, Linum usitatissimum* and *Carthamus tinctorious*.

The sole record of carbonised seeds belonging to *Artocarpus integrifolius* from Narhan is the first report from the Indian subcontinent.

An impression of a fishing hook with a small part of thread on a mud clod was also studied. The microscopic study of the fibre fragment recovered from the thread impres-

sion on mud clod reveals that the fishing thread was made up of ramie fibre (*Boehmeria nivea*), which is the most resistant quality fibre against the effect of water.

K. S. Saraswat and N. K. Sharma

Subproject I.D.16.2. : *History of early domestication of plants*

Objective : *To work out usefulness of wild plants in ancient times and the origin of cultivars*

The wood charcoals recovered from different cultural horizons of Northern Black Polished (N.B.P.) Ware Phase (ca. 600 B.C.) at Kausambi in Allahabad District were sectioned and tentatively identified on anatomical grounds. They belong to taxa of Combretaceae, Meliaceae, Fabaceae and Bambusaceae. A few kernels of barley (*Hordeum vulgare*) and seeds of cotton (*Gossypium arboreum/herbaceum*) have also been identified.

Chanchala

Wood charcoals from calcolithic Sringaverapura in Allahabad District, dating back to ca. 1,050-700 B.C. have been studied anatomically. They belong to *Pinus roxburghii*, *Acacia* sp., *Zizyphus* sp., *Mangifera indica*, *Albizia lebbeck*, *Mesua ferrea*, *Betula utilis* and Bamboo. The ancient settlers exploited *Pinus roxburghii* and *Betula utilis* from the Himalayan forests and *Mesua ferrea* from Assam region. These elements are suggestive of wide range forest resource utilization.

The ancient grains of *Oryza sativa*, *Hordeum vulgare*, *Triticum spherococcum*, *T. compactum*, *Vigna radiata* and *Cicer arietinum* are suggestive of rich and varied agriculture. Additional evidence of rice and barley cultivation have been sought in the silicified fragments of husk and leaf cuticles. Cuticle remains of palm (*Phoenix* sp.) and Khus-grass (*Vetiveria zizanioides*) have also been encountered.

K. S. Saraswat

Project Sp. 1. : Geology, palaeobiology, geochemistry and isotopic composition of Archaean sediments of India

Objective : *To search stromatolitic structures and organic remains in the Archaean sediments and their evaluation*

A concentrated effort to study the records of biogenic and chemogenic processes in Archaean sediments of India has been taken up jointly with National Geophysical Research Institute, Hyderabad and Bhabha Atomic Research Centre, Bombay. The results achieved fill the information gap between the oldest authentic records of life from Warrawoona Group, Australia (3.5 Ga), Fortesque Group, Australia (2.8 Ga) and some of the younger known Proterozoic microbiota.

Silicified cyanobacterial remains are recorded from the black cherts interbedded in the Donamalai Formation of the Archaean Sandur Schist Belt (2.9-3.0 Ga) and amorphous organic matter has been recorded in the stromatolites underlying Deogiri Formation of the same belt. The presence of elemental carbon at the fringes of the cyanobacteria is confirmed by microprobe analysis. Presence of cyanobacteria along with carbon ($S13C = -1.4+0.5\%$ vs PDB) and oxygen ($S180 = +10.6+0.5\%$ vs SMOW) isotopic ratios extended the existence of photosynthetic activity into the Archaean.

Stromatolites have been found in the cherty dolomite member of the Vahivilas Formation of Chitradurga Group belonging to 2.6 Ga old Archaean Dharwar Supergroup, South India. They occur in Bhimasamudra, Marikanve and Dodguni areas of the Chitradurga Schist Belt. The Bhimasamudra stromatolites consist of pseudocolumnar and columnar types. The pseudocolumnar developed on a wavy base and have concave tops. The columnar variety exhibits terete and cylindrical forms, both of which have well-developed walls, although some naked columns have been noted. The cylindrical forms show V-type branching; coalescing and branching habits have been noticed. Convexity of horizontal septa varies from gently to strongly convex.

The Marikanve stromatolites are stratiform, often grading into pseudocolumnar and domical types.

Naked stromatolite columns showing B-type as well as markedly divergent branching are found in Dodguni area.

Syngenetic cyanobacterial filamentous microfossils recognised in thin sections of the stromatolitic cherts of Bhimsamudra and Marikanve indicate that the Archaean stromatolites of Chitradurga belt were built by cyanobacteria. The stromatolites developed on shallow marine shelf. The Bhimsamudra stromatolites probably developed in a high energy, shallow water environment which often witnessed desiccation. The Marikanve stromatolites, however, suggest continued wet conditions.

Scanning Electron Microscopic study of the Archaean (2.6 Ga old) banded Iron Formation of the Bababudan Group, Dharwar Super group reveals the presence of coccoid and rod-shaped bacteria in syngenetic pyrite grains of the Kudremukh Iron-Formation. They resemble sulphur reducing bacteria. The synsedimentary nature of this bacteria along with pyrite is being worked out in collaboration with scientists of National Geophysical Research Institute, Hyderabad.

B. S. Venkatachala, Manoj Shukla, Vinod K. Yadav, Mukund Sharma and Rajendra Bansal

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME

I.G.C.P. Project 166 : Global correlation of coal bearing formations

G. K. B. Navale, Assistant Director
Member, National Working Group

I.G.C.P. Project 196 : Numerical calibration of Geological Time Scale

Out of three blind check samples of glauconite sent by Dr G. S. Odin, France two have been dated by Fission Track method. The results agree well with respective K-Ar ages of these samples.

A. P. Srivastava, Senior Scientific Assistant
Member, National Working Group

I.G.C.P. Project 216 : Global biological events in earth history

K. P. Jain, Assistant Director
Member, National Working Group

I.G.C.P. Project 237 : Precambrian to Tertiary floras of the Gondwana continents

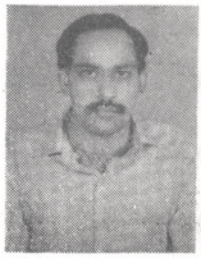
Hari K. Maheshwari, Assistant Director
Co-convener, National Working Group

I.G.C.P. Project 237 : Precambrian to Tertiary floras of the Gondwana continents

R. S. Tiwari, Assistant Director
Member, National Working Group

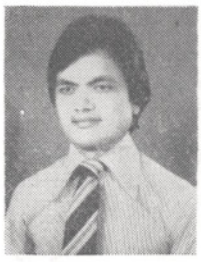
DOCTORATE DEGREE AWARDED

Rakesh C. Mehrotra : Ph.D. Degree by the Lucknow University for his work entitled "Further contribution to the knowledge of the Deccan Intertrappean flora of India".



Dr R. C. Mehrotra

Bhagwan D. Singh : Ph.D. Degree by the Banaras Hindu University for his work entitled "Organic petrology and chemical studies of coal seams of Singrauli Coalfield, Son Valley, Madhya Pradesh, India".



Dr B. D. Singh

Rashmi Srivastava : Ph.D. Degree by the Lucknow University for her work entitled "Contribution to the fossil woods of Deccan Intertrappean flora of Madhya Pradesh, India".

Dr Rashmi Srivastava

DOCTORATE THESES SUBMITTED

Annamraju Rajanikanth	: "Contribution to the Mesozoic flora from the Pranhita-Godavari Valley and East-Coast of India."
Kalyan L. Meena	: "Biological life from the Precambrian of Vindhyan"
Mahesh Prasad	: "Studies on the plant fossils from the Siwalik Group"
Mohan S. Chauhan	: "Origin and history of tropical deciduous forest, Madhya Pradesh"

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Anand-Prakash, Singh, T. & Srivastava, Suresh C.—Occurrence of faunal coal balls in Gondwana sediments (Permian), Arunachal Himalaya, India. *Coal Geology.*

Awasthi, N. & Lakhanpal, R. N.—Addition to the Neogene florule from near Bikhnathoree, West Champaran District, Bihar. *Palaeobotanist.*

Bajpai, Usha—Floristics, age and stratigraphical position of fossiliferous band in Chitra mine area, Saharjuri Outlier, Deogarh Coalfield, Bihar. *Palaeobotanist.*

Bande, M. B., DeChamps, R., Lakhanpal, R. N. & Prakash, U.—Some new fossil woods from the Cenozoic of Zaire. *Annual Report Geol. Dept. Mus. Afr. Cent., Tervuren.*

Banerji, Jayasri—Addition to the Mesozoic flora of Kutch, Gujarat. *Geophytology.*

Gupta, H. P. & Sharma, Chhaya—Palynostratigraphy and palaeoenvironments : Ningle Nullah, Lower Karewa, Kashmir. *Palaeobotanist.*

Gupta, H. P. & Sharma, Chhaya—Palynostratigraphy and palaeoenvironments : Hirpur Loc. I., Lower Karewa, Kashmir. *Palaeobotanist.*

Gupta, H. P. & Sharma, Chhaya & Ram Ratan—A new pollen type *Arecicolpites hirpurensis* gen. et sp. nov. from Hirpur Formation (Lower Karewa), Kashmir Valley. *Palaeobotanist.*

Gupta, H. P. & Yadava, R. R.—Interplay between pollen rain and vegetation of the tarai/bhabar zone in Kumaon Division, U. P., India. *Palaeobotanist.*

Jafar, S. A.—Fe-micrometeorites with Early Cretaceous plant fossils of Trambau, Kutch, western India.

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Khandelwal, A. & Gupta, H. P.—Diatom analysis of Kua Tal, District Nainital, Kumaon Himalaya, U. P. *Palaeobotanist.*

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Kumar, P.—Fungal remains from Kerala Coast, South India. *Rev. Palaeobot. Palynol.*

Lakhanpal, R. N., Tiwari, A. P. & Awasthi, N.—Occurrence of Bamboo in the Siwalik beds near Ranital, Himachal Pradesh. *Palaeobotanist.*

Maheshwari, H. K., Singh, V. K. & Bajpai, Usha—Venation pattern in sphenophyll *Trizygia speciosa* Royle from the Raniganj Formation. *Palaeobotanist.*

Maheshwari, H. K., Singh, V. K. & Bajpai, Usha—*Bengalia raniganjensis*, a new sphenopsid from the Raniganj Formation (Upper Permian). *Palaeobotanist.*

Maithy, P. K. & Babu, R.—The mid-Proterozoic Vindhyan macrobiota from the Chopan, South-east Uttar Pradesh.

Mehrotra, R. C.—A new fossil dicot wood from the Deccan Intertrappean beds of Mandla District, Madhya Pradesh. *Palaeobotanist.*

Mehrotra, R. C.—Occurrence of a solenoporoid alga in the Deccan Intertrappean beds of Mohgaonkalan, Chhindwara District, Madhya Pradesh. *Palaeobotanist.*

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Rajendran, C. P., Raha, P. K. & Kar, R. K.—Palynological correlation of subsurface and surface sediments of Kerala Coast, India. *Q. Jl geol. Min. metall. Soc. India.*

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FIELD WORK

Nauhatta and Chutiya for geological mapping and collection of megascopic biota from the Vindhyan Sequence.

P. K. Maithy, Rupendra Babu, Kedar Narayan and A. Sarkar

Semri Group, Vindhyans exposed around Neemuch and Chittorgarh.

P. K. Maithy and Rupendra Babu

Vindhyan exposures in South-west Rajasthan for comparison with the earlier work done at the eastern exposures in Chopan, Son Valley, Mirzapur District and Chitrakut, Banda District. Samples of base rock Bearch granite and other glauconitic sandstones from various localities near Chittorgarh and Rawat Bhata have been collected.

G. Rajagopalan and Abhay P. Srivastava

Plant megafossils and samples for bulk maceration were collected from the Raniganj Formation of Mahuda sub-basin, Raniganj Coalfield and Rajmahal Hills.

H. K. Maheshwari, Usha Bajpai, H. N. Boral and V. K. Singh

K. D. M. Institute of Petroleum Exploration, Dehradun to collect drill core samples of Lakhpat and Suthri well of Kutch Basin.

B. N. Jana

Outcrop samples were collected from Nidpur area (Son Valley) for palynological investigation and several new sections were traversed.

R. S. Tiwari and Ram Awatar

Collected samples for palynological investigation from Gondwana Sequence in new areas of Son-Mahanadi Graben, Madhya Pradesh and Orissa.

R. S. Tiwari, Archana Tripathi, Vijaya and A. P. Bhattacharya

Visited Bokaro and Raniganj coalfields for collection of samples for palynological studies.

R. S. Tiwari, Vijaya and K. L. Meena

An excursion was undertaken to Khasi and Jaintia Hills, Meghalaya to collect rock samples and field data from the Cretaceous-Palaeocene section.

K. P. Jain and Rahul Garg

Palynological samples collected from upper part of Jhuran Formation and lower part of Bhuj Formation in the Kutch Mainland Basin (B. S. I. P./O. N. G. C. collaborative project).

K. P. Jain, H. K. Maheshwari and Rahul Garg
S. B. Deshpande (ONGC)

Siang and Subansiri areas of Arunachal Himalaya and Naya Bazar area of Sikkim Himalaya to collect coal and associated shale samples from Gondwana and Upper Tertiary sediments for biodiagenetic and palynological studies.

Suresh C. Srivastava and Anand Prakash

Systematic sampling, coupled with field data of Lathi, Jaisalmer, Bhadesar and Parihar formations.

S. A. Jafar and Jyotsana Rai

Collected samples from Duarmara 2 and Telani 7 bore-hole cores from Oil India Limited, Duliajan.

R. K. Kar

Tura Formation, Garo Hills, Meghalaya to collect samples for palynological studies.

K. Ambwani

Langrin Coalfield, Meghalaya to collect samples for palynological studies.

R. S. Singh

Jarain colliery, Meghalaya to collect samples for palynological studies.

Madhav Kumar

One hundred eightysix samples from two bore-holes drilled by the Central Ground Water Board in South Arcot District, Tamil Nadu were collected for palynological studies.

R. K. Saxena

West Siang District, Arunachal Pradesh to collect samples from the Tertiary sediments for palynological studies.

S. K. M. Tripathi

Field work in the Cannanore District, Kerala was carried out and 95 samples of lignite and associated sediments were collected from Meenkunnu, Azhikud, Karyankod, Payangadi and Nileshwar. Sixty two samples from three bore-hole drilled by the Central

Ground Water Board in Alleppey District, Kerala were collected for palynological study.

M. R. Rao

Collected fossil woods from near Jaisalmer and Bharauch. Discovered some new fossil localities in Gujarat.

J. S. Guleria

Palamau District, Bihar for collection of fossil plants and Herbarium material.

M. B. Bande, G. P. Srivastava and Diwakar Pradhan

Foot-hills in North Bengal for collection of leaf-impressions from Siwalik beds near Siliguri, Jalpaiguri District.

N. Awasthi and J. S. Antal

Surai Khola and Arjun Khola, Nepal for collection of megafossils and palynological material from the Siwalik beds.

N. Awasthi, Mahesh Prasad and Samir Sarkar

Mahanadi Delta in Orissa to collect surface samples and soil profiles from Chilka Lake and Paradip for palynological investigations.

H. P. Gupta and R. R. Yadav

Kumaon Himalaya to survey and collect material from the lakes.

Chhaya Sharma and M. S. Chauhan

A Mesolithic site at Damdama in Pratapgarh District of U. P. (*Ca* 10,000 B.C.) to collect seed samples to unveil the food gathering habit of late stone age man.

K. S. Saraswat and D. C. Saini

An ancient mound in Senuwar Village, District Sasaram (Rohtas), Bihar to collect plant remains recovered through archaeological excavation, with a view to determine the Neolithic-Chalcolithic plant economy.

K. S. Saraswat

Collected research material of Painted-Grey Ware and Kushana's Culture (C. 600 B.C.—400 A.D.) from Hulas-Khera, in Mohanlalganj Tehsil of Lucknow District.

Chanchala and N. K. Sharma

Collected stromatolites from the Archaean sediments of Chitradurga Schist Belt and Sandur Schist Belt, Karnataka.

Manoj Shukla

PAPERS PRESENTED AT SYMPOSIA/CONFERENCES/ MEETINGS

Abhay P. Srivastava—*F-T dating of stratigraphy using authigenic mineral glauconite.* Fifth National Seminar on SSNTD, Saha Institute of Nuclear Physics, Calcutta.

Abhay P. Srivastava & G. Rajagopalan—*F-T dating of glauconite.* Sixth International Conference in Geochronology and Isotope Geology, Cambridge.

Abhay P. Srivastava, G. Rajagopalan & H. S. Virk—*F-T age of a petrified wood from Bijou Basin, Colorado State, U.S.A.* Fifth National Seminar on SSNTD, Calcutta.

Amalav Bhattacharyya—*Dendroclimatic research in India.* International Symposium on palaeoclimatic and palaeoenvironmental changes in Asia during the last 4 million yrs, Ahmedabad.

Archana Tripathi—*Dubrajpur Formation and its palynodating.* XII Indian Colloquium on Micropalaeontology and stratigraphy, Delhi.

Ashwini K. Srivastava—*Evolutionary tendency in Glossopteridae.* IX Indian Botanical Congress, Madras.

Bhagwan D. Singh—*Organic petrological studies of Permian coal seams in Singrauli, Son Valley.* National Conference in Coal Resources of India, Varanasi.

Chhaya Sharma—*Palaeovegetation and palaeoenvironmental interference from the Quaternary palynostratigraphy of Himachal Pradesh and Kumaon.* International Symposium on palaeoclimatic and palaeoenvironmental changes in Asia during last 4 million years, Ahmedabad.

Chanchala—*Wood remains from Neolithic Gufkral, Kashmir Valley.* Annual Conference of the Indian Archaeological Society, Varanasi.

Garud K. B. Navale—*Characterization of Permian coals of India.* National Conference on Coal Resources of India, Varanasi.

Jaswant S. Guleria—*Fossil woods from Tertiary sediments near Jaisalmer, Rajasthan and their bearing on the age of "Shumar Formation.* Special Indian Geophytological Conference, Pune.

Kripa S. Saraswat—*On the remains of some medical plants from the Ghagra Valley cultures* (C. 600-200 B. C.). Annual Conference of Indian Archaeological Society, Varanasi.

Krishna P. Jain—*Fossil radiolaria from India : A review.* XII Indian Colloquium on Micropalaeontology and stratigraphy, Delhi.

Madhav Kumar—*Palaeocene spores and pollen grains from Jarain Coalfields, Meghalaya.* IX Indian Botanical Congress, Madras.

Mohan B. Bande, Anil Chandra & B. S. Venkatachala—*Deccan traps : Floristics and their stratigraphic implication.* I.A.P. Symposium on Palaeocene of India—Limits and Subdivisions, Lucknow.

Narendra K. Sharma—*Plant economy at ancient Narhan* (C. 1,000-600 B.C.). Annual Conference of the Indian Archaeological Society, Varanasi.

Rahul Garg—*Significance of dinoflagellate cysts in resolution of Palaeocene time boundaries with special reference to Cherrapunji-Therriaghat area, Meghalaya.* I. A. P. Symposium on Palaeocene of India—Limits and Subdivisions, Lucknow.

Rahul Garg, Krishna P. Jain & Jaikrishna—*Dinoflagellate cyst assemblages from Index Upper Jurassic Ammonoids from India.* XII Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi.

Ram S. Tiwari—*Palynological evidence for Permo-Triassic boundary in India.* Symposium on Coal Resources of India, Varanasi.

Ram S. Tiwari—*Reassessment of palynological dating of Krol-Belt.* XII Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi.

Ramesh K. Saxena—*Significance of spores and pollen grains in Palaeocene biostratigraphy of India.* I. A. P. Symposium on Palaeocene of India—Limits and Subdivisions, Lucknow.

Ramesh K. Saxena—*Neogene palynofloras of India and their stratigraphic significance.* XII Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi.

Sayed A. Jafar—*Fallacious status of Palaeocene in Kutch Basin.* I.A.P. Symposium on Palaeocene of India—Limits and Subdivisions, Lucknow.

Sayed A. Jafar & Jyotsana Rai—*Problems and Prospects of Nannoplankton Research in India.* XII Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi.

Sukh Dev & Annamraju Rajanikanth—*The Gangapur Formation : Plant life and stratigraphy.* Special Indian Geophytological Conference, Pune.

Suresh C. Srivastava & Neerja Jha—*Reappraisal of Permian Sequence in Godavari Valley coalfields, Andhra Pradesh, India.* Symposium on Coal Resources of India, Varanasi.

Vijaya—*Gondwana affinities in palynofloras of circum Tethys-realm during Permo-Triassic times.* XII Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi.

LECTURES DELIVERED

Abhaya P. Srivastava—F-T dating of stratigraphy using authigenic mineral glauconite. Calcutta.

Govindraja Rajagopalan—Radiocarbon dating of some of the Quaternary deposits in India. Presidency College, Calcutta.

Hari K. Maheshwari—*An introduction of Palaeobotany* (two lectures) for short term course in Palaeontology and Stratigraphy under COSIP-ULP-GEOL. Banaras Hindu University, Varanasi.

Krishna P. Jain—*Fossil dinoflagellates—An introduction.* M.Sc. (Special) Students, Department of Geology, Lucknow University, Lucknow.

Syed A. Jafar—*Calcareous Nannoplankton : An introduction.* M.Sc. (Special) students. Department of Geology, Lucknow University, Lucknow.

B. S. Venkatachala—*An introduction to Palynology* (two lectures) for short term course in Palaeontology and Stratigraphy under COSIP-ULP-GEOL. Banaras Hindu University, Varanasi.

B. S. Venkatachala—*Botanzing in rocks*, Prof. Panchanan Maheshwari Memorial Lecture. University of Delhi, Delhi.

B. S. Venkatachala—*Palaeocene of India.* Keynote Address, Indian Association of Palynostratigraphers. Birbal Sahni Institute of Palaeobotany, Lucknow.

B. S. Venkatachala—*Palynology in Gondwana Coal Exploration in India.* Keynotes Address, University of Delhi, Delhi.

B. S. Venkatachala—*Origin and antiquity of life.* Prof. M. O. P. Iyenger Centenary celebrations, Centre of Advanced Study in Botany, Madras.

TECHNICAL ASSISTANCE RENDERED TO OTHER AGENCIES

A. Training Provided

The Institute provided training both in palaeobotanical as well as palynological studies to the following scientists from other organisations :

Shri N. N. Dogra, Centre of Advanced study in Geology, Panjab University, Chandigarh in Palynology of Gondwana sediments.

Shri Hariharan, Geologist, Neyveli Lignite Corporation, Tamil Nadu in lignite microscopy.

Miss Meera Pandey, Wadia Institute of Himalayan Geology, Dehradun, Precambrian biota

Shri S. Rabindranath, I. I. T., Bombay on Nannoplankton studies.

B. Technical Assistance

This is one of the important aims of the Institute and thus the expertise assistance has been provided to the following organisations this year :

Centre of Environmental Education, Ahmedabad

Technical advice was provided in connection with the exhibition on "Evolution of life".

Geological Survey of India

Identification of biota recovered from Blaini-Krol Sequence of Garhwal.

Palynological dating of some bore-core samples from Rajmahal, Raniganj and Panagarh basins and Godavari Graben.

Neyveli Lignite Corporation

Rank determination of 3 bore-core samples.

Central Mining, Planning and Design Institute of Coal India Ltd.

Type and rank evaluation of Umaria, Korar and Rajmahal coals.

Oil and Natural Gas Commission

Fission Track dating of the apatite mineral grains in gabbro-rock samples from Ganga Valley.

Wadia Institute of Himalayan Geology, Dehradun

Geological, biopetrological and maturation studies of Gondwana and Upper Tertiary coals from Arunachal Himalaya.

Central Ground Water Board, Jamshedpur

Pollen analyses of samples from Negu, Midnapur, West Bengal.

Directorate of Geology and Mining

Analysis of four samples for diatoms.

DEPUTATION/TRAINING/STUDY ABROAD

Abhaya P. Srivastava

Participated in the VI International Conference on "Geochronology, Cosmochronology, and Isotope-Geology" held at the Department of Earth Sciences, Cambridge, U. K. from 30th June to 4th July, 1986. In this conference he presented a paper 'F-T dating of glauconites' in the Symposium on 'Phanerozoic and Prephanerozoic Time Scale Calibration'. He also visited several colleges and departments of Cambridge University, Museum of Archaeology and George Museum of Fossils in the Department of Archaeology and Earth Sciences at Cambridge.

Amalava Bhattacharyya

Under Indo-US Monsoon Research Programme he was deputed for advanced training in Dendrochronology from August 10, 1983 to September 30, 1986. While returning he also visited Geology Department, Botany Department, etc. of King's College in London and Swiss Federal Institute of Forestry Research, Switzerland.

Ram R. Yadav

Visited Tree Ring Laboratory of Geological Observatory, Columbia University, New York and University of Arizona, USA from 20th October, 1986 to 15th December, 1986.

TRAINING COURSES ATTENDED OUTSIDE BY INSTITUTE STAFF

Training Programme on personal computer	:	Wipro Information Technology Ltd., New Delhi, August, 1986
Personal Secretaries	:	Institute of Technology and Management System, New Delhi, August, 1986
Computer System, appreciation and application	:	Institute of Management Development, Lucknow, November, 1986-January, 1987
Management-Information System	:	—DO—
Double Entry System of Accounting	:	—DO—
Effective processing and Decision making	:	—DO—
Computers in Library Management and Information Handling	:	Central Drug Research Institute, Lucknow, March, 1987
Use of Electron Microscope and allied techniques in Biology	: :	Regional Sophisticated Instrumentation Centre, C. D. R. I., Lucknow, March, 1987

COURSES/LECTURES IN THE INSTITUTE BY OUTSIDE SCIENTISTS

Dr V. H. Meher-Homji Institut Francais de Pondichery, Pondichery	: Vegetation and Bioclimate in India. May, 1986
Dr J. M. Dickins Bureau of Mineral Resources, France	: Permian Reconstruction and Position of India. May, 1986
Dr C. Caratini Centre Etudes Geographic Talence, France	: Palaeoenvironmental Reconstruction of Mahakam Delta from Upper Pliocene to Recent. June, 1986
Dr S. M. Mathur Geological Survey of India, Lucknow	: Stratigraphy and Some Geological Aspects. July, 1986
Prof. C. Manoharachari Osmania University, Hyderabad	: Soil Fungi. November, 1986
Prof. K. K. Swaminathan Administrative Staff College of India, Hyderabad	: Interpersonal Relationship in Management. November, 1986
Dr Eric Buffetaut Laboratoire des Palaeontologie Vertebres, Paris VI, France	: Gondwana Flora. November, 1986
Prof. Denis E. B. Bates, University College of Wales, U.K.	: The Celedonian Plate Tectonic Implications. November, 1986
Prof. J. W. Schopf, Institute of Geophysics and Planetary Physics, Centre for the Study of Evolution and Origin of Life (CSEOL), University of California, U.S.A.	: Status of Precambrian Palaeobiology. November, 1986
Prof. D. D. Pant, Allahabad Prof. P. S. Ramakrishnan, New Delhi	: Glossopteris Flora. March, 1987 Ecology of Rain Forests, March, 1987

PULBICATION AND INFORMATION SECTION

Publication

The Palaeobotanist

The format and size of the Institute journal has been changed and it is now being printed by photo-offset process. During the year number 1 of Volume 35 was brought out. Manuscripts of the second issue were also processed and sent to press for publication.

Birbal Sahni Memorial Lecture

The fourteenth lecture entitled on the 'Mixed Permian floras of Gondwana and Cathaysia or Euramerica' delivered by Prof. Li Xingxue, Nanjing Institute of Geology and Palaeontology, China was published. The sixteenth lecture entitled "Our oldest rocks and the early record of life" delivered by Dr B. P. Radhakrishna, Geological Society of Bangalore was sent for publication.

Sir Albert Charles Seward Memorial Lecture

The thirty-third lecture entitled "Analysis of some palaeogeographic and palaeoecologic problems of palaeobotany" by Daniel I. Axelrod, Department of Botany, University of California, Davis (USA) was published.

Annual Report

The Annual Reports, both in English and Hindi, were compiled and published. This year the publication of the Institute netted an income of Rs. 74,290.54 out of which about Rs. 27,843.28 were earned in foreign exchange approximately equivalent to US $ 1,645.20 plus £ 293.44.

Library

The Library of the Institute holds a large collection of books, journals, reprints, theses, reports, maps, and atlases. Their details are as follows :

Particulars	Position on 31.3.1986	Additions during 1986-1987	Total
Books	4028	94	4122
Journals	8177	102	8279
Reprints	30678	601	31279
Microfilms/fisches	290	—	290

Theses	56	7	63
Reports	46	—	46
Maps and Atlases	51	—	51
Reference Books	164	1	165

Eighty-one current periodicals are being subscribed by the Institute's Library.

The total number of registered borrowers of the Institute's Library is 136.

Exchange Programme

A special programme to disseminate and exchange the published palaeobotanical literature of the Institute is being carried out. The main achievements of this programme are :

(i) Number of research papers purchased for exchange	.. 21
(ii) Total number of reprints sent out in exchange	. 2569
(iii) Number of institutions on exchange	.. 58
(iv) Number of individuals on exchange	.. 425
(v) Number of periodicals on exchange	.. 69

Current Awareness Service

A Quarterly list of new addition to the library, i.e. books, reprints and journals as well as relevant subject titles selected from various journals was compiled in order to keep the readers in touch with the latest acquisitions in the Library. This service is also made available to other Indian scientific organisations and universities.

The services of the Library were also made available to scientists from other organisations and universities.

HERBARIUM

The Institute maintains a Herbarium for reference collection of herbarium sheets, wood specimens, wood slides, polleniferous material, pollen slides, fruits and seeds. The details of which are as follows :

Details	Position on 31.3.1986	Additions during the year	Total as on 31.3.1987
Hebarium sheets	10,880	238	11,118
Wood specimens	3,596	76	3,6712
Pollen slides	10,905	479	11,384
Wood slides	4,009	171	4,180
Fruits and seeds	1,873	15	1,888

Ninety four Herbarium specimens and 13 fruits and seeds belonging to about 65 species were collected from Mahudan, Palamau District, Daltonganj, Bihar.

The Herbarium also maintains exchange of wood specimens with institutions both from India and abroad.

Material received from

1. The Officer-in-Charge, Wood Anatomy Branch, F. R. I., Dehradun — 16 wood specimens

2. Prof. W. Lee
College of Forestry, Kangweon National University,
Chun Cheon 200, Korea — 60 wood specimens

Material sent to

Dr Pierre Detienne,
Chief de la, Division d' Anatomie des Bos, Centre Technique
Forestier Tropical, 45, Bis Uvenue de la Belle,
Gabrielle-94736, Nogent sur Marne, Cedex, France — 8 woods specimens

MUSEUM—A FOSSIL REPOSITORY

The Institute participated in the '*India on the move : Science and Technology Exhibition*' which was held in the Parliament House Annexe, New Delhi. With the help of a number of coloured charts and fossil specimens achievements and activities of the Institute were shown in it. A diarama depicting the coal-forming vegetation of Permian Period was also displayed. The members of Parliament, for whom this exhibition was organised, showed deep interest in our exhibits and achievements made so far by the Institute. A redisplay of these exhibits arranged at the Institute and local organisations were invited. Besides, expert advice and help were provided to the Centre for Environmental Education (Sarabhai Foundation), Ahmedabad for their exhibition on 'Evolution of Life'.

On 28th February, 1987 National Science Day was celebrated. A talk on the life and works of Professor C.V. Raman was arranged. The students of local schools and colleges were invited to attend this function and visit the Museum as well as laboratories of the Institute.

An alphabetical list of Research papers published by the Institute's scientists up to the year 1985-86 was prepared. This list enumerates only those papers of which type and figured specimens have been deposited to the repository of the Institute Museum.

In order to popularise the study of fossil plants, fossil specimens were gifted to 11 Indian and foreign educational institutions.

This year students of 17 educational institutions visited the Museum. Dignitaries from USA, USSR, West Germany, UK, Sri Lanka, Australia and France also visited the Museum and appreciated the displayed exhibits.

Some of the Institutions are :

1. Botany Department, Bihar University, Muzaffarpur, Bihar
2. Janta Mahavidyalaya, Etawah, U. P.
3. R. B. C. College, Naihati, West Bengal
4. Rajendra College, Chhapra, Bihar
5. D. A. V. College, Siwan, Bihar
6. Sibsagar College, Sibsagar, Assam
7. Cotton College, Gauhati, Assam
8. Ranchi University, Ranchi, Bihar
9. Tinsukhia College, Tinsukhia, Assam

10. Arya Vidyapith College, Gauhati, Assam

11. M. V. College of Science, Bhopal, M. P.

12. Allahabad University, Allahabad, U. P.

13. Sawai Madhopur College, Gangapur City, Rajasthan

14. Banaras Hindu University, Varanasi, U. P.

15. K. S. S. (P. G.) College, Faizabad, U. P.

16. Lucknow University, Lucknow, U. P.

17. Trainees of Indo-British Fertilizer Education Project, Bihar

Type and Figured Specimens/Slides/Negatives

Specimens of slides/negatives of 33 research papers were submitted to the repository of Museum. Their position as on 31.3.1987 is as under:

Type and Figured specimens	4,099
Type and Figured slides	9,142
Photo Negatives of Type and Figured specimens, etc.	10,616

New Collections (from India)

Fossil specimens/samples from 211 localities were collected during the year.

Departments

	Specimens	*Samples*
Department of Non-Vascular Plants	152	217
Department of Palaeophytic Evolutionary Botany	1,170	77
Department of Mesophytic Evolutionary Botany	351	10
Department of Cenophytic Evolutionary Botany	754	—
Department of Quaternary Biogeography and Archaeobotany	—	862
Department of Pre-Gondwana and Gondwana Palynostratigraphy	—	1,292
Department of Post-Gondwana Palynostratigraphy of Peninsular India	—	716
Department of Post-Gondwana Palynostratigraphy of Extra-Peninsular India	—	349
Department of Planktonology	—	303

Department of Biodiagenesis	—	155
Department of Radiometric Dating	—	33

New Collection (from abroad)

Dr P. L. Robinson, Geology Department, University College, London, U.K. 11

Presentation of Fossil Specimens

(A) Within Country

1. Prof. T. S. Sadasivan, Madras
2. Department of Geology and Geophysics, Allahabad University, Allahabad
3. Bose Institute, Calcutta
4. Delhi Public School, Ranipur, Haridwar
5. B. P. College, Kinwat, Maharashtra
6. B. R. N. College, Jalna, Maharashtra
7. Department of Botany, Delhi University, Delhi
8. Dr B. P. Radhakrishna, Geological Society of India, Bangalore
9. Dr V. K. Gaur, Director, National Geophysical Research Institute, Hyderabad
10. Centre for Environmental Education (Sarabhai Foundation), Ahmedabad

(B) Abroad

Department of Geology, Queens University, Belfast, North Ireland

FOUNDER'S DAY CELEBRATIONS

The Birthday of founder, Professor Birbal Sahni, was celebrated on 14th November, 1986. In the morning at 8.30 a.m. wreaths and flowers were placed on the '*Samadhi*' of Professor Sahni by the Institute's staff and several other distinguished persons. In the evening, the 'Samadhi' was decorated by flowers and garlands.

The main function started at 4.00 p.m. with *VANDANA*. Thereafter Dr B. S. Venkatachala, Director BSIP, welcomed the Chief Guest and other guests present on the occasion in the Auditorium. Then at 4.25 p.m. Dr B. P. Radhakrishna, Geological Society of Bangalore, Bangalore delivered the 16th Birbal Sahni Memorial Lecture entitled "Our oldest rocks and the early record of life". Thereafter at 5.05 p.m. 34th Sir Albert Charles Seward Memorial Lecture entitled "Architecture of the Himalaya" was delivered by Prof. V. K. Gaur, Director, National Geophysical Research Institute, Hyderabad.

DISTINGUISHED VISITORS

1. Dr Caratini C., Centre Etudes Geographie Tropicale, Talence, France
2. Dr Tissot C., Centre Etudes Geographie Tropicale, Talence, France
3. Dr J. M. Dickins, Canberra, Australia
4. Shri Veer Bahadur Singh, Chief Minister, Uttar Pradesh
5. Prof. C. L. Johanssen, University of Oregon, Eugene, USA
6. Mr N. A. Z. Parkar, Johanssen, University of Oregon, Eugene, USA
7. Mr Nov Bjart, Faadors, Denmark
8. Mr Per Bjart, Faadors, Denmark
9. Mr S. Lakdusinghe, Museum of Colombo, Sri Lanka
10. Prof. A. Mahadevan, Director, CAS in Botany, Madras University, Madras
11. Ms Manju Bhargava and Mr Kant Bhargava, High Commission of India, Mauritius
12. Dr N. J. Chenoy, Gujarat University, Ahmedabad
13. Dr M. D. Pathak, Agricultural Adviser to Government of Uttar Pradesh (Director, R. N. T.) International Rice Research Institute
14. Dr J. J. Jaeger, Lab. Palaeontologie Vertebes, University of Paris, France
15. Dr Eric Buffetant, Lab. Palaeontologie Vertebes, University of Paris, France
16. Dr B. P. Radhakrishna, Geological Society of India, Bangalore
17. Mrs & Prof. J. W. Schopf, UCLA, Los Angeles, California, USA
18. Dr Denis Bates, Department of Geology, University College of Wales, UK
19. Dr J. Boner, Botanique Garden, Munich, West Germany
20. Prof. T. V. Batygihia, Komarov Botanical Institute, Academy of Science, Leningrad, USSR

21. Dr V. E. Vasilyeva, Komarov Botanical Institute, Academy of Science, Leningrad, USSR

22. Dr Gregory L. Possehl, University Museum, Philadelphia, USA

23. Dr B. G. Jachim Hoffmann, Director, German Academic Exchange Service, New Delhi Office

24. Prof. V. K. Gaur, Director, National Geophysical Research Laboratory, Hyderabad

APPOINTMENTS AND PROMOTIONS

Department of Palaeophytic Evolutionary Botany

Dr A. K. Srivastava, J.S.O., was promoted as Senior Scientific Officer w.e.f. 9.1.85.

Museum

Sri G. P. Srivastava, Curator (Museum) was promoted as Senior Scientific Officer w.e.f. 4.6.1986.

Photography

Sri Pradeep Mohan, Dark Room Assistant, was promoted in the higher scale w.e.f. 31.3.1987.

Technical Services

Sri Madhukar Arvind was appointed as Computer Operator w.e.f. 16.3.1987.

Administration

Sri S. K. Suri, Stenographer, was promoted as Deputy Registrar (in Temporary officiating capacity) w.e.f. 30.4.1986.

Sri S. P. Chadha, P. A. to Director, was promoted as Private Secretary to Director w.e.f. 26.8.1986.

Ms Jagjit Kaur was appointed as Lower Division Clerk w.e.f. 13.6.1986.

DST Project

Sri V.K. Yadav, M.Sc., was appointed as Senior Research Fellow w.e.f. 14.11.1986.

Sri Mukund Sharma, M.Sc., was appointed as Junior Research Fellow w.e.f. 12.11.86 (A.N.)

Sri Rajendra Bansal, M.Sc., was appointed as Junior Research Fellow w.e.f. 24.11.86.

RETIREMENTS

Shri S. D. Mehtani, Deputy Registrar, retired on 30.4.1986.

Shri Nanhoo, Safaiwala, retired on 31.12.1986.

INTERNAL COMMITTEES

Building Construction & Maintenance Committee

H. K. Maheshwari	—	Chairman
Anand Prakash		
S. B. Verma		
Deputy Registrar (E)		
P. K. Bajpai		

Canteen Committee

Sukh Dev	—	Chairman
P. K. Bajpai	—	Secretary
Ms Kamla Amarlal	—	Treasurer
Shyam C. Srivastava		
Ms Rita Banerjee		
A. K. Bhattacharya		
H. S. Srivastava		

Data Handling Committee

H. P. Singh	—	Chairman
G. Rajagopalan		
R. S. Tiwari		

Electron Microscope Committee

G. Rajagopalan	—	Chairman
K. Ambwani		
Rahul Garg		
Ms Usha Bajpai		

Excursion Committee

H. P. Singh	—	Chairman
P. K. Maithy		
R. K. Saxena		

Faculty Consultative Committee

R. S. Tiwari	—	Chairman
M. B. Bande	—	Secretary
Shaila Chandra		

S. K. M. Tripathi
Rakesh Saxena
Khowaja Ateequazzaman

Garden Committee

R. K. Kar	—	Chairman
B. N. Jana		
R. R. Yadav		
Samir Sarkar		
M. R. Rao		

Herbarium Advisory Committee

H. P. Singh	—	Chairman
Nilamber Awasthi		
H. P. Gupta		

Instrumentation & Maintenance Committee

H. P. Singh	—	Chairman
H. P. Gupta		
B. K. Misra		

Joint Consultative Committee

N. N. Joshi	—	Chairman
B. Sekar	—	Secretary
Ms V. Nirmala		
E. G. Khare		
V. S. Panwar		
N. C. Saxena		
I. J. Mehra		
Diwakar Pradhan		
Ram Dhari		
Hanuman Prasad		
Chhangelal		
Bashir		

Library Advisory Committee

H. P. Singh	—	Chairman
Suresh C. Srivastava		
J. S. Guleria		

Maceration Committee

Suresh C. Srivastava	—	Chairman
K. P. Jain		
H. N. Boral		

Museum Advisory Committee

H. P. Singh	—	Chairman
Ms Shaila Chandra		
Shyam C. Srivastava		

Photography Committee

K. P. Jain	—	Chairman
Anil Chandra		
Ms Vijaya		

Programme Committee

R. S. Tiwari	—	Chairman
Ms Shaila Chandra		

Publication & Information Advisory Committee

H. P. Singh	—	Chairman
H. K. Maheshwari		
R. S. Tiwari		
J. S. Antal		

Purchase Committee

B. S. Venkatachala	—	Chairman
K. P. Jain		
M. B. Bande		
S. B. Verma		
N. K. Khasnavis		
Accounts Officer		

Quality Control Committee

M. B. Bande	—	Chairman
B. K. Jain		
Bhagwan Singh		

Research Programming & Monitoring Committee

H. P. Singh	—	Chairman
G. K. B. Navale		

K. P. Jain
H. K. Maheshwari
R. S. Tiwari

Vehicle Maintenance Committee

Anand Prakash	—	Chairman
S. B. Verma		
S. K. Suri		

AUDITOR'S REPORT
OF
BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW

We have audited the annexed Balance Sheet of the Birbal Sahni Institute of Palaeobotany, Lucknow as at 31st March, 1987 and also the relevant Income and Expenditure Account and Receipts and Payment Account for the year ended on that date with the account books, vouchers, information and explanation furnished to us.

We report that to the best of our information and according to the explanations given to us, in our opinion, the Balance Sheet read with notes thereon, shows a true and correct state of affairs of the Institute as at 31st March, 1987 and the Income & Expenditure Account gives a true and fair view of income over expenditure.

For R. N. KHANNA & COMPANY
Chartered Accountant

(Sd. R. N. KHANNA)
Partner

M.No. F-13255

NOTES ON BALANCE SHEET OF BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW AS AT 31ST MARCH, 1987

1. The Institute maintains the Accounts on cash system.

2. No depreciation are provided on Fixed Assets. The fixed assets are shown at cost.

3. In the absence of classified details of completed building works, the sum of Rs. 32,52,634.58 have been shown as 'Building Works under Construction'. Efforts should be made to classify the capitalisation under the various works.

4. The figures have been recasted or regrouped.

For R. N. KHANNA & COMPANY
Chartered Accountant

(Sd. R. N. KHANNA)
Partner

Place : Lucknow

Statement of Accounts for the year 1986-87

BIRBAL SAHNI INSTITUTE

Balance sheet as on

Liabilities	Amount Rs.	Amount Rs.
Capital Fund:		
Balance as per last year's Balance Sheet	1,87,18,252.34	
Add : Government of India Grant as Capital Account	31,50,000.00	2,18,68,252.34
Advance Funds for Employees		
As per last years Balance Sheet	9,04,667.00	
Advances during the year	7,47,240.00	
	16,51,907.00	
Less : Recovery during the year	1,25,225.00	15,26,682.00
Excess of Income Over Expenditure	21,39,801.25	
Less : Transfer to Advance Fund	6,22,015.00	15,17,786.25
Donated Funds/Grants:		
Cost of Land donated by U.P. Government	32,292.00	
Founder's Donation	1,52,500.00	
C.D. Pant Memorial Fund	2,444.38	
C.L. Katiyal Memorial Fund	4,079.08	
P.C. Bhandari Memorial Fund	4,353.20	
A.C. Seward Memorial Fund	14,012.58	
Other Misc. Donation	14,357.34	
M.G.T. Scheme (C.S.I.R.)	8,100.79	
Coal Scheme (C.S.I.R.)	7,784.66	
Palynological Scheme (C.S.I.R.)	5,207.87	
UNESCO Aid Fund	19,629.75	

OF PALAEOBOTANY, LUCKNOW

31st March, 1987

Assets	Amount Rs.	Amount Rs.
Fixed Assets:		
Land (Donated by Govt. of U.P.)		32,292.00
Works & Building:		
(i) **Building:**		
As per Last Year's Balance Sheet	17,26,652.04	
Addition during the year 1986-87	18,746.14	
	17,45,398.18	
(ii) Building Works under construction		
Additions during the year 1982-83	9,25,836.18	
Less : Sale proceeds of Cement	58,300.00	
	8,67,536.18	
Additions during the year 1983-84	10,38,988.91	
Additions during the year 1984-85	8,94,139.81	
Additions during the year 1985-86	4,51,969.68	49,98,032.76
Research Apparatus & Equipments:		
As per last year's Balance Sheet	43,99,891.99	
Additions during the year	9,96,035.54	53,95,927.53
Workshop Equipment:		
As per last year's Balance Sheet	67,374.85	67,374.85
Office & Miscellaneous Equipments:		
As per last year's Balance Sheet	3,18,572.24	
Additions during the year	7,335.36	3,25,907.60
Establishment of C-14 Radiometric Lab:		
As per last year's Balance Sheet	27,13,885.46	
Additions during the year	7,46,061.72	34,59,947.18

Liabilities	Amount Rs.	Amount Rs.
Burmah Oil Co. Donation	1,900.00	
Rajasthan Scheme (Sponsored by University of Wisconsin)	23,009.15	
Gift in Kind:		
Humboldt Foundation (West Germany)	75,000.00	
P.K. Srivastava Memorial Fund	3,460.85	
Birbal Sahni Research Award Endowment	25,395.50	
Prof. T. Maxwell Harris Endowment	8,375.00	4,01,902.15
General Provident Fund/Contributory Provident Fund/Current Liabilities and Provisions:		31,55,269.37
Security & Earnest Money Deposit		42,208.83
Total		2,85,12,100.94

Assets	Amount Rs.	Amount Rs.
Plant & Machinery:		
As per last year's Balance Sheet	14,47,762.18	
Additions during the year	1,82,595.26	16,30,357.44
Apparatus & Equipment (Donated):		
M.G.T. Scheme (C.S.I.R.)	7,155.79	
Burmah Oil Co.	700.00	
Founder's Donation	2,500.00	
Coal Scheme (C.S.I.R.)	6,645.29	
Palynological Scheme (C.S.I.R.)	5,207.87	
Rajasthan Scheme (Sponsored by University of Wisconsin)	21,138.90	
UNESCO Aid Equipment	19,629.75	
Humboldt Foundation (West Germany)	75,091.50	1,38,069.10
Vehicles:		
As per last year's Balance Sheet	2,88,685.07	
Additions during the year	2,11,462.50	5,00,147.57
Furniture & Fixtures:		
As per last year's Balance Sheet	15,16,673.58	
Additions during the year	1,04,962.92	16,21,636.50
Furniture & Fixture (Donated):		
Burmah Oil Company	1,200.00	
M.G.T. Scheme (C.S.I.R.)	945.00	
Coal Scheme (C.S.I.R.)	1,139.37	
Rajasthan Scheme (Sponsored by University of Wisconsin)	979.70	4,264.07
Books and Journals:		
As per last year's Balance Sheet	8,34,031.24	
Addition during the year	1,13,460.83	9,47,492.07

Liabilities	Amount Rs.	Amount Rs.
Total		2,85,12,100.94
Total		2,85,12,100.94

Assets	Amount Rs.	Amount Rs.
Founder's Library (Donated):		50,000.00
Founder's Fossil Collection (Donated):		50,000.00
Maps & Topo-Sheets:		
As per last year's Balance Sheet	13,142.00	
Additions during the year	—	13,142.00
Investment (Bank Guarantee)		13,000.00
(For A.C.C. Unit)		
UNESCO Book Coupons:		793.02
Investment (Donation Account)	67,687.50	
ADD : Investment during the year	—	67,687.50
Cash and Bank Balances:		
Cash in Hand	472.30	472.30
Current Account with State Bank of India	19,06,211.78	19,06,211.78
Advances:		
Unsettled Advances : Plan Revenue Account	1,19,389.50	
Unsettled Advance : Plan Capital Account	24,71,167.95	
Unsettled Advance : Non-Plan Revenue Account	8,677.50	
Unsettled Advances : D.S.T. Project (Dr. P. K. Maithy)	3,374.10	
Unsettled Advances : D.S.T. Project (Dr. B. S. Venkatachala)	4,785.25	26,07,394.30
Loans & Advances to Employees:		
House Building Advance	12,86,068.00	
Festival Advance	15,800.00	
Conveyance Advance	2,22,334.00	
Fan Advance	2,480.00	15,26,682.00

Liabilities	Amount Rs.	Amount Rs.
Total		2,85,12,100.94
Grand Total		2,85,12,100.94

Sd/-	Sd/-	Sd/-
(S. B. Verma)	(T. N. Shukla)	(B. S. Venkatachala)
Registrar	*Accountant*	*Director*
Birbal Sahni Institute of Palaeobotany	Birbal Sahni Institute of Palaeobotany	Birbal Sahni Institute of Palaeobotany

Assets	Amount Rs.	Amount Rs.
General Provident Fund/Contributory Provident Fund		
Investment	25,00,000.00	
Advances	3,89,208.00	
Insurance out of G.P.F.	6,049.00	
With State Bank of India	2,60,012.37	31,55,269.37
Grand Total :		2,85,12,100.94

Auditor's Report

As per our attached Report of even date

For R. N. KHANNA & CO.
Chartered Accountants

BIRBAL SAHNI INSTITUTE

Income and Expenditure Account

Expenditure	Plan Rs.	Non-plan Rs.	Total Rs.
Academic Expenses :			
To Pay and Allowances of Academic Staff	—	25,48,399.91	25,48,399.91
To Field Excursion	1,09,011.13	35,168.15	1,44,179.28
To Remuneration of Birbal Sahni Professor	—	—	—
To Sponsoring & Participation in Conferences & Symposia etc.	9,926.00	—	9,926.00
To Honorarium to Lecturers :			
For Birbal Sahni Mem. Lecture	—	500.00	500.00
For Silver Jubilee Mem. Lecture	—	—	—
To International Programme :			
Deputation Abroad	20,279.00	19,380.00	39,659.00
Honorarium for Visiting Scientist	1,876.00	—	1,876.00
To Expenses of Services Ancillary to Research:			
To Pay & Allowances of Aux. Tech. staff	10,712.90	8,51,290.89	8,62,003.79
To Chemicals & Glasswares, photogoods & Small Apparatus etc.	2,64,250.48	1,04,768.31	3,69,018.79
To Library Requirements	—	25,074.75	25,074.75
To Museum Requirements	9,050.00	5,515.43	14,563.43
To Maintenance of Apparatus and Equipments & Workshop Machinery	74,523.42	—	74,523.42
To Publication Expenses :			
"The Palaeobotanist"	—	68,291.25	68,291.25
Birbal Sahni Memorial Lecture	—	—	—
Annual Report	—	19,404.50	19,404.50
Seward Memorial Lecture	—	—	—
Silver Jubilee Lecture	—	—	—
Travelling & other Allowances :			
For Governing Body, Scientific Programme & Evaluation Committee & Selection Committee Meetings and for other purpose	39,692.05	47,973.64	87,665.69
For Attending Scientific Meetings & Conferences in India	—	5,431.10	5,431.10

OF PALAEOBOTANY, LUCKNOW

for the year ending 31st March, 1987

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
By Grants from Govt. of India	22,00,000.00	54,00,000.00	76,00,000.00
By Grant from U. P. Govt. on Revenue Account	—	5,000.00	5,000.00
By Sale Proceeds of Priced Publications:			
"The Palaeobotanist"	—	73,792.69	73,792.69
Monograph	—	—	—
Symposia & Spl. Publication	—	46.85	46.85
Seward Memorial Lecture	—	16.00	16.00
Birbal Sahni Memorial Lecture	—	41.00	41.00
Silver Jubilee Lecture	—	19.00	19.00
Picture Post Cards	—	657.00	657.00
Catalogue of Indian Fossil Plants	—	75.00	75.00
Aspects & Appraisal of Indian Palaeobotany	—	300.00	300.00
By Miscellaneous Receipts and Recoveries:			
By Vehicle Charges	—	—	—
By Telephone Charges	--	517.00	517.00
By V. S. Room Charges	—	3,620.00	3,620.00
By Application Fees	—	—	—
Miscellaneous Receipts and Recoveries	—	4,548.97	4,548.97
Interest on Conveyance Advance	—	2,242.80	2,242.80
Pension Contribution	—	3,313.50	3,313.50
Leave Salary	—	1,130.50	1,130.50
Deposit Account	—	—	—
Interest on Savings Bank Account	—	81,718.94	81,718.94
Interest on Fan Advance	—	21.75	21.75
O. N. G. C. Project:			
Grant	—	31,467.97	31,467.97
Misc./Receipts/Refunds	—	—	—

Expenditure	Plan Rs.	Non-plan Rs.	Total Rs.
For Reimbursement of Medical Expenses	2,924.13	31,085.46	34,009.59
For Over Time Allowance	3,366.00	2,984.05	6,350.05
For Leave Travel Concession	31,400.00	49,985.45	81,385.45
For Reimbursement of Tution fees	—	963.00	963.00
For Efficiency Bonus	—	1,542.24	1,542.24
For Children Education Allowance	—	—	—
For Funds for Training of staff in India	—	9,618.75	9,618.75
For Productivity Bonus	1,17,781.43	20,396.94	1,38,178.37
To Pensionary Expenses:			
To Superannuation Allowance and Pension	—	3,26,651.24	3,26,651.24
Payment under Insurance scheme	—	—	—
G. P. F. Interest	—	—	—
C. P. F. Contribution	—	7,508.00	7,508.00
To General Expenses:			
To Pay & Allowances of Administrative Staff	—	10,68,473.72	10,68,473.72
To Telephone & Trunk Call Charges	—	60,746.70	60,746.70
To Postal Charges		21,290.00	21,290.00
To Advertisement Charges	3,858.00	4,880.00	8,738.00
To Hot & Cold Weather Charges	24,642.85	9,373.44	34,016.29
To Petrol & Mobil Oil Charges	9,954.44	10,677.29	20,631.73
To Electricity Charges	1,14,765.48	44,893.66	1,59,659.14
To Municipal Taxes	—	18,715.13	18,715.13
To Insurance of Vehicle and Library	—	10,110.00	10,110.00
To Uniform to Class IV Staff	8,999.57	15,067.70	24,067.27
To Printing & Stationery	35,363.76	39,750.74	75,114.50
To Custom Duty & Port Trust Charges	—	—	—
To Railway Ft. & Carriage	—	7,077.00	7,077.00
To Entertainment Allowance to Director	—	3,101.21	3,101.21
To Miscellaneous & Unforeseen	1,01,137.16	77,733.58	1,78,870.74
To Maintenance Expenses:			
To Building	—	17,247.41	17,247.41
To Garden	—	5,332.20	5,332.20

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Oil Industry Development Board Project			
Grant	—	85,303.00	85,303.00
U. G. C. Project:			
Grant	—	3,629.03	3,629.03
All India Coordinated Research Project on Ethnobiology:			
Grant	—	45,300.00	45,300.00
D. S. T. Project			
"Palaeobiology, Sedimentology and Stratigraphy"			
Grant	—	55,000.00	55,000.00
D. S. T. Project II:			
"Geology Palaeobiology....Sediments of India"			
Grant	—	13,26,500.00	13,26,500.00
D. S. T. Project III:			
"Nannoplankton....Andaman Islands, India"			
Grant	—	3,10,000.00	3,10,000.00
C. S. I. R. Project I :			
"Palynostratigraphy....Associated sediments"			
Grant	—	5,000.00	5,000.00
C. S. I. R. Project II:			
"Palynological dating....Siwanganj area, West Bengal"			
Grant	—	7,500.00	7,500.00
C. S. I. R. Project III:			
"Phytoplankton Biostratigraphy....with emphasis on...."			
Grant	—	5,000.00	5,000.00
Total	22,00,000.00	74,51,761.70	96,51,761.70

Expenditure	Plan Rs.	Non-Plan Rs.	Total Rs.
To Vehicles	26,762.32	12,361.15	39,123.47
To Repairs & Renewals	44,170.50	19,538.18	63,708.68
To Other Expenses:			
To Medical Advice	—	48.00	48.00
To Audit Fees	—	3,000.00	3,000.00
To Legal Advice	—	940.00	940.00
To welfare Expenses:			
Financial Assistance to Departmental Canteen	—	5,041.40	5,041.40
Birbal Sahni Research Scholarship	—	7,390.00	7,390.00
Birbal Sahni Research Scholarship Contingencies	—	508.33	508.33
Birbal Sahni Research Scholarship House Rent	—	1,893.50	1,893.50
Emeritus Scientist	—	24,000.00	24,000.00
O. N. G. C. Project			
To Pay & Allowances	—	18,089.63	18,089.63
Chemicals & Glasswares	—	—	—
Miscellaneous	—	9,992.79	9,992.79
Oil Industry Development Board Project:			
To Pay & Allowances	—	75,499.90	75,499.90
Travelling Allowances	—	11,732.25	11,732.25
Miscellaneous	—	5,028.55	5,028.55
U. G. C. Project			
Honorarium to Mr. D. N. Pant	—	3,629.03	3,629.03
Contingency	—	239.08	239.08
All India Coordinated Research Project on Ethnobiology:			
Research Fellowship	—	13,110.00	13,110.00
To Pay & Allowances	—	27,455.00	27,455.00
Travelling Allowance	—	1,016.00	1,016.00
Miscellaneous	—	1,600.80	1,600.80

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	22,00,000.00	74,51,761.70	96,51,761.70
Total	22,00,000.00	74,51,761.70	96,51,761.70

Expenditure	Plan Rs.	Non-Plan Rs.	Total Rs.
D. S. T. Project I :			
"Palaeobiology....Stratigraphy"			
To Pay & Allowances	—	30,720.40	30,720.40
To Contractual Services	—	4,787.10	4,787.10
To Supplies & Materials	—	2,925.30	2,925.30
Contingency	—	410.68	410.68
Travelling	—	2,991.58	2,991.58
D. S. T. Project II			
"Geology....of India"			
To Staff Salary	—	10,183.25	10,183.25
To Permanent Equipment	—	12,89,587.39	12,89,587.39
To Contingency	—	800.50	800.50
To Travelling Allowance	—	15,563.95	15,563.95
To Advertisement	—	3,750.00	3,750.00
To Chemical & Glasswares	—	191.21	191.21
D. S. T. Project III			
"Nannoplankton....Islands, India"			
To Advertisement	—	6,378.00	6,378.00
C. S. I. R. Project:			
"Palynostratigraphy....Associated Sediments"			
To Advertisement	—	3,984.00	3,984.00
To Contingency	—	17.00	17.00
C. S. I. R. Project:			
"Palynological....Diwanganj area, West Bengal"			
To Advertisement	—	3,971.00	3,971.00
To Staff Salary	—	800.00	800.00

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	22,00,000.00	74,51,761.70	96,51,761.70

Total	22,00,000.00	74,51,761.70	96,51,761.70

Expenditure	Plan Rs.	Non-Plan Rs.	Total Rs.
C.S.I.R. Project:			
"Phytoplankton....Sequence of Assam Shelf"			
To Staff Salary	—	624.19	624.19
To Advertisement	—	4,011.00	4,011.00
Excess of Income over Expenditure Bd	11,35,553.38	2,31,548.72	13,67,102.10
Grand Total	22,00,000.00	74,51,761.70	96,51,761.70
To Balances transferred to Balance Sheet	18,07,643.50	3,32,157.75	21,39,801.25
	18,07,643.50	3,32,157.75	21,39,801.25

Auditor's Report

As per our report on the Balance Sheet of even date

For R. N. KHANNA & CO.
Chartered Accountant

(Sd. T. N. Shukla)
Accountant

Birbal Sahni Institute of Palaeobotany

Income	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	22,00,000.00	74,51,761.70	96,51,761.70
Grand Total	22,00,000.00	74,51,761.70	96,51,761.70
By Balance brought forward from previous year	6,72,090.12	1,00,609.03	7,72,699.13
Excess of Income over Expenditure B/F	11,35,553.38	2,31,547.72	13,67,102.10
Total	18,07,643.50	3,32,157.75	21,39,801.25

(S. B. Verma)
Registrar
Birbal Sahni Institute of Palaeobotany

(B. S. Venkatachala)
Director
Birbal Sahni Institute of Palaeobotany

BIRBAL SAHNI INSTITUTE

Period from 1.4.1986

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
To Opening Balance:			
Bank Account:			
Non-Plan Revenue Account	—	6,412.47	6,412.47
Plan Revenue Account	6,20,814.42	—	6,20,814.42
Plan Capital Account	2,88,482.72	—	2,88,482.72
Donation Account	—	3,346.18	3,346.18
Cash Account:			
Non-Plan Revenue Account	—	408.55	408.55
To Govt. of India Grants on	31,50,000.00	—	—
Capital Account:	*2,34,818.00	—	33,84,818.00
To Govt. of India Grants on Revenue Account	22,00,000.00	54,00,000.00	76,00,000.00
To Govt. of U. P. Grant on Recurring Account	—	5,000.00	5,000.00
To Sale Proceeds of Publications:			
The Palaeobotanist	—	73,792.69	73,792.69
Monograph	—	—	—
Symposium	—	46.85	46.85
Catalogue	—	75.00	75.00
Aspects & Appraisal of Indian Palaeobotany	—	300.00	300.00
Seward Memorial Lecture	—	16.00	16.00
Birbal Sahni Mem. Lecture	—	41.00	41.00
Picture Post Cards	—	657.00	657.00
Silver Jubilee Mem. Lecture	—	19.00	19.00
To Administrative Receipts:			
Income Tax		53,720.00	
Insurance Premium (S. S. Sch.)		63,613.78	
G. P. F. Subscription		6,48,296.00	
Recovery of G. P. F. Advance		2,21,124.00	
Recovery of B.S.I.P. Credit Cooperative Society		73,830.20	

OF PALAEOBOTANY, LUCKNOW

to 31.3.1987

Payments	Plan Rs.	Non-Plan Rs.	Total Rs.
Capital Account:			
By Works and Building	18,746.14	—	18,746.14
By Research Apparatus and Equipments	21,14,582.69	—	21,14,582.69
By Equipment for Services Ancillary to Research :			
Library	1,50,018.28	—	1,50,018.28
Photography	82,772.01	—	82,772.01
C-14 Laboratory	3,57,995.47	—	3,57,995.47
Plant & Machinery	1,82,595.26	—	1,82,595.26
By Furniture & Fixtures:	1,04,962.92	—	1,04,962.92
By Vehicles	1,08,150.50	—	1,08,150.50
By Pay and Allowances:			
Pay (Academic)	—	12,73,984.84	12,73,984.84
Pay (Technical)	10,712.90	4,63,366.51	4,74,079.41
Pay (Administrative)	—	5,74,081.12	5,74,081.12
D.A. (Addl. D.A.)	—	14,56,330.38	14,56,330.38
House Rent Allowance	—	4,14,747.13	4,14,747.13
City Comp. Allowance	—	83,204.67	83,204.67
Interim Relief	—	2,02,449.87	2,02,449.87
Over Time Allowance	3,366.00	2,984.05	6,350.05
Medical Reimbursement	2,924.13	30,085.46	33,009.59
Reimbursement of Tuition Fee	—	963.00	963.00
Leave Travel Concession	32,460.00	50,000.45	82,460.45
Efficiency Bonus	—	1,542.24	1,542.24
Bonus	1,17,781.43	20,396.94	1,38,178.37
By Travelling Allowance			
Governing Body & Selection Committee Meetings	—	—	—
For attending meetings & Conferences in India	—	4,631.10	4,631.10
Funds for Training of staff in India	—	9,618.75	9,618.75
For other purposes	37,591.05	47,973.64	85,564.69

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Pension Contribution		3,313.50	
Leave Salary		1,130.50	
To Misc. Receipts and Recoveries			
Application Fees		—	
V. S. Room Rent		3,620.00	
Telephone Charges		517.70	
Vehicle Charges		—	
Other Misc. Receipts		4,548.97	
To Recoveries of Loans and Advances:			
Recovery of Festival Advance		36,900.00	
Recovery of Conveyance Advance		30,188.00	
Interest of Conveyance Advance		2,242.80	
Recovery of House Building Advance		55,017.00	
Recovery of Fan Advance		3,120.00	
Interest of Fan Advance		21.75	
To Deposits:			
Security Deposits		—	
To Donation and Endowments:			
Proceeds of Interest		7,444.25	
To Misc. Receipts on Capital Accounts:	1,400.00	—	1,400.00
Interest earned in Savings Bank Account	—	81,718.94	
O.N.G.C. Project:			
Opening balance	—	18,876.35	—
Grant	—	31,467.97	—
Misc. Receipts/Refunds	—	—	—
Oil Industry Development Board Project:			
Opening Balance	—	4,918.04	—
Grant	—	85.303.00	—
U. G. C. Project:			
"Encyclopaedic Dictionary of Palaeobotany"			
Opening Balance		239.08	—

Payments	Plan Rs.	Non-Plan Rs.	Total Rs.
By Maintenance of Property:			
For Building	—	13,798.41	13,798.41
For Garden	—	5,332.20	5,332.20
For Equipment & Apparatus	74,523.42	—	74,523.42
For Vehicles	26,762.32	12,361.15	39,123.47
For Repairs and Renewals	44,498.50	19,538.18	64,036.68
By Contingencies:			
By Telephone and Trunk Call Charges	—	60,746.70	60,746.70
For Postage	—	21,290.00	21,290.00
For Advertisement	3,858.00	4,880.00	8,738.00
For Hot and Cold Weather Charges	24,642.85	9,373.44	24,016.29
For Petrol & Mobil Oil	9,954.44	10,677.29	20,631.73
For Electricity Charges	1,14,765.48	44,893.66	1,59,659.14
For Insurance of Vehicle & Library	—	10,110.00	10,110.00
House & Water Tax	—	18,715.13	18,715.13
For Liveries to Sub-Staff	8,999.57	15,067.70	24,067.27
For Printing & Stationery	35,363.76	39,750.74	75,114.50
For Railway Ft. & Carriage	—	6,077.00	6,077.00
For Custom Duty and Port Trust Charges	—	—	—
For Entertainment Allowance to Director	—	3,101.21	3,101.21
For Miscellaneous and Unforeseen	1,04,747.16	76,733.58	1,81,480.74
For Chemicals and Glasswares	2,64,250.48	1,04,768.31	3,69,018.79
For Library Requirements	—	25,074.75	25,074.75
For Museum Requirements	9,050.00	5,515.43	14,565.43
For Legal Advice	—	940.00	940.00
For Medical Advice	—	48.00	48.00
For Audit Fee	—	3,000.00	3,000.00
For Publications:			
The Palaeobotanist	—	68,291.25	68,291.25
For Annual Report	—	19,404.50	19,404.50
For Birbal Sahni Mem. Lect.	—	—	—

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Grant	—	3,629.03	—
All India Coordinated Research Project on Ethnobiology			
Opening Balance	—	10,539.09	—
Grant	—	45,300.00	
D. S. T Project I:			
"Palaeobiology, Sedimentology and Stratigraphy"			
Opening Balance	—	14,535.45	—
Grant	—	55,000.00	—
D. S. T. Project II:			
Geology Palaeobiology sediments of India			
Grant	—	13,26,500.00	—
D. S. T. Project III:			
Nannoplankton, Biostratigraphy....and Andaman Islands India			
Grant		3,10,000.00	3,10,000.00
C. S. I. R. Project-I:			
Palynostratigraphy of the Ratnagiri and Neyveli lignites sediments			
Grant	—	5,000.00	5,000.00
C. S. I. R. Project-II:			
Palynological dating and....Diwanganj area, W. Bengal.			
Grant	—	7,500.00	7,500.00
C. S. I. R. Project-III:			
Phytoplankton biostratigraphy with emphasis.... Tertiary sequence of Assam shelf			
Grant	—	5,000.00	5,000.00
Total	64,95,515.44	87,04,290.14	1,51,99,805.58

Payments	Plan Rs.	Non-Plan Rs.	Total Rs.
For Academic Expenses:			
For Field Excursion	1,74,227.93	18,449.65	1,92,677.58
For Birbal Sahni Mem. Lect.	—	500.00	500.00
For Sir A.C. Seward Mem. Lecture out of Donation A/c	—	2,000.00	2,000.00
Symposium and Seminar Cosponsored & Participation	9,926.00	—	9,926.00
By International Programmes:			
Air passage for members of staff proceeding on Foreign Followship or invited to attend Scientific Meetings and Conference abroad (Deputation Abroad)	20,279.00	19,380.00	39,659.00
Honourarium for Visiting Scientists	1,876.00	—	1,876.00
By Welfare Expenses:			
Financial Assistance to Departmental Canteen	—	5,041.40	5,041.40
By G. P. F. Account:			
G. P. F. Subscription Transferred to G. P. F. A/c	—	6,48,296.00	6,48,296.00
Recovery of Advance transferred to G. P. F. A/c	—	2,21,124.00	2,21,124.00
G. P. F. Interest	—	—	—
Institute Contribution to C. P. F.	—	7,508.00	7,508.00
By Miscellaneous:			
Income Tax remitted	—	53,720.00	53,720.00
Insurance Premium remitted (Salary Saving Scheme)	—	63,613.78	63,613.78
B. S. I. P. Co-operative Credit Society	—	73,830.20	73,830.20
B. S. Research Scholarship	—	7,390.00	7,390.00
B. S. Research Scholarship (Contingency)	—	508.33	508.33
B. S. Research Scholarship (House Rent Allowance)	—	1,893.50	1,893.50
By Loans and Advances:			
Festival Advance	—	32,000.00	32,000.00
Conveyance Advance	1,53,200.00	24,000.00	1,77,200.00
House Building Advance	5,32,440.00	—	5,32,440.00
Security Money Refunded	38,544.00	—	38,544.00
Fan Advance	400.00	5,200.00	5,600.00

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	64,95,515.44	87,04,290.14	1,51,99,805.58
Total	64,95,515.44	87,04,290.14	1,51,99,805.58

Payments	Plan Rs.	Non-Plan Rs.	Total Rs.
By Investments:			
Funds under Donation and Endowment Invested	—	—	—
By Pension and Superannuation:			
Pension, Family Pension and Gratuity etc.	—	3,26,651.24	3,26,651.24
Emeritus scientists	—	24,000.00	24,000.00
O. N. G. C. Project:			
Pay of Staff	—	5,685.00	5,685.00
D. A. & Addl. D. A.	—	9,504.80	9,504.80
House Rent Allowance	—	1,215.27	1,215.27
City Comp. Allowance	—	364.56	364.56
Interim Relief	—	1,320.00	1,320.00
Chemicals and Glasswares	—	—	—
Miscs. and Unforeseen	—	9,992.79	9,992.79
Oil Industry Development Board Project:			
Pay of Staff	—	22,991.53	22,991.53
D.A. and Addl. D.A.	—	40,009.50	40,009.50
House Rent Allowance	—	5,017.35	5,017.35
City Comp. Allowance	—	1,505.19	1,505.19
Interim Relief	—	5,976.33	5,976.33
Chemicals and Glasswares	—	—	—
Travelling Allowance	—	2,782.25	2,782.25
Miscellaneous	—	5,028.55	5,028.55
Photography/Typing	—	—	—
U. G. C. Project:			
"Encyclopaedic Dictionary of.... Palaeobotany"			
Honourarium to Mr. D. N. Pant	—	3,629.03	3,629.03
Contingency	—	239.08	239.08
All India Coordinated Research Projecton Ethnobiology:			
Research Associate/Fellow	—	13,110.00	13,110.00
Pay of Staff	—	9,160.00	9,160.00
D. A. and Addl. D. A.	—	14,038.40	14,038.40

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	64,95,515.44	87,04,290.14	1,51,99,805.58
Total	64,95,515.44	87,04,290.14	1,51,99,805.58

Payments	Plan Rs.	Non-Plan Rs	Total Rs.
House Rent Allowance	—	1,913.35	1,913.35
City Comp. Allowance	—	587.25	587.25
Interim Relief	—	1,756.00	1,756.00
Travelling Allowance	—	1,016.00	1,016.00
Miscellaneous	—	1,600.80	1,600.80
D. S. T. Project-I			
"Palaeobiology, Sedimentology....and Str. tigraphy"			
Salary of Staff	—	30,720.40	30,720.40
Contractual Services	—	4,787.10	4,787.10
Permanent Equipment	—	—	—
Supplies and Material	—	2,925.30	2,925.30
Travelling Allowance	—	3,265.68	3,265.68
Contingency	—	410.68	410.68
D. S. T. Project-II : (Director)			
"Geology, Palaeobiology,....sediments of India"			
Salary of Staff	—	10,183.25	10,183.25
Permanent Equipment	—	12,89,587.39	12,89,587.39
Chemicals & Glasswares	—	191.21	191.21
Advertisement	—	3,750.00	3,750.00
Travelling Allowance	—	20,349.20	20,349.20
Miscellaneous	—	800.50	800.50
D. S. T. Project-III			
"Nannoplankton, Biostratigraphy and....Andaman Islands, India			
Advertisement	—	6,378.00	6,378.00
C. S. I. R. Project-I:			
"Palynostratigraphy of the Ratnagiri and Neyveli lignites,....sediments"			
Advertisement	—	3,984.00	3,984.00
Miscellaneous	—	17.00	17.00

Receipts	Plan Rs.	Non-Plan Rs.	Total Rs.
Total	64,95,515.44	87,04,290.14	1,51,99,805.58
Total	64,95,515.44	87,04,290.14	1,51,99,805.58

BALANCE

Plan	**Bank**	**Cash**	**Total**	
Central Recurring	10,02,214.00	—	10,02,214.00	
Central Non-Recurring	5,12,333.75	—		
In Saving Bank Account	4,000.00	—	5,16,333.75	
				15,18,547.75
Non-Plan				
Central Recurring	264.52	472.30	736.82	
Donation and Endowment	8,790.43	—	8,790.43	
Projects:				
O. N. G. C.	22,261.90	—	22,261.90	
Ethnobiology	12,657.29	—	12,657.29	
D. S. T. (Dr. P. K. Maithy)	27,426.29	—	27,426.29	
D. S. T. II (Director)	1,638.45	—	1,638.45	
D. S. T. III (Dr. S. A. Jafar)	3,03,622.00	—	3,03,622.00	
O. I. D. B.	6,910.34	—	6,910.34	
C. S. I. R. Projects (3)	4,092.81	—	4,092.81	3,88,136.33
				19,06,684.08

Payments	Plan Rs.	Non-Plan Rs.	Total Rs.
C. S. I. R. Project-II:			
"Palynological dating and....Diwanganj area, West Bengal"			
Advertisement	—	3,971.00	3,971.00
Salary of Staff	—	800.00	800.00
C. S. I. R. Project-III:			
"Phytoplankton biostratigraphy with emphasis.... Tertiary sequence of Assam Shelf"			
Advertisement	—	4,011.00	4,011.00
Salary of Staff	—	624.19	624.19
Total	49,76,967.69	83,16,153.81	1,32,93,121.50

Auditor's Report

As per our report on the Balance Sheet of the even date

For R. N. Khanna & Co.
Chartered Accountant

(T. N. Shukla)	(S. B. Verma)	(B. S. Venkatachala)
Accountant	*Registrar*	*Director*
Birbal Sahni Institute of Palaeobotany	Birbal Sahni Institute of Palaeobotany	Birbal Sahni Institute of Palaeobotany