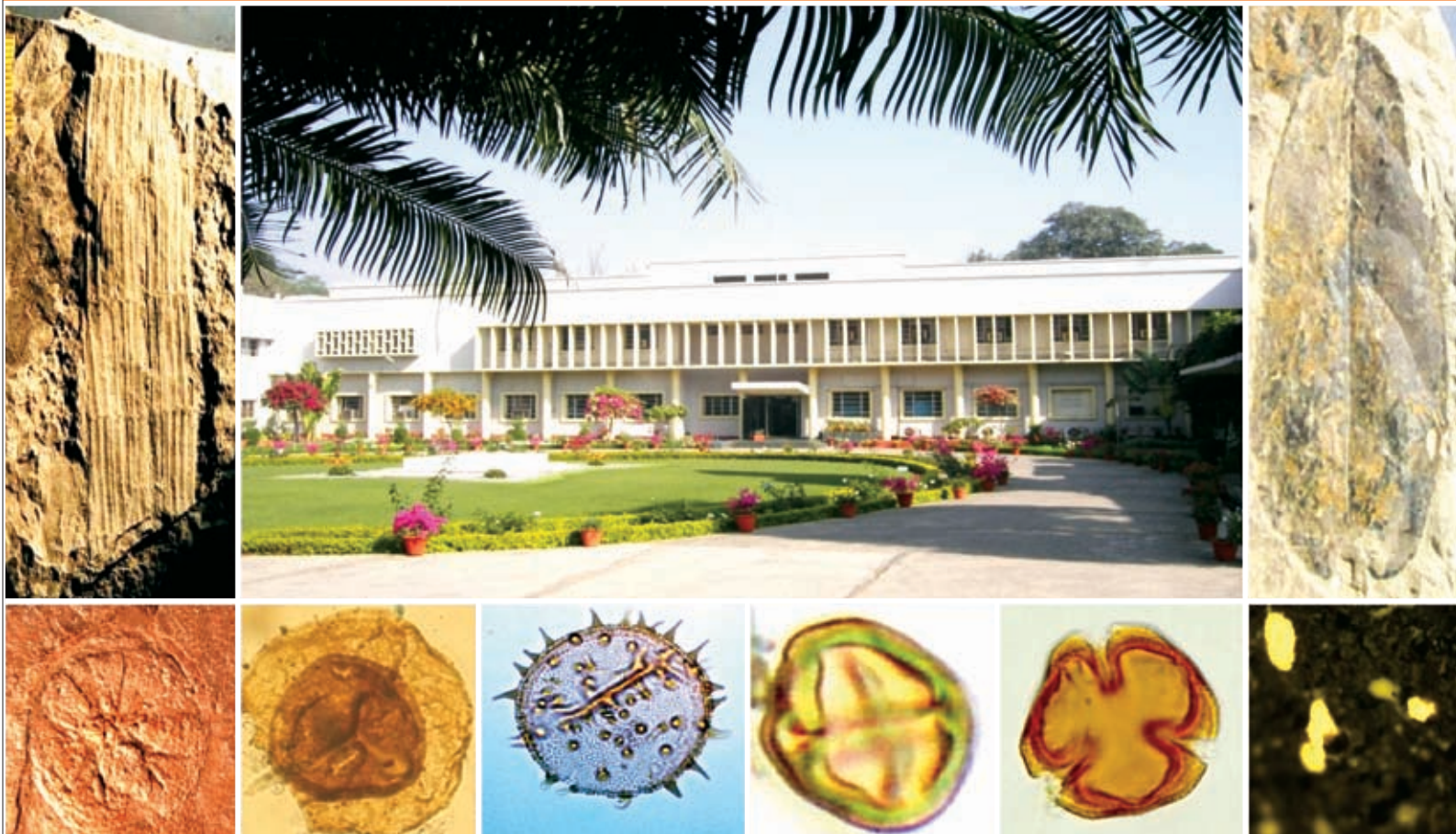


# Annual Report

## 2011-2012



**BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW**

An Autonomous Institute under Department of Science & Technology  
Government of India, New Delhi

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

# Annual Report

## 2011-2012



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An Autonomous Institute under Department of Science & Technology  
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***October 2012***



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# Organization Structure

**Department of Science & Technology**  
Autonomous Institute



**GOVERNING  
BODY**

**CHAIRMAN**

**RESEARCH ADVISORY  
COUNCIL**

**FINANCE AND  
BUILDING COMMITTEE**

**DIRECTOR**

**THRUST AREAS  
RESEARCH GROUPS**

Precambrian Palaeobiology  
Gondwana-Mesozoic Palaeofloristics  
Gondwana Palynology  
Cenozoic Palaeofloristics  
Late Mesozoic-Cenozoic Palynology  
Marine Micropalaeontology  
Organic Petrology  
Quaternary Palaeoclimate  
Dendrochronology  
Palaeoethnobotany  
Isotope and Geochemistry  
Arctic-Antarctic Research

**UNITS ANCILLARY  
TO RESEARCH**

Research Planning &  
Co-ordination Cell  
Publication  
Library  
Museum  
Herbarium  
Maceration Laboratory  
Section Cutting Workshop  
Scanning Electron Microscope  
Electronic Data Processing  
Photography

**REGISTRAR  
ADMINISTRATION**

Finance & Accounts  
Establishment  
Scientific Activities  
Stores & Purchase  
Works, Building & Maintenance  
Transport & Guest House

**Vigilance Officer**  
Dr. C.M. Nautiyal, Scientist-D

**Central Public Information Officer**  
Dr. B.D. Singh, Scientist-E

**Women's Forum**  
Dr. Rajni Tewari, Scientist-E



## Foreword

The Birbal Sahni Institute of Palaeobotany (BSIP) is a unique institution engaged in pursuing the basic as well as applied aspects of palaeobotanical (fossil botany) and allied disciplines. With time, the approach, the tools and the materials have evolved, but the basic pursuit has remained the same as envisaged by the Founder.

The year 2011-12 was the last year of the XI Five Year Plan during which the researchers carefully approached towards the set goals. The scientific research also responds to the societal needs. In consonance with this, the Institute has invigorated its efforts towards designing and refining the hydrocarbon and other fossil fuel exploration approach. Considering the great influence of monsoon and climate exert on our agriculture-based economy and culture, the Institute has focused on understanding the past climate changes through the palaeobotanical and other proxies. Several projects are aimed at studying different aspects of climate and cultural changes. Special efforts have been made to nurture young scientists in these disciplines by holding orientation courses and by providing many of them national and international exposure to the current trends in the fields. The approach has paid dividends in terms of enhancement in the quality and quantity of research publications. The approach is being diversified during the XII Plan and considerable addition of new equipments is also on the anvil. Collaborative efforts have also increased to complement our specializations. The Institute also reaches out to more and more people through its outreach efforts.

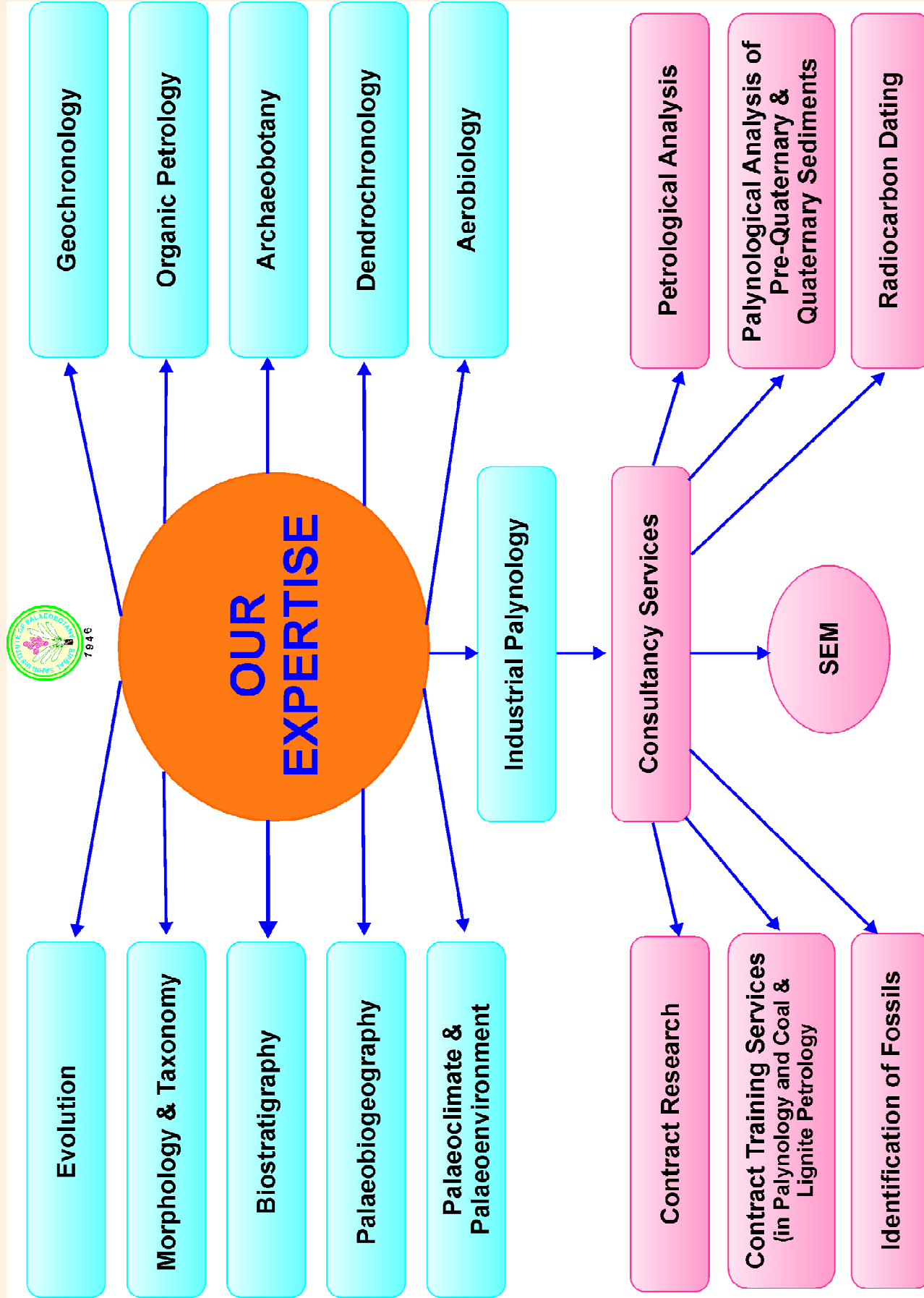
The Institute operates as an autonomous institution under the Department of Science and Technology (DST), Govt. of India. The support from the Secretary Dr. T. Ramasami and the Department has been invaluable. The constant improvement in the publication profile, in terms of number and impact both, is a result of guidance and the gain from the collective wisdom of our Governing Body and Research Advisory Council. The variety of expertise of the advisers also brings a better synergy to the research efforts of the Institute.

This document, a result of efforts of the RPCC (Research Planning and Coordination Cell) and many other units, reflects our efforts and achievements in nut shell.

A handwritten signature in black ink, appearing to read 'N.C. Mehrotra', written over a horizontal line.

(N.C. Mehrotra)

Director



## Research Highlights

**B**irbal Sahni Institute of Palaeobotany (BSIP) is devoted to develop both fundamental as well as applied aspects of Palaeobotany and allied Earth System Sciences, especially focusing on past plant life and palaeoclimate. The palaeobotanical researches are being conducted right from Archaean to Recent geological sequences (3200 Ma to 400 AD), adopting an integrated and multidisciplinary approach. To achieve the targets of the XI Five Year Plan, 14 research projects for the year 2011-2012 have been continued under the umbrella of six identified Thrust Areas:

1. *Early life, atmosphere and oceans*: Evidences from Indian Craton (Bio-Geosphere interactions in the Precambrian).
2. *Fossil land plant communities*: Morpho-structure, Evolution, Systematics with applications to Biostratigraphy and Palaeoecology (Plant evolution, Anatomy, Taxonomy and Stratigraphy).
3. *Integrative Micropalaeontology, Biopetrology and Organic facies*: Relevance to fossil fuel characterization and exploration (Integrated approach to realizing economic potential in prospective basins).
4. *Multi-proxy parameters for Quaternary palaeoclimate reconstructions*, vegetation dynamics, relative sea level changes and anthropogenic influence (Integrated approach to climate change, modeling and sustainable ecosystems).
5. *Polar and Major Planetary Events* (Polar research and record of events such as Tsunami, Earthquakes and Volcanism).
6. *Frontiers in Palaeobotanical Research* (Reconnaissance Projects to aid in development of future research direction).

Some of the significant outcomes of scientific research during the year are as under:

- Study of trace-fossils from the siliciclastic sequence of Nagaur Formation (Marwar Supergroup) provided definitive evidence of the Cambrian succession for hitherto suggestive Precambrian-Cambrian sequence in peninsular India.
- Biotic communities from the Singhora and Raipur groups (Chhattisgarh Supergroup) and their global correlation with equivalent sediments shows an evolutionary trend from Calymmian to Cryogenian age in ascending order that were evolved and survived in different complexes of shallow sea.
- Occurrence of Peltasperms in Satpura Gondwana Basin (central India) assigns the Indian subcontinent in the equatorial zone of mixed Laurasian/Gondwanan floristic assemblages.
- Recovered plant fossils from the South Rewa Basin are compared with various Early Cretaceous palaeofloral assemblages of India, which shows dominance of conifers and pteridophytes and absence of cycadophytes.
- New finds of Podocarpean and Araucarian woods along with Ginkgoean fossil leaves in the Krishna-Pranhita-Godavari basins demonstrate their luxuriant growth during Cretaceous time.



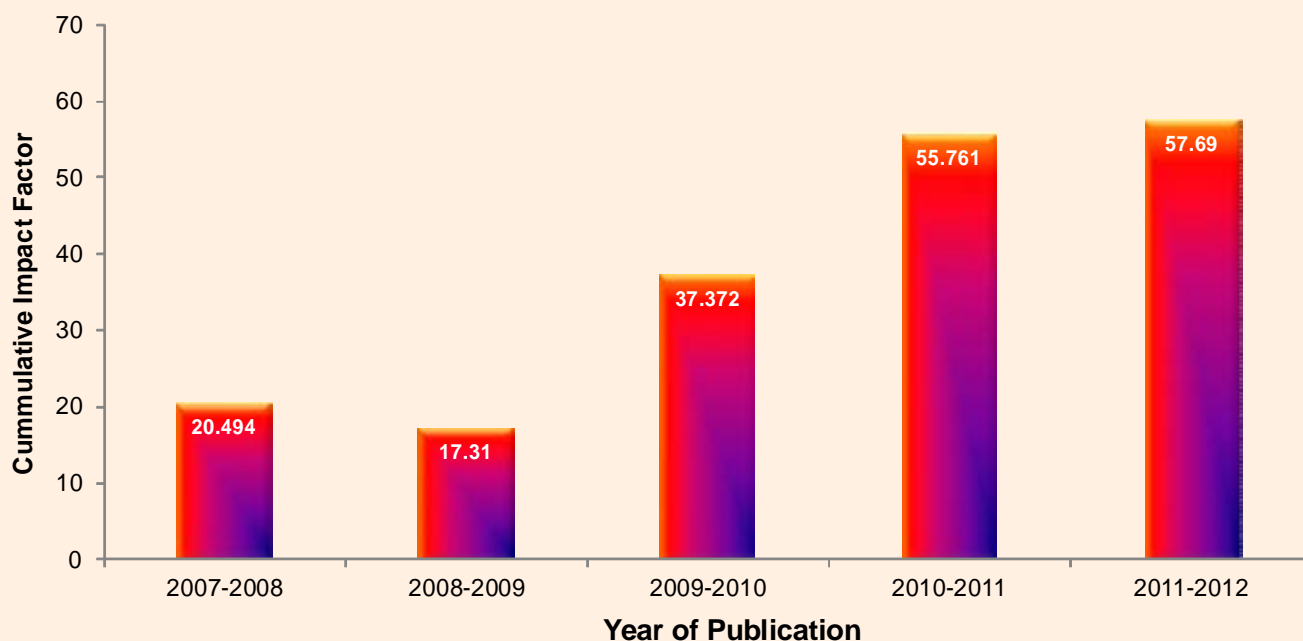
- Continued documentation of spores-pollen assemblages from the coal-bearing sequences of Raniganj, Sohagpur, Ib-River, and Wardha-Godavari Valley coalfields in order to demarcate their significance in biostratigraphic interpretation and coal seam's correlation.
- Compiled the data of spores from Indian Permian successions, which provides comprehensive information in different coal-bearing sedimentary basins.
- Generated additional data on plant megafossils from the Palaeogene horizons of Rajasthan, Gujarat, Maharashtra, MP, HP, Uttarakhand, Assam and Meghalaya in terms of their significance in palaeogeographic and palaeoecological significance, besides morphotaxonomy.
- Presence of Palm leaves, along with the other known fossil records indicates that CMMT (cold month mean temperature) was not less than 18°C with plenty of rainfall, in the Makum Coalfield (Assam) region during the period of deposition.
- The epidermal and stomatal features of the fossil leaves collectively suggest the existence of a broad leaved mesophytic forest at low altitude all along the Himalayan foothills during 8-12 million years ago.
- Analyzed palynofloral assemblages from various Tertiary sequences of north-west, and north-east Indian, Andaman-Nicobar regions for stratigraphic zonation and correlation.
- Palynofloral and palynofacies analyses of Tikak Parbat Formation (Makum Coalfield, Assam) evidenced that the late Oligocene tropical delta vegetation has much in common with modern lowland wet mega-thermal forests from south-east Asia.
- Integrative studies of the Um Sohryngkew Cretaceous-Tertiary transition in the Khasi Hills of Meghalaya revealed biotic and environmental changes about 800 km from the Deccan volcanic province.
- Recorded nannofossil assemblage from Kaladongar Formation (Patcham Island, Kachchh Basin) indicates that after faulting, the first transgressive event for the basin might have occurred during the Pleinsbachian-Toarcian boundary interval, some 15 Ma earlier than the much accepted Late Bajocian.
- Attempted taphonomy and growth-form analysis of coralline algae, palaeodiversity of algal forms and benthic foraminifera from the late Middle Miocene sediments of Hut Bay Limestone (Little Andaman Island).
- Evaluated Permian coal from Bhupalpalli area (Godavari Valley), and Tertiary lignites from Vastan and Mangrol (Cambay Basin) areas for their categorization in terms of economic suitability, besides depositional history.
- Evidenced four climatic phases during the terminal Pleistocene and across the Holocene, while pollen analysed from sediment core of the Chilka Lake, Orissa. The overall vegetational sequence indicates that between 13,607 and 8,842 yrs BP, there is low recovery of core mangrove taxa.
- Identified a new proxy (fresh water thecamoebians) with the work carried out from fresh water lakes, and its importance in understanding fresh-water palaeoecology and palaeo coastal-wetland changes has been established for the first time from India.

- Variation in the palynofacies assemblages around Vembanad Estuary indicates that owing to variable carrying capacity of streams, differential runoff conditions, the rate of sediment influx during the monsoonal times, salinity changes, display differential productivity signals.
- Pollen rain deposition pattern in tropical deciduous Sal forest in Shahdol district (south-eastern MP) revealed that *Shorea robusta* (sal) is recovered with average 2% pollen only, despite being a high pollen producers; attributing to their poor preservation in the sediments.
- Record of Arecaceae pollen from Itanagar wildlife sanctuary is significant which is not growing in and around the sanctuary, needs further investigation. An urgent need is required for immediate steps to conserve the rich plant diversity in the sanctuary.
- Studied spatio-temporal variability in Pinus trees of north-east India revealed inter-species tree growth variations are not uniform suggesting no common factor influenced the radial tree growth in this region, which may be related to anthropogenic impact or non-climatic factors.
- Added more palaeo-ethnobotanical finds from Chalcolithic site Ahichchhatra, District Bareilly (UP), revealing advanced agricultural practices in this region of Upper Ganga Plain in ancient times.
- The water geochemistry shows that Indus water (in Ladakh) is getting their ionic load largely from the silicate rocks; however all other smaller rivers show a mix of contribution from silicate and carbonate sources.
- Radiocarbon dates on northern Indian materials of archaeological significance reflects the emerging opinion regarding greater antiquity for Indian cultural sites than usually believed.
- Studied diatoms from the lake samples of Schirmacher Oasis to understand the impact of environmental factors; helping in to detect changes (if any) in the pristine Antarctic ecosystem.
- Participated in the India's Arctic Programme for Quaternary palaeoclimatic studies of Ny-Alesund (Swalbard) region, based on pollen and field records.
- Documented floral elements of *Dicroidium* from the Triassic sediments of Lashly Formation, Allan Hills, Central Transantarctic Mountains, Antarctica, and the megafossil assemblage has been compared globally.
- Recorded a diverse assemblage of palynomorphs from the samples of Neyveli Lignite field (TN); indicating Early to Middle Eocene age and coastal (ranging from back-mangrove to mangrove) environment of deposition.

Integrated collaborative research activities with institutions in India and abroad (China, USA, UK, Brazil, etc.) in several spheres, have helped to expand scientific knowledge. The collective research efforts are expressed in the form of 118 published papers, one book, 95 conference/symposia abstracts, besides 62 research papers accepted for publication. A dozen Ph.D. degrees were awarded to the scholars during the year. One scientist was deputed abroad (China) under Inter-academy Exchange Programme of INSA. Two scientists participated in the Indian Expedition to Arctic. Two scientists visited China on invitation, and another 20 scientists, 6 Research Associates, and one Technical personal were deputed for attending various conferences abroad (in Australia, Brazil, Canada, China, Romania, Scotland, Switzerland, Thailand and USA). Thirty-six scientists, 4 Research Associates, and 4

Research Fellows were deputed to attend various national and international conferences/ workshops held in the country. Concerned scientists were also deputed to attend the Symposium on *Climate Change and Geo-hydrology* organised at BSIP. About 65 research papers were presented in these scientific meetings at different centers of India and abroad.

The visit of Prof. M.S. Swaminathan, FRS during August was a highlight of the year. He not only was generous in appreciation and called BSIP "a world leader in Palaeobotany", he also committed generously from his MP-LAD fund to the Institute's museum development.



**Cumulative Impact Factor of Published Research Papers**

## Governing Body

(w.e.f. 22.02.2011)

### Chairman

**Dr. Shailesh Nayak**

Secretary, Ministry of Earth Sciences  
Block-12, CGO Complex, Lodhi Road  
New Delhi-110 003

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(Nominee of the Secretary, DST)  
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**Dr. V.P. Dimri**

Distinguished Scientist  
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**Prof. G.V.R. Prasad**

Department of Geology  
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University of Delhi  
Delhi-110 007

**Dr. N.K. Datta**

Ex. Director General, GSI  
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**Financial Adviser**

Department of Science and Technology  
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New Delhi-110 016

**Prof. A.K. Gupta**

Director  
Wadia Institute of Himalayan Geology  
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Dehradun-248 001

**Prof. R. Ramesh**

Project Director, ISRO-GBP  
Physical Research Laboratory  
Navrangpura  
Ahmedabad-380 009

**Dr. N.C. Mehrotra**

Director  
Birbal Sahni Institute of Palaeobotany  
Lucknow-226 007

### Non-Member Secretary

**Dr. S.C. Bajpai**

Registrar  
Birbal Sahni Institute of Palaeobotany  
Lucknow-226 007

**Research Advisory Council**

(w.e.f. 01.04.2011)

**Chairman****Professor S.N. Bhalla**

Ex-Chairman, Geology Department, AMU  
A-525, Sarita Vihar, New Delhi-110 076

**Member-Convener (Ex-officio)**

**Dr. N.C. Mehrotra**, Director  
Birbal Sahni Institute of Palaeobotany, Lucknow

**Members****Dr. V.P. Dimri**

Distinguished Scientist  
National Geophysical Research Institute  
Uppal Road, Hyderabad-500 007

**Professor A.K. Singhvi**

Outstanding Scientist, Geosciences Division  
Physical Research Laboratory  
Navrangpura, Ahmedabad-380 009

**Dr. M. Shanmukhappa**

General Manager & Head (Geology Lab)  
KDM Institute of Petroleum Exploration  
Oil & Natural Gas Corporation Ltd.  
9, Kaulagarh Road, Dehradun-248 195

**Shri Rasik Ravindra**

Director  
National Centre for Antarctic & Ocean  
Research (NCAOR), Headland Sada  
Vasco da Gama, Goa-403 804

**Professor C.L. Verma**

Department of Botany  
University of Lucknow  
Lucknow-226 007

**Professor Manju Banerjee**

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N.C. Choudhary Road, Kolkata-700 042

**Professor M.P. Singh**

CAS in Geology  
Lucknow University  
Lucknow-226 007

**Dr. Rajeev Nigam**

Scientist-G & Head  
Geological Oceanography Division  
National Institute of Oceanography  
Dona Paula, Goa-403 004

**Professor R.P. Tiwari**

Department of Geology  
Mizoram University  
Aizawl, Mizoram-796 009

**Co-opted Member****Dr. Prabhaskar Pande**

34, Shanker Nagar  
Lucknow-226 020

**Member (Ex-officio)****Deputy Director General**

In-charge, Northern Region  
Geological Survey of India  
GSI Complex, Vasundhara  
Sector-E, Aliganj, Lucknow-226 024



## Finance and Building Committee

(w.e.f. 01.04.2011)

### Chairman (Ex-officio)

**Dr. Shailesh Nayak**

Secretary, Ministry of Earth Sciences &  
Chairman, Governing Body  
Birbal Sahni Institute of Palaeobotany

### Members

**Dr. Akhilesh Gupta**

(Nominee of the Secretary DST)  
Head Climate Change Programme  
DST, New Delhi

**Ms Sheila Sangwan**

Additional Secretary & Finance Advisor  
DST, New Delhi

/

**Ms Anuradha Mitra**

Joint Secretary & Finance Advisor  
DST, New Delhi

**Shri Parvez Mahmood**

Sr. Superintending Engineer  
Laboratory Service Engineering  
CDRI, Lucknow

**Dr. N.C. Mehrotra**

Director  
Birbal Sahni Institute of Palaeobotany

### Non-Member Secretary

**Dr. S.C. Bajpai**

Registrar  
Birbal Sahni Institute of Palaeobotany

# Foundation Day

The Institute celebrated its 65<sup>th</sup> Foundation Day on September 10, 2011. On this occasion Dr. Prabhas Pande, Former Additional Director General, Geological Survey of India delivered ‘15<sup>th</sup> Jubilee Commemoration Lecture’ on the topic *Mineral Wealth of India: Present Status and Future Strategies*.

On the same evening of 10<sup>th</sup> September, Guest of Honour Dr. Vikram Singh, Vice-Chancellor, Noida

International University, Gautam Buddha Nagar delivered a popular lecture in Hindi on *Paryavaran ka Swaroop* to mark the beginning of Hindi Pakhwara.

Dr. N.K. Datta, Former Director General, Geological Survey of India and Member Governing Body, BSIP presided over the function. Many guests and scientists from outside the Institute attended the function.



## Founders' Day

The Institute celebrated its Founder- Prof. Birbal Sahni 120<sup>th</sup> birth anniversary on November 14, 2011. On November 14- the Founders' Day, the Institute's staff and distinguished guests from other organizations offered *Pushpanjali* on the *Samadhi* of the Founder Professor Birbal Sahni, FRS in the campus. Same day following Memorial Lectures were organized:

Prof. V.N. Sergeev of Geological Institute, Russian Academy of Sciences, Moscow, Russia delivered the '41st Birbal Sahni Memorial Lecture' on the topic- *Cryogenian-Ediacaran*

*Transition and the Radial changes in the Biosphere.*

Prof. David L. Dilcher, NAS of Department of Biology and Geology, Indiana University, Bloomington, USA delivered the '57th Sir Albert Charles Seward Memorial Lecture' entitled- *The Evolution of Flowering Plants.*

Prof. S.N. Bhalla, Chairman, Research Advisory Council of the Institute presided over the function. Many guests and scientists from outside the Institute attended the occasion.





## Symposium on Climate Change & Geo-hydrology

A two-day Symposium on *Climate Change and Geo-hydrology* was inaugurated at BSIP on August 28, 2011 by the renowned agro- scientist Padma Vibhushan Prof. M.S. Swaminathan. The symposium was organised under the patronship of Dr. T. Ramasami, Secretary, DST and Dr. Shailesh Nayak, Secretary, MoES and under the auspices of BSIP and NCAOR, Goa.

In the inaugural session Dr. N.C. Mehrotra, Director and a Chairperson of the Organising Committee, outlined the significant achievements of the Institute including the increase in impact factor publications. He highlighted the incentives to the young scientists and other significant achievements of BSIP. He projected palaeoclimate as a major research activity during the 12<sup>th</sup> Plan. The Convener of the symposium Dr. C.M. Nautiyal provided a background on the symposium and introduced the speakers.

Inaugurating the symposium, Prof. M.S. Swaminathan, Member of Parliament, said that development has to be sustainable. He reviewed the various Earth Summits since the one at Rio de Janeiro in 1992. He said that climate change is a real threat and farmers must be trained to tackle it. He cautioned that climate change would adversely affect us worsen the impact of pests, diseases and weeds. In addition, the quality of grains and nutrient - use ability may be adversely affected. He summarised that some crops may benefit from the increase in carbon dioxide level in the atmosphere, but the overall impact would be negative. He showed concern on the reducing water level in Panjab, the grain bowl of India. Prof. Swaminathan observed that the Institute has made remarkable progress in recent years and is a leading institution in the world in this field. He recorded his impressions of the presentations by the young





scientists on the previous evening and said that no institute can progress without the encouragement to the young.

On this occasion, Prof. Robert A. Spicer from Open University, UK also released a festschrift volume (a special issue of the Journal *Palynology*) in the honour of Prof. M.S. Swaminathan. With Dr. P.K.K. Nair, a well known palynologist as the Chief Editor, the volume 'Vistas of Palynological Sciences' includes contributions from leading Indian experts. During the technical session, Prof. Spicer talked on the origin of Asian Monsoon. Shri Rasik Ravindra, Director, National Centre for Antarctic and Ocean Research (NCAOR), Goa and a Chairperson of the Organising Committee spoke on India's Polar programme. Prof. R. Ramesh from PRL, Ahmedabad elaborated on the application of oxygen isotopes in Dendro-climatology. Glaciologist Dr. V.K. Raina, formerly with GSI, lectured on monitoring of the Himalayan Glacier. Prof. Yeadong Kim gave details of the Korean climate change programme. Dr. Akhilesh Gupta, Head of the Climate Change Programme at DST, New Delhi highlighted the relevance of the symposium and assured

of all support for studies in this area. In the afternoon, Prof. Swaminathan visited the museum, library, radiocarbon and other labs and interacted with the scientists, evincing keen interest in all aspects of Institute activities.

On the second day of the symposium, Dr. Baek-Min Kim (Korea) spoke on the accelerating climate change due to Arctic Sea-ice melting. Prof. I.B. Singh from the University of Lucknow dwelt on the evolution of lake systems in Ganga plains. Prof. Manju Banerjee presented detailed account of the effect of climate change on Western geo-province of Bengal, while Dr. Rajiv Nigam of NIO, Goa explained the results on past climate changes including cyclicities based on marine foraminifera. Dr. K.P.N. Kumaran, ARI, Pune talked of the response of vegetation in Konkan to variations in the South Asian Monsoon.

A large number of scientists from University of Lucknow, GSI (Northern Region) and other institutions also attended the sessions. Dr. Ratan Kar, Organising Secretary, proposed the Vote of Thanks.



## Distinguished Visitors

Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences,  
Govt. of India, New Delhi

Prof. M.S. Swaminathan, FRS, Chairman, MS  
Swaminathan Foundation Research Center,  
Chennai

Dr. P.K.K. Nair, Director, ERRC, Thiruvananthapuram

Dr. S.L. Chopra, Vice Chancellor, University of Petroleum  
and Energy Studies, Dehradun

Dr. Sankar Chatterjee, Curator of Paleontology, Texas  
Tech University, Lubbock, Texas (USA)

Dr. Akhilesh Gupta, Head, Climate Change Programme,  
DST, New Delhi

Prof. Robert A. Spicer, Open University, Milton Keynes,  
UK

Prof. Cheng-Sen Li, Institute of Botany, Beijing,  
China

Shri Rasik Ravindra, Director, National Center for  
Antarctic and Ocean Research, Goa

Prof. David L. Dilcher, Indiana University, Bloomington,  
USA

Prof. V.N. Sergeev, Geological Institute, Russian  
Academy of Sciences, Moscow, Russia

Dr. S.V. Naugolnykh, Geological Institute, Russian  
Academy of Sciences, Moscow, Russia

Dr. Vikram Singh, Vice Chancellor, Noida International  
University, Gautam Buddh Nagar (UP)

Shri Rajnandan Kumar, Audit Officer, C.A.G., New Delhi

Shri Pankaj Srivastava, IFS, Chief Conservator of Forest,  
R/E Indore, MP

Shri Shreekanta Kabi, IAS, Secretary, BDA, BBSR,  
Odisha

Dr. Chris Mays, School of Geosciences, Monash  
University, Victoria, Australia

Prof. Yu-Fei Wang, Institute of Botany, Beijing, China

Shri Prem Singh, Joint Director (Official Language),  
Ministry of Science & Technology, New Delhi



## Research

### Thrust areas and Projects

**Thrust Area:** EARLY LIFE, ATMOSPHERE AND OCEANS: EVIDENCES FROM INDIAN CRATON (Bio-Geosphere interactions in the Precambrian)

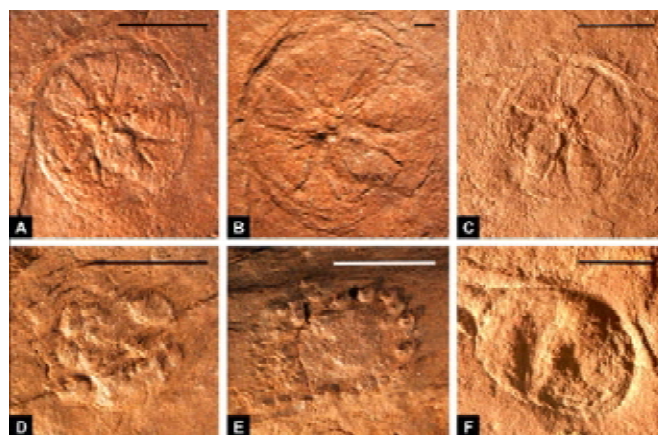
#### Precambrian Palaeobiology Group

**Project 1.1:** Palaeobiology of the Neoproterozoic Marwar Supergroup and the Bhandar Group of Vindhyan Supergroup: Biostratigraphical correlation

The trace-fossils collected from the siliciclastic sequence of Nagaur Formation of the Marwar Supergroup have been processed for description. These include (in order of abundance) *Cruziana*, *Rusophycus*, *Palaeophycus*, *Dimorphicnus*, *Monomorphicnus*, *Planolites*, *Bergaueria* and varied arthropod scratch marks. Absence of true body fossils of trilobite and small shelly fossils in the sequence put a constraint of fine division of the Nagaur Group. The study provides definitive evidence of the Cambrian succession for hitherto suggestive Precambrian-Cambrian sequence in peninsular India. Fresh investigations of the siliciclastic sequence of the Sonia Sandstone of the Jodhpur Group have shown the presence of cluster of circular structures on the top surface of the bedding plane. A large collection has been made from the Artiyan Kalan locality of Jodhpur. At present the fossil assemblage of Marwar Supergroup indicate that entire sequence range from Pre-Ediacara-Ediacara-Early Cambrian in age. Samples from Bilara Group have been collected for microfossils studies in thin section and maceration studies.

**Mukund Sharma, Yogmaya Shukla & S.K. Pandey**

A field-visit has been undertaken with Mr. Deepak Singh and Mr. Uday Bhan of the University of Petroleum



*Marsonia artiansis* from the Sonia Sandstone Formation, Marwar Supergroup

and Energy Studies, Dehradun for validation of data of the Ph.D. problem. A set of systematic samples are collected from Semri and Bhandar Groups of the Vindhyan sections exposed in Maihar area in Satna district (MP), central India. Field-work have been carried out in the Vindhyan Supergroup in an around Rewa-Satna-Katni districts of MP. Also carried out the field work in the Marwar Supergroup in an around Jodhpur-Nagaur-Bikaner-Jaisalmer districts of Rajasthan.

**Mukund Sharma & S.K. Pandey**

**Project 1.2:** Tracing the palaeobiological entities from the eastern part of Chhattisgarh Basin with geologic implications

Studied the biotic communities from the samples belonging to Singhora and Raipur groups of Chhattisgarh Supergroup collected from the outcrops exposed in various localities in Raigarh district to understand the significance and evolutionary status of varied palaeobiotic communities (micro-macrofossils and organo-sedimentary structures viz. stromatolites) preserved in variety of sedimentary

rocks. Structurally, three/two dimensional, cellularly preserved microbiota (prokaryotes & eukaryotes both) comprising 12 genera of acritarchs and 4 genera of cyanobacterial remains from the macerated residue of black carbonaceous shale belong to the lower Saradih Formation, the youngest carbonate horizon of the Raipur Group exposed on the right bank of Mahanadi River at

NE of Sarangarh township. The assemblage represents well-preserved population of both sphaeromorphic and few acanthomorphic acritarchs along with low amount of cyanobacterial remains. The recovered acritarchs are sphaeromorphs (simple & ornamented in nature) followed by very few acanthomorphs (spinated) belonging to Sphaeromorphitae, Netromorphitae, Herkomorphitae and Acanthomorphitae subgroups. The cyanobacterial remains represent solitary and colonies of sphaeroidal cells and unbranched trichomes both septate/aseptate with/without mucilaginous sheath resembles with the extant forms belonging to Nematomorphitae subgroup of cyanobacteria.

Chemically processed shale samples of Charmuria Formation of Raipur Group, crop out in a nala near Amlipali village have yielded moderately well-preserved assemblage of sphaeromorphic acritarchs followed by less amount of cyanobacterial remains. Dominance of sphaeromorphic acritarchs particularly the species of genus *Leiosphaeridia* in the assemblage suggesting Early Neoproterozoic age for the fossiliferous unit. Finalized the study of rich and well-diverse assemblage of organic walled microfossils comprising 27 genera (16 acritarchs, 10 algae and single VSM) yielded from the heterolithic shale unit of Chhaporadih Formation of Chandarpur Group exposed in and around ridges of Dhobinipali villages of Raigarh district. Assemblage shows dominance of both sphaeromorphic and acanthomorphic acritarchs followed by cyanobacterial remains.

Recorded and studied morphologically 10 distinct type of varied shaped megascopic tapic carbonaceous film preserved on the shale samples collected from the

Chhuipali Formation of Singhora Group cropout at Pudarali hill in Raigarh district. The assemblage indicates a fairly well-preserved biotic realm of multicellular tissue forming thalli, bilateral symmetry and erect growth are the main characteristic features. Morphologically, the carbonaceous films can be compared with the extant Phaeophyta, Chlorophyta and Rhodophyta groups of algae. The fossil assemblage can be compared with known carbonaceous films of eukaryotic remains known from the Knob Lake Group, Canada; Michigane and the Negaunee Iron Formation, Michigan USA; and the Changcheng Group, China. The studies of recorded different biotic communities from the fossiliferous units of the Singhora and Raipur groups and their global correlation with equivalent sediments shows an evolutionary trend from Calymmian to Cryogenian age in ascending order that were evolved and survived in different complexes of shallow sea.

**Rupendra Babu & V.K. Singh**

Visited total 24 localities in and around Sarangarh and adjoining areas of Raigarh district, Chhattisgarh and Barapahar region of Bargarh district, Odisha for the field checks and collection of palynological samples (shales, siltstones and cherts). Collected trace fossils from the Chhaporadih Formation of Chandarpur Group, lenticular, nodular black chert and stromatolites from the Saradih Limestone, and volcanic tuffs from the Churtela Shale of Raipur Group for the microfossils studies to establish the biostratigraphy of the Chhattisgarh Supergroup. Also collected dolerite and thoriferous conglomerate from the Chandarpur Group.

**V.K. Singh**

**Thrust Area:** **FOSSIL LAND PLANT COMMUNITIES: MORPHO-STRUCTURE, EVOLUTION, SYSTEMATICS WITH APPLICATIONS TO BIOSTRATIGRAPHY AND PALAEOECOLOGY (Plant evolution, anatomy, taxonomy and stratigraphy)**

### Gondwana-Mesozoic Palaeofloristics Group

**Project 2.1: Palaeobotanical investigation of Satpura Gondwana Basin to analyze the floristic succession, evolutionary perspective, biostratigraphy and palaeoenvironment.**

Well-preserved leaf compressions and reproductive structures of Peltasperm have been studied from Lower Permian Barakar Formation of Satpura Basin, where they co-occur with diverse glossopterids. The Indian peltasperm record is evidence of floristic exchanges between Laurasia and Gondwana in the Early Permian involving a dominant group of North American-European arboreal vegetation of the time. The phytogeographic

differentiation, leaf micromorphology and stratigraphic occurrence of Permian Peltasperms suggest a thermophilic group appearing in central India during the transition from humid peat forming to seasonally dry red bed environments. Therefore, Peltasperms are unlikely invaders to high-latitude cool-temperate zone postulated for Early Permian Australindia. Instead their Satpura occurrence assigns the Indian subcontinent in the



equatorial zone of mixed Laurasian/Gondwanan floristic assemblages.

Morphological and taxonomic features of dispersed sterile scale leaves collected from the Barakar Formation of Pench, Kanhan and Pathakhera coalfields of Satpura Gondwana Basin have been described. The scale leaves are normally described as morphological types without their assignment to taxonomic status. Due to this practice, the identity and significance of the scale leaves have gone astray in the *Glossopteris* flora. The presence of large number of sterile scale leaves with different morphological features has helped to discuss their structure, nature and affinity. The scale leaves have been assigned to different genera and species namely *Pantolepis indica* gen. et sp. nov., *Penchiolepis gondwanensis* gen. et sp. nov., *Penchiolepis indica* sp. nov., *Surangelepis ambarai* gen. et sp. nov., *Surangelepis elongatus* sp. nov. and *Utkaliolepis indica* Tiwari et al. 2009.

**A.K. Srivastava** (superannuated w.e.f. 31.01.2010) & **Deepa Agnihotri**

Finalization of work and report has been done regarding the detailed study of plant fossil assemblage collected from Gottitoria open cast project, Mohpani Coalfield pertaining to morphotaxonomy and depositional environment. Observation, description and comparison of plant fossil assemblage collected from the Sitarewa River

Section of the coalfield have been carried out. The Plant fossil assemblage includes *Gangamopteris*, *Noeggerathiopsis*, *Buriadia* and *Glossopteris*, Equisetalean axes and seeds along with few unidentified taxa. Compilation of the work has been done.

**A.K. Srivastava** (superannuated w.e.f. 31.01.2010) & **Anju Saxena**

Plant fossils collected from Rawanwara area of Pench Valley Coalfield have been investigated and their morphotaxonomy, photo-documentation, comparison with other basins of India, stratigraphical significance and palaeoclimatic interpretation are analysed. A new species of the genus *Cheirophyllum*, viz. *C. maithyi* is described from the Pench East Incline mine. The species is characterized by absence of apical lobes, obtuse apex and presence of ridges and furrows on lamina, ridges showing number of thin veins. Floristically assemblages indicate the possibility of Karharbari equivalent bed in the lower Barakar sequence (encountered in Giridih, Auranga and South Rewa Gondwana basins). The higher number of *Glossopteris* species in comparison to *Gangamopteris* species in Rawanwara area suggests the local and lateral variation of *Glossopteris* flora in Satpura Gondwana Basin.

**A.K. Srivastava** (superannuated w.e.f. 31.01.2010) & **S.S.K. Pillai**

### **Project 2.3: Morphotaxonomy, floristics, biostratigraphy and palaeoecological studies in Hasdev and Chirimiri areas (Son-Mahanadi Basin)**

Around 50 megafossil samples from the Rajnagar and Kurasia collieries have been studied. The assemblage includes *Gangamopteris cyclopteroides*, *Gan. angustifolia*, *Gan. rajaensis*, *Noeggerathiopsis hislopai*, *Ottokaria transvalensis*, *Samaropsis* sp., Equisetalean stems, *Glossopteris communis*, *G. stenoneura* and *G. indica*.



*Paracalamites australis* from Rajnagar Colliery

**K.J. Singh**

### **Project 2.4: Palaeofloral diversity, biostratigraphy and palaeoecological study during Mesozoic in South Rewa Basin, Madhya Pradesh**

The morphotaxonomic study of plant fossils collected from Jhala area has been undertaken to document the palaeofloral assemblage. The pinkish-grey shale embodies well preserved plant fossils comprising

number of species of *Elatocladus*, *Brachyphyllum*, *Pagiophyllum*, *Araucarites*, *Podozamites*, *Todites* and *Gleichenia*. Branched or unbranched twigs of *Elatocladus* are found enormously in the sedimentary



deposits, indicating that the forest was dominant with podocarpaceous elements, whereas Pteridophytes were in paucity.

The morphotaxonomic study of plant fossils collected from various localities, viz. Chandia, Patparha, Barambaba, Jhala, Praghua and Khareri have been carried out. The plant fossils are well preserved in blackish grey–pinkish white shales, embody number of species of *Elatocladus*, *Brachyphyllum*, *Pagiophyllum*, *Araucarites*, *Podozamites*, *Todites*, *Weichselia*, *Gleichenia* and *Phlebopteris*. Branched or unbranched twigs of *Gleichenia* are commonly found in these sedimentary deposits. The floral assemblage is dominated by conifers and pteridophytes. While comparing and correlating with various Early Cretaceous palaeofloral assemblages of India this has been observed that the

palaeoflora is coeval with the floral assemblage of Dhrangadra and Himmatnagar formations, where too the flora is dominated by conifers and pteridophytes. The present floral assemblage resembles to some extent with Gangapur floral assemblage of Andhra Pradesh, as both are rich in conifers and pteridophytes, but can easily be differentiated by the broad-leaved bennettitalean remains which are prevalent in quite good number in Gangapur Formation. Studied palaeofloral assemblage of South Rewa Basin shows close affinity with Floristic assemblage zone-10 Sukh-Dev (1987), which is also characterized by occurrence of *Weichselia*, *Onychiopsis*, proliferation of *Gleichenia*, *Araucaria*, *Allocladus*, *Brachyphyllum* and *Pagiophyllum* and lack of cycadophytes and pteridosperms.

Neeru Prakash

#### Project 2.5: Palaeofloristical analysis of Mesozoic sedimentary succession of western India

Compiled the megafloral assemblage, consisting of fossil algal mats, *Thallites*, *Coniopteris*, *Onychiopsis*,

*Brachyphyllum*, etc., recovered from the *Isoetites*-rich locality near Than (Gujarat).

B.N. Jana (superannuated w.e.f. 30.06.2009)

#### Project 2.6: Integrated palaeobiology of East Coast Cretaceous

Xylotomical studies on the petrified woods of the Krishna-Pranhita-Godavari basins reveal variations within the wood structure of Cretaceous flora. New finds of Podocarpean and Araucarian woods along with

Ginkgoean fossil leaves demonstrate their luxuriant growth. In addition, undertook field excursion to Pranhita-Krishna-Godavari basins and collected fossil specimens and sediment samples.

A. Rajanikanth

#### Project 2.7: Investigation of carbonified/ fusainised plant mesofossils recovered through bulk maceration of Late Triassic and Tertiary sediments of India and comparative studies on selected modern taxa

Cuticle isolated from plant compressions on hand specimens collected from the Nidhpuri plant-bearing bed

has been described and compiled.

Usha Bajpai (superannuated w.e.f. 31.05.2010)

### Gondwana Palynology Group

#### Project 3.1: Palynostratigraphy and evolution of palynoflora through the Palaeozoic and Mesozoic sequence in Rajmahal Basin

Compiled the palynological data generated from coal-bearing horizon encountered in 10 bore-holes of the Rajmahal Basin. The study evidenced definite Late

Permian age for part of coal-bearing strata in the basin, along with the coal seams of Early Permian Barakar Formation.

Archana Tripathi (superannuated w.e.f. 31.07.2009)



### Project 3.2: Palynostratigraphy of Late Palaeozoic and Mesozoic sequence in Singrauli and Tatapani-Ramkola coalfields and adjacent areas in Madhya Pradesh

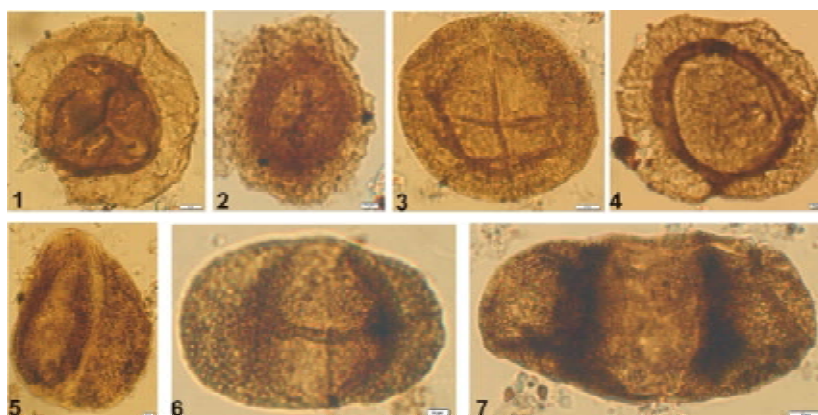
Compiled the palynological data generated from coal-bearing horizons encountered in different bore-holes

of the Singrauli and Tatapani-Ramkola coalfields, as per MoU between BSIP and GSI (Coal Wing).

**Vijaya** (superannuated w.e.f. 30.09.2011) & **Archana Tripathi** (superannuated w.e.f. 31.07.2009)

### Project 3.3: Palynostratigraphy and palaeoclimatic studies on Gondwana sediments of Sohagpur and Mand Raigarh coalfields

Quantitative analysis palynoflora recovered from strata between 6.60 to 514.06 m encountered in bore-hole JNN-1 (Parsora Formation) has revealed the dominance of non-striate bisaccate pollen– *Minutosaccus*, *Falcisporites*, *Klausipollenites*, *Satsangisaccites* and *Alisporites* in association with *Lundbladispora*, *Kraeuselisporites*, *Densoisporites*, *Brachysaccus*, *Staurosaccites* and *Lunatisporites*. Two palynozones have been identified in the above sequence. *Enzonalsporites ignacii*-*Minutosaccus crenulatus* zone (391-399.5 m) and *Rimaesporites potonieii*-*Samaropollenites speciosus* zone (309.7-324.15 m) suggesting Late Triassic age of the strata. Two manuscripts have been finalized on the aspects. Additionally, undertook field work for the



Late Triassic palynoflora recovered from Parsora Formation.

collection of outcrop samples from Sohagpur and Umari coalfields (MP). Plant fossils have also been collected from Umari Coalfield.

**RamAwatar**

### Project 3.4: Morphotaxonomy, floristics evolution, biostratigraphy and palaeoenvironmental studies of Ib-River Coalfield (Odisha)

The surface and subsurface samples collected from the Belpahar area, Kuraloi block: A (Jharsuguda district) has been thoroughly studied to understand the composition of the palynomorphs to assign its age. The two palynoassemblages have been recorded from the surface samples of Lilahari nala section, Belpahar area. The Palynoassemblage- I resulted with the dominance of *Faunipollenites* and sub dominance of *Scheuringipollenites* in the presence of *Rhizomaspora*, *Verticipollenites*, *Striapollenites*, *Cyclogranisporites* and *Ephedripites*, etc.; suggesting resemblance with Upper Barakar palynoflora of late Early Permian age. Palynoassemblage- II marked with dominance of *Striatopodocarpites* and subdominance of *Faunipollenites* in the presence of *Rhizomaspora*, *Verticipollenites*, *Striapollenites*, *Cyclogranisporites*,

*Ephedripites*, *Distriates*, *Distrimonosaccites*, *Microbaculispora*, *Parasaccites*, *Callumispora*, *D. magnicarpus*, etc., and the appearance of *Arcuatipollenites*, *Densoisporites*, *Lundbladispora*, *Densisporites*, *D. magnicarpes* shows the younger affinities equal to Upper Raniganj palynoflora (early Late Permian age) (worked jointly with SSK Pillai). Triassic palynoassemblage has been reported for the first time from the samples of bore-hole IBKAN-2. This palynoassemblage consisted of *Kamthisaccites kamtheinsis*, *Goubinispora indica*, *Indospora*, etc. shows the affinity of middle Triassic palynoflora indicating the late Late Permian age. Additionally, collected more surface and sub-surface samples from the coalfield for the palynological studies.

**K.L.Meena**

**Project 3.5: Palynostratigraphy and patterns of evolution in palynoflora in Damodar Basin**

The study of Palaeozoic and Mesozoic palynomorphs in the borecores from the north-central and eastern parts of the Raniganj Coalfield includes Barakar, Barren Measures (bore-holes RJS-2 & RT-4), Panchet and Rajmahal formations (bore-hole RRK-1). Present review is aimed to establish the age correlation of Barren Measures and Panchet formations in the studied area. As a result, strata equatable to the Raniganj Formation have been proved to be in the Barren Measures Formation. Thus, based on the result of palynodating, lithologically delimited Barren Measures Formation is inferred as the time- transgressive deposit. Similarly, infra-trappean sediments are recognized in the uppermost part

of the Panchet Formation which in turn re-defines the status of the Panchet Formation. To conclude with the unrecognized unconformity in the Barren Measures and Panchet formations has been identified, thus featuring it in the litho-packages for the first time. In addition, compiled the data of spores from Indian Permian succession, which provides comprehensive information in different coal-bearing sedimentary basins. This will be continued frequently for morpho-taxonomy and dating of strata.

**Vijaya** (superannuated w.e.f. 30.09.2011) &  
**Srikanta Murthy**

**Cenozoic Palaeofloristics Group****Project 4.1: Tertiary floristics of Rajasthan and Gujarat**

A fossil fruit wing of *Shorea* of the Dipterocarpaceae has been investigated and a manuscript on the same is finalized. Besides, two manuscripts based on fossil woods are also finalized. The first one describes a fossil wood of *Gluta* (Anacardiaceae) from the Early Eocene of Gujarat, while the other one includes the woods of *Terminalia* (Combretaceae) and *Lagerstroemia*

(Lythraceae) from the Neogene of the Jaisalmer district, Rajasthan. In addition, collected a large number of leaf and fruit impressions from various Tertiary localities of Bikaner and Barmer districts of Rajasthan. These specimens are first cleared and then photographed and their study is under progress.

**J.S. Guleria** (superannuated w.e.f. 31.05.2010),  
**R.C. Mehrotra & Anumeha Shukla**

**Project 4.2: Floristics (Megafossil) of Deccan Intertrappean beds of India**

Anatomical details of well-preserved dicotyledonous wood, resembling extant genus *Corchorus* L. (Jute) of the extended family Malvaceae (subfamily Grewioideae), has been studied from the Deccan Intertrappean sediments of Jhargad, Yavatmal district, Maharashtra. The genus is herbaceous to shrubby and native to tropical and subtropical regions throughout the world (pantropical). Further work is under progress to confirm its identification. Besides, number of dicot woods studied from the same locality belongs to already known genera, namely *Barringtonia* (Lecythidaceae) and *Ailanthus* (Simarubaceae). Their presence signifies that the climate was tropical with plenty of rainfall during the period of deposition.

Studied a number of palm leaves collected from Dindori and Seoni districts of Madhya Pradesh. They are assigned to two fossil palm leaf genera, viz. *Amesoneuron* and *Sabalites*. In one specimen few structures seems to

be inflorescence. Further work is being done to finalize the result. In addition, extensive collections have been made from number of Deccan Intertrappean localities of MP and Maharashtra. Fossil woods and fruits from newly discovered locality (Dhangaon) in Mandla district, and fossil woods (mainly palms) and fruit from Binori Reserve Forest, Ghansor circle, Seoni district have been collected. Large numbers of dicotyledonous woods from Kathotiya village, Dindori district have also been collected from newly digged well section. Woods are recovered from 10-12 ft below the surface. While in Khajri village, big logs of palms are observed. Few woods and chert pieces are also collected from Jhargad near Jhadgaon village in Yavatmal district. Betul-Multai area is extensively surveyed for the first time. The area is not rich in fossils. Few palm roots, woods and *Physa princepii* are observed.

**Rashmi Srivastava**

### Project 4.3: Cenozoic floral changes in northeast India vis-à-vis movement of the Indian Plate

About 15 specimens of a fossil leaf from the Late Palaeocene sediments of Nangwalbibra near Williamnagar, East Garo Hills district, Meghalaya has been investigated. They have been tentatively assigned to the Family Convolvulaceae. A few palm leaves collected from the Makum Coalfield, Assam have also been investigated and a paper on the same is finalized. Their presence, along with the other known fossil records indicates that CMMT (cold month mean temperature) was not less than 18°C with plenty of rainfall, in the region during the period of deposition.

A number of leaf and fruit impressions have been collected from the Oligocene sediments of Makum Coalfield. They are cleared and photographed. A manuscript on the oldest leaf of *Semecarpus* (Anacardiaceae) from the coalfield is finalized. Based on the distribution of its modern comparable forms, it may be inferred that warm and humid climate was prevailing in northeast India during the deposition of the sediments.

**R.C. Mehrotra & Gaurav Srivastava**

### Project 4.4: Tertiary floristics of South India

Compiled data on plant megafossils (carbonized woods, petrified woods, leaves, fruits, seeds) recovered from Neyveli (Tamil Nadu), Ratnagiri (Maharashtra),

Bahur Basin (Pondicherry), and Cochin, Cannanore, Payangadi and Warkala (Kerala).

**Anil Agarwal** (superannuated w.e.f. 31.07.2009)

### Project 4.5: Study on Tertiary plant megafossils of north-west Himalaya

Fossil leaf impressions and two fruits (one fabaceous and another yet to be identified) from the sediments of Kasauli and nearby road sections, Himachal

Pradesh have been studied.

**J.S. Guleria** (superannuated w.e.f. 31.05.2010) &  
**Rashmi Srivastava**

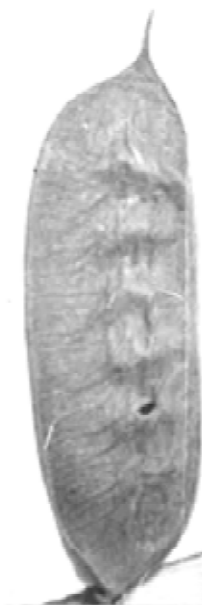
### Project 4.6: Sub-Himalayan floral diversity and its palaeoclimatic and stratigraphic implications

Fossilized fruits collected from Lower Siwalik sediments of Tanakpur area, Uttarakhand has been studied in detail and identified with their modern taxa. They have been referred to 4 new form species— *Humboldtia miocenica*, *Wagatia miospicata*, *Dalbergia tanakpurensis* and *Derris trifoliata* of the family Fabaceae. Their modern comparable taxa suggest the prevalence of tropical evergreen to moist deciduous forest in the Tanakpur area during Middle Miocene period. In addition, a variety of plant fossils (petrified woods, leaf & fruit impressions) and palynological samples have been collected from the Siwalik sediments of Tanakpur and nearby area in Champawat district.

Several fossil leaves have been collected from the Siwalik group of India



Fabaceous fossil fruit from Siwalik (Mio-Pliocene) of Tanakpur



Fossil leaf (*Paranephelium xestophyllum*)

and Nepal. Few of them are possessing sufficient cuticle, which have been identified on the basis of both morphological and cuticular features. These resemble with 7 extant taxa belonging to the family Flacourtiaceae, Sterculiaceae, Dichapetalaceae, Sapindaceae, Anacardiaceae and Sapotaceae. The extinction of their comparable taxa (except *Pterospermum acerifolium*) from the Sub-Himalayan zone indicates the environmental change after Mio- Pliocene time. The epidermal and stomatal features of the fossil leaves collectively suggest the existence of a broad leaved mesophytic forest at low altitude all along the Himalayan foot hills during 8-12 million years ago. Also consulted Central National Herbarium, Howrah for the identification of plant fossils collected from different Siwalik fossil localities of India

and Nepal. More than 40 fossil leaves and 3 fruit impressions have been identified.

Palynofloral investigation has been carried out for the first time from clay stone sediments of Miocene age of Darjeeling district. Basically 23 rock samples are processed for the study purpose and recovered rich and well preserve diverse floral assemblages from all the litho-successions. Present reported assemblage representing 10 genera and 16 species of pollen-spore and 3 genera and 3 species of the fungal remains. The palynofloral assemblage indicate dense forest environment of the gymnospermous plant in the Miocene age and fungal remains represent humid tropical climate during the deposition of sediments.

**Mahesh Prasad**

### Late Mesozoic-Cenozoic Palynology Group

#### **Project 5.1: Palynological investigation of Tertiary sediments of Kachchh Basin: biostratigraphic and palaeoenvironmental applications**

A field work in western Kachchh, Gujarat has been carried out and collected palynological samples from Palaeogene and Neogene sediments from the areas of Dayapar, Matanomadh, Matanomadh lignite, Narayana Sarovar (Lifri Mine), and Khari Nadi river sections.

**R.K. Saxena** (superannuated w.e.f. 31.07.2011) & **M.R. Rao**

Laboratory processing of samples of Lifri mine (Matanomadh lignite) and Dayapar-Kara road sections (Intertrappean beds) have been done. Scanning, photo-documentation and identification of spore-pollen recovered from Dayapar-Kara road section have been done. Some of the important genera are: *Callialasporites*, *Araucariacites*, *Podocarpidites*, *Lygodiumsporites*, *Cyathidites*, *Todisporites*, *Cicatricosisporites*, *Concavisporites*, *Proxapertites* and *Palmidites*. Scanning, photo-documentation and identification of spore-pollen have also been done on Matanomadh lignite. Some of the important genera are: *Lygodiumsporites*, *Cyathidites*, *Dandotiaspora*, *Todisporites*, *Biretisporites*, *Liliacidites*, *Arengapollenites*, *Neocouperipollis*, *Proxapertites*, *Palmidites*, *Retitricolporites*, *Lakiapollis*, *Triangulorites*, *Doorenipites*, *Palaeosantalaceaepites*, *Retitrescolpites*, *Dermatobrevicolporites*, *Sastriipollenites*, *Alangiopollis*, *Rhoipites*, *Margocolporites*, *Tricolporopollis*, *Proteacidites* and *Clavainapertutrites*. Data interpretation of these two

areas have been taken up and continued

**M.R. Rao & Poonam Verma**

The samples collected from Intertrappean bed and gypseous Shale Member of Naredi Formation exposed near Naredi village have yielded fossil *Acarines* along with palynoflora. This is the first record of mites (*Acarina*) from the Palaeogene sediments of Kachchh, western India. Madh Formation (Early Eocene), near Matanomadh village has yielded terrestrial palynoflora and dinoflagellate cysts. The later includes the species of *Operculodinium*, *Achomosphaera*, *Spiniferites*, *Glaphyrocysta*, *Cordosphaeridium*, *Homotryblium* and *Polysphaeridium*. Palaeoecologically *Homotryblium* and *Polysphaeridium* are characteristic warm inner-shelf environments. The manuscript is under preparation.

**R.K. Saxena** (superannuated w.e.f. 31.07.2011) &

**P.S. Ranhotra**

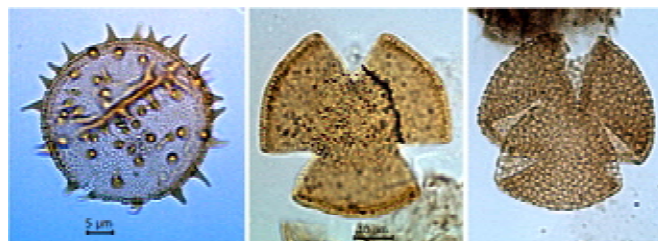
Another field trip to western Kachchh is carried out and collected samples from various Tertiary formations belonging to Matanomadh and Panandhro lignites. The new localities, viz. Fulra (Fulra Limestone Formation), Akri (contact of Palaeocene-Eocene ?), Harudi (contact of Harudi and Fulra formations), and Chhasra Formation have also been visited and collected samples and lithologs are prepared.

**P.S. Ranhotra**



### Project 5.2: Palynological investigation, facies analysis and palaeoenvironmental interpretations of Palaeocene-Eocene sediments in Rajasthan Basin

Palynofossils from Matasukh lignite mine, Nagaur district representing Marh Formation have been studied. The sequence, constituted by carbonaceous shale, siltstone and lignite, yielded a rich palynological assemblage. Quantitatively as well as qualitatively, angiosperm pollen dominates over the pteridophytic spores and fungal remains. Significant palynotaxa in the assemblage are assigned different species of *Lygodiumsporites*, *Todisporites*, *Lycopodiumsporites*, *Dandotiaspora*, *Arecipites*, *Palmidites*, *Longapertites*, *Proxapertites*, *Matanomadhiasulcites*, *Pseudonyssapollenites*, *Dermatobrevicolporites*, *Sastripollenites*, *Ratariacolporites* and *Meliapollis*. Based on the



*Spini prominatus*

*Dipterocapus*

stratigraphical record of palynofossils in Indian Palaeogene strata, the investigated sequence is dated as early Eocene.

S.K.M. Tripathi & Hukam Singh

### Project 5.3: High resolution biostratigraphy of Cretaceous-Tertiary sedimentary sections of Cauvery Basin

A manuscript entitled 'Palynological evidence for dating of Grey Shale, Dalmiapuram Formation, Cauvery Basin, Tamil Nadu' has been prepared. Additionally, a field visit to Ariyalur and adjoining areas, Tamil Nadu has

been undertaken and collected fresh rock samples from Grey Shale of Dalmiapuram Formation [GVKC and Kallakudi Mine-II, and Ananadawadi (K/T boundary)] areas for palynological investigation.

M.R. Rao

### Project 5.4: Palynological studies of the Late Cretaceous-Early Palaeocene sediments of Central India and the Khasi Hills of Meghalaya, India

Myxomycetaceous fossil spores have been recovered from the Deccan Intertrappean beds of Padwar (MP). These remains are found in association with the index palynotaxa of Maastrichtian age, viz. *Azolla cretacea*, *Ariadnaesporites ariadnae*, *Gabonisporites vigourouxii* and *Aquillapollenites bengalensis*. The fossil spores, flagellate swarm cells, zygotes and spores of the Myxomycetes are recovered from the highly carbonaceous lignitic shales of the dry dug out well at Padwar. The well is more than 9 m deep and the basal and top parts are composed of the traps. There is also a 3 m thick volcanic ash bed in between. The samples are rich in fungal and pteridophytic spores and angiospermic pollen, out of which the myxomycetaceous forms are

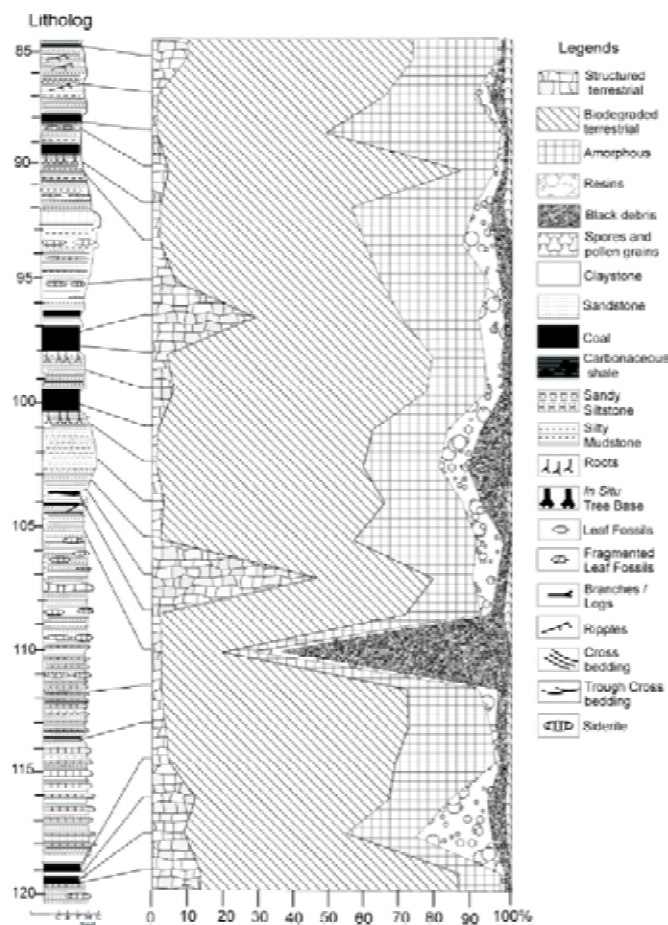
studied in detail. The myxomycetaceous spores apparently resemble some pteridophytic spores in the sub-circular shape and broad reticulation. However, the absence of trilete or monolete mark and its dark brown colour, easily differentiate them from others. Further, 4 types of motile cells are distinguished on the characters of flagella— i) unicellular cells with a posterior whiplash type of flagellum, ii) uniflagellate cells with an anterior tinsel type of flagellum, iii) biflagellate cells with one flagellum of tinsel type and the other whiplash type, and iv) both the flagella are of whiplash type. On the basis of detailed morphological characters, the myxomycetaceous forms are being constituted into new genera and species.

R.S. Singh

### Project 5.5: Palynofacies analysis and palyno-cyclicity in Palaeogene-Neogene sediments of Upper Assam and Jaintia Hills, northeast India

Finalized palynofloral and palynofacies analyses of 188 m thick section of Tirap colliery of Makum coalfields (Tikak Parbat Formation, Chattian) in Upper Assam. The studied section provides important insights into the

composition and distribution of plant communities in a late Oligocene tropical delta (palaeolatitude approximately 18° N). The lower two thirds of this section represent lower delta plain environments with only a small degree of



Distribution of sedimentary organic matter, Tirap Colliery

brackish water (marine) influence. Raised mires, autochthonous swamps and allochthonous organic matter accumulations comprise the vitrinite-rich high volatile bituminous B coals. The upper third of the section

represents upper delta plain environments with high sediment pass-through. Here standing fossil 'forests' attest to frequent inundation and recovery of the arborescent inter-fluvial vegetation. A dominance of spores attributed to the Cyatheaceae and other fern taxa indicate tree ferns and other pteridophytes were a major component of the vegetation throughout the environments represented by the section, despite the absence of ferns in the megafossil record. *Nypa* and mangrove mega remains together with mangrove pollen and *Acrostichum* spores attest to the presence of a mangrove community similar in composition to those of modern south-east Asia. Palms and megathermal tree taxa such as those belonging to the Malvaceae, Meliaceae, Alangiaceae, Anacardiaceae and Pellicieraceae inhabited the interfluvial and swamp forests.

Palynofacies analysis shows a dominance of anoxic/dysoxic environments with a small part of the lower part of the section exhibiting more oxic conditions associated with circumstantial evidence for mild marine, possibly tidal, influence. Most palynodebris fluoresce only weakly consistent with the relatively high rank for coals of this age. A small number of reworked Gondwanic (Permian) grains suggest sediment erosion from the highlands to the north. The late Oligocene tropical delta vegetation has much in common with modern lowland wet megathermal forests from south-east Asia. (jointly with N.C. Mehrotra, R.C. Mehrotra, Gaurav Srivastava, R.A. Spicer & T.E. Spicer). In addition, macerated samples collected from Jagun coal mine and well drilled for tracing coal seams along the Namphuk River, Assam N # 4, N # 7 and N#11. Slides of productive samples have been prepared and scanned.

Madhav Kumar

### Project 5.6: Palynological investigation of Miocene sediments of Mizoram and Tripura

A rich and diversified palynofloral assemblage has been recorded from the Bhuban Formation exposed along Kanchanpur road cutting section (north of Tripura). The palynoassemblages are assigned to an early Miocene in age, based on marker taxa, such as *Spinizonocolpites echinatus*, *Striatriletes susannae*, *Pteridacidites tripuraensis*, *Osmundacidites wellmanii*, *Acanthotricolpites brevicolpus*, *Retitrescolpites typicus*, *Hibisceapollenites robustispinosus*, etc. The other associated palynotaxa are *Malvacearumpollis* sp, *Trisyncolpites ramanujamii*, *Chenopodipollis* sp, *Piceapollenites excellens*, *Abiespollenites cognatus*, *Pinuspollenites crestus*, *Operculodinium centrocarpum*, *Cleistosphaeridium diversispinosum*,

*Spiniferites mirabilis*, *Oligosphaeridium complex*, *Densoisporites velatus*, *Callialasporites* sp, *Cannanoropollis trilobatus* and *Cuneatisporites rarus*. The significant taxa of the palynoflora have been compared to those of the extant members of the family Microthyriaceae, Cyatheaceae, Osmundaceae, Schizeaceae, Parkeriaceae, Acaceae, Parkeriaceae, Polypodiaceae, Pteridaceae, Malvaceae, Pinaceae, Podocarpaceae, etc. The sediments were deposited in a marginally marine environment under terrestrial influence, as indicated by the presence of very rare dinocysts and significant amount of cuticular material. The presence of *Spinizonocolpites* suggests a shoreline inhabited by mangroves. The occurrence of pollen mangrove taxa

which belongs to a coastal marsh vegetational community, support the presence of tidal swamps near the area of deposition. The diversity of angiosperm palynoflora, which forms the bulk of assemblage, is thought to indicate a dense low land vegetation cover. The taxonomic diversity of palynofloral associations indicate that the deposition

of Miocene sediments took place in high energy, brackish water and reducing conditions. Recorded palynotaxa indicate the prevalence of a moist, subtropical climate in the studied area. In addition, field work is conducted in Tripura and its adjoining areas, and collected 185 palynological samples for study.

B.D. Mandaokar

**Project 5.7: Palynological investigations of the Disang Group its palaeofloristic trends, palaeoecological and palaeogeographical interpretations**

Completed palynological study of Disang Group exposed along Silchar-Haflong Road, North Cachar Hills district, Assam. Disang Group exposed along the road is predominantly made up of shales which are generally black to dark steel grey, weathering to reddish brown. This is laminated, highly fissile to splintery. The Disang shales are assumed to be fluvial, non-marine, flood plain deposits formed in a narrow trough. Recovered and identified palynofossils like *Cyathidites australis*, *C. minor*, *Todisporites major*, *T. minor*, *Lygodiumsporites pachyexinus*, *L. eocenicus*, *Intrapunctisporis intrapunctis*, *Baculatisporites wellmanii*, *Monolites mawkmaensis*, *Polypodiisporonites repandus*, *P. tuberculensis*, *Laevigatosporites tertiarus*, *Hammenisporis micoverrucosus*, *Pinuspollenites crestus*, *Densiverrupollenites eocenicus*, *Pellicieripollis langenheimii*, *Favitracolporites magnus*, *Palmaepollenites ovatus*, besides reworked Gondwana palynofossils like *Cingulatisporites* sp., *Indotriradites sparsus*, *Vitreisporites densus*, *Lundbladisporea* sp., *Callialasporites segmentatus*.

dominated by pteridophytes particularly those belonging to family Cyatheaceae, Polypodiaceae, Parkeriaceae, Schizaeaceae, Matoniaceae and Osmundaceae. Presence of gymnospermous bisaccate pollen, *Pinuspollenites*, suggests that the topographically elevated areas were not far away from the basin of sedimentation. The recorded assemblage indicates that the area enjoyed moist, warm, humid, tropical to subtropical climate and the sedimentation seem to have taken place in fresh water environment with ponding conditions nearby. The upper recorded palynoassemblage indicates Late Eocene age to these Disang sediments. Additionally, scanned slides of the samples of Disang Group collected from Jotsoma village, near Kohima TV Station, Nagaland. Recovered and identified palynofossils like *Cyathidites australis*, *Lygodiumsporites lakiensis*, *Gleicheniidites senonicus*, *Monolites mawkmaensis*, *Lavigatosporites tertiarus*, *Polypodiisporonites oligocenicus*, *Hammenisporis susannae*, *H. multicostatus*, *Pinuspollenites crestus*, *Lakiapollis ovatus*, *Dermatobrevicolpites dermatus*, *Margocolporites tsukadae*.

The palynological assemblage recovered is

G.K. Trivedi

**Thrust Area: INTEGRATIVE MICROPALAEONTOLOGY, BIO-PETROLOGY AND ORGANIC FACIES: RELEVANCE TO FOSSIL FUEL CHARACTERIZATION & EXPLORATION (Integrated approach to realizing economic potential in prospective basins)**

**Marine Micropalaeontology Group**

**Project 6.1: High resolution biostratigraphy, biotic turnover, palaeoclimate and relative sea level changes during Late Cretaceous-Early Palaeogene (~80-35 Ma) in South Shillong Plateau, Meghalaya, northeastern India**

Within a precise sedimentological framework palynofacies analysis of Mahadek Formation (late Cretaceous), Cherrapunji area has been studied. Lithofacies in different sections of the Mahadek Formation have been determined and interpreted in terms of

depositional processes. The sedimentological study shows formation of fan delta complex during earliest marine incursion in South Shillong plateau. Palynofacies study of fine grained sediment succession in between the boulder conglomerate facies of Mahadek Formation indicate



varied types of sub-environment ranging from inner neritic, tidal flat, freshwater. (jointly with I.B. Singh)

**Rahul Garg** (superannuated w.e.f. 30.11.2010),  
**Vandana Prasad, Biswajeet Thakur & Khawaja**  
**Ateequzzaman** (superannuated w.e.f. 31.12.2009)

Multidisciplinary integrative sedimentological, mineralogical, geochemical, biostratigraphic and palynofacies studies of the Um Sohryngkew Cretaceous-Tertiary (K-T) transition in the Khasi Hills of Meghalaya, reveal biotic and environmental changes about 800 km from the Deccan volcanic province (DVP). Upper Cretaceous sedimentary succession indicates deposition in a shallow marine environment with high detrital influx from nearby continental terrains. High kaolinite and illite in clay mineral assemblages indicate high humidity and high runoff. In the Danian, sandy shale is replaced by marly limestone, indicating decreased detrital influx and a rising sea level. Microfossil assemblages (foraminifera, dinocysts & nannofossils) define the K-T boundary and suggest stressful eutrophic conditions and sea level fall, followed by a rise as indicated by increased diversity.

Marly limestone deposition and the first diverse nannofossils, dinoflagellates and planktic foraminiferal assemblages occur in zone P1c and mark the biotic recovery in the Danian correlative with the recovery after the last Deccan volcanic pulse in C29N. Biotic turnover (blooms of *Guembelitra cretacea*) likely due to mesotrophic to eutrophic conditions suggests extended periods of environmental stress during Late Maastrichtian yielding critical information related to the main phase-2 of Deccan volcanism during C29r. Kaolinite increases beginning about 40 cm below the K-T boundary and is dominant in the Danian, suggesting humid climatic conditions in the Meghalaya area. In contrast, semi-arid climate conditions prevailed in the contemporaneous Deccan Traps province, which appears to be linked to "mock aridity". These results clearly link the K-T mass extinction, high pre-K-T biotic stress, delayed biotic recovery, and anomalous PGE concentrations to Deccan volcanic activity. (jointly with Gerta Keller & co-workers, Princeton University, USA)

**Rahul Garg** (superannuated w.e.f. 30.11.2010) &  
**Vandana Prasad**

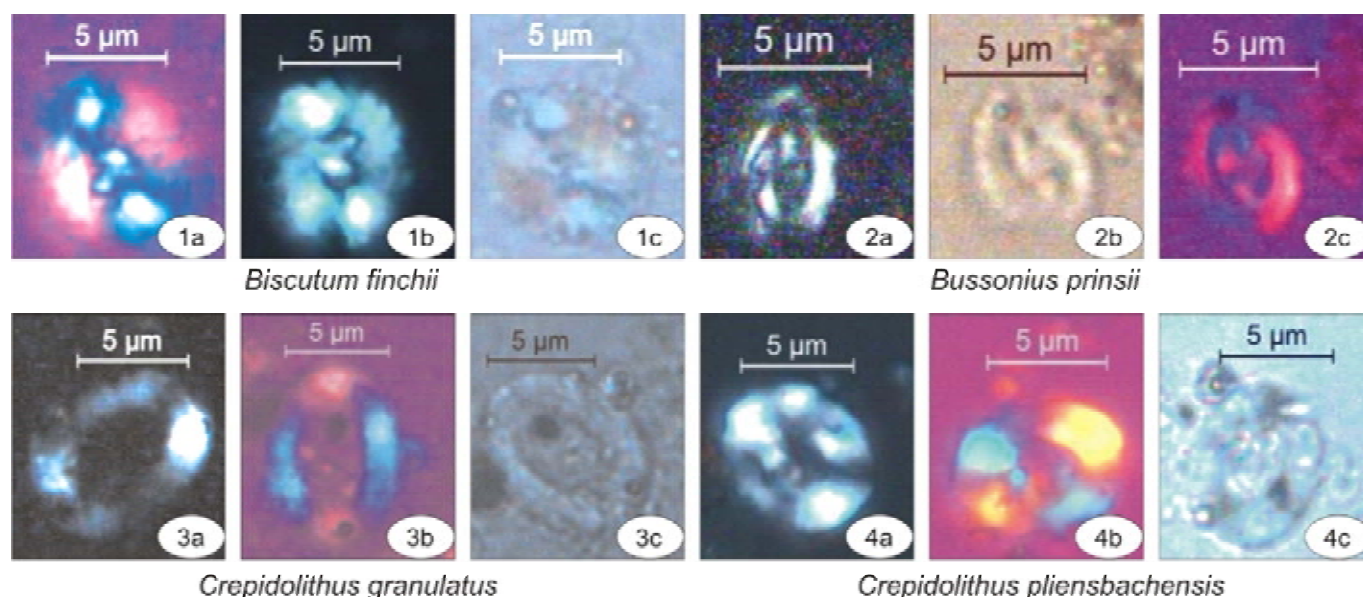
### Project 6.2: Mesozoic nannofossils from western Indian continental shelves and its palaeobiogeographic significance

**Kachchh Basin** (Wagad Island)— The oldest marine sedimentary rock unit in the Patcham Island, the Kaladongar Formation is exposed in Kuar Bet Islet situated about one km, northwest of Patcham. The Kaladongar Formation is divided into two members, lower Dingi Hill and upper Kaladongar Sandstone. The Dingi Hill Member, exposed in the Patcham Island, shows thinly bedded alternations of khaki coloured and red siltstones with hard calcareous sandstones and abundant ichnotaxa. At Point 16 in the Kuar Bet (also called Mori Bet), exposures are seen in a hillock with profuse pelyceps with rare gastropod shells near the top. The lower part of the section shows current and flaser bedding, suggesting high energy conditions. Within in this current bedding unit, a sample has yielded calcareous nannofossils (GPS location 23°59'40"N: 69°42'28"E). The recovered nanotaxa include are *Axopodorhabdus cylindratus*, *Biscutum finchii*, *Biscutum* sp., *Bussonius prinsii*, *Crepidolithus crassus*, *C. pliensbachensis*, *Crucirhabdus primulus*, *Diazmatolithus lehmanii*, *Discorhabdus criotus*, *Discorhabdus striatus*, *Ethmorhabdus gallicus*, *Lotharingius contractus*, *Micula staurophora*, *Mitrolithus elegans*, *Octopodorhabdus* sp., *Parhabdololithus liassicus constrictus*, *Schizosphaerella* sp., *Triscutum sullivanii*, *Tubirhabdus patulus*, *Watznaueria barnesae*, and *W. fossacincta*.

Presence of *Biscutum finchii* (FAD NJ5-LAD NJ6), *Bussonius prinsii* (NJ5B), *Crucirhabdus primulus* (NJ5B) and *Discorhabdus criotus* (FAD NJ7) suggests the placement of this assemblage between NJ5 to NJ7 nannofossil Zones straddling the Pleinsbachian-Torcion boundary. NJ5 represents upper Pleinsbachian whereas NJ6-7 indicates Early Toarcian. This find has wide palaeogeographical implications as it indicates that after faulting, the first transgressive event for the Kutch basin might have occurred during the Pleinsbachian-Toarcian boundary interval, some 15 million years earlier than the much accepted Late Bajocian (ammonite: *Leptosphinctes* sp. and coral: *Isastrea bernardiana* records). Record of Late Pleinsbachian age nannofossils from Masirah Island from the Sultanat of Oman, Arabia also strengthens this Kachchh finding.

Additionally, and interestingly, Pleinsbachian-Aalenian interval age reworked nannofossils have previously been recorded from the Callovian sediments of the Jara Dome, the easternmost extremity of the Kachchh Mainland (Rai, 2003). It is proposed that a global eustatic rise during the Pleinsbachian-Aalenian boundary interval coupled with local tectonics could be twin reasons for this early record.

**Jyotsana Rai**



**Jaisalmer Basin**— Thesis entitled ‘Subsurface Cretaceous age calcareous nannofossils biostratigraphy from Tanot well-1, Jaisalmer basin, Rajasthan’ has been documented. The highlights of Thesis are— i) in all 222 nannofossils species were recovered from 114 bore-well samples which are delineated in 17 alpha-neumetric biozones and 5 subzones on the basis of first occurrences of marker taxa, ii) 23 light-microscopic plates containing family-wise nannotaxa and 4 scanning electron microscopic plates are prepared, iii) the recovered nannotaxa have been plotted with respect to stratigraphic distribution, preservation factor, and r & k-strategist mode related frequency distribution, iv) on the basis of recorded global marker taxa *A. octoradiata*, *R. levis*, *T. orionatus*, *E. eximius*, *S. primitivum*, *Z. biperforatus*, *Z. noeliae*, *Z. kerguelensis*, *R. planus*, *E. rarus*, *H. chiasia*, *A. albianus*, *C. kennedyi*, *S. gausorhethium*, *Z. xenotus*, *B. africana*, *E. turrisieffellii* and *B. stenorhetha* the age assigned for these sediments is from Albion to Lower

Maastrichtian, v) record of high latitude cold water forms, viz. *S. primitivum*, *R. parvidentatum*, *B. dissimilis*, *A. octoradiata*, *Z. kerguelensis* and *Nephrolithus* spp. with warm water taxa *W. barnesae* and nannoliths, viz. *Braarudospherids* and nannoconids indicate mixing of warm and cold water currents in Jaisalmer Basin during Late Cretaceous time situated at mid latitudes (ca. 30° S), and vi) the recorded nannofossil assemblage broadly indicates shelf deposit.

Pariwar Formation in the Jaisalmer Basin, Rajasthan has been precisely dated for the first time as early Middle Albion on the basis of presence of a well diversified, moderately preserved calcareous nannofossil assemblage of the upper part of *Chiastozygus litterarius* Zone CC7b/ *Prediscosphaera columnata* Zone CC8 of Sissingh 1978 corresponding with NC8/9 zones of Bown et al. (1998).

**Jyotsana Rai & Abha**

**Project 6.3: Integrated diatom stratigraphy and palynofacies analysis of Tertiary sediments of Andaman-Nicobar Group of Islands: Implication to palaeoclimate and basin evolution**

Over 100 rock samples from 4 measured stratigraphic sections, viz. Arong road, Mus Jetty, Kakana beach Cliff, and Sawai Bay sections of Car Nicobar Island have been chemically processed for palynofossils. The productive samples of all the sections yielded rich palynofloral assemblages mostly dominated by diatoms. Important diatom taxa recorded are: *Actinocyclus ellipticus*, *Coscinodiscus excentricus*, *C. marginatus*, *C. rothii*, *Gramatophora undulata* and *Arachnoidiscus ehrenbergii*; silicoflagellates viz., *Dictyocha brevispina*, *D. fibula* and *Mesocene circulus* are occasionally found in some of the samples from Mus Jetty and Kakana beach

Cliff sections. Morphotaxonomic study of the recorded palynofossils is completed. SEM photography of selected stratigraphically important taxa is done for better understanding of taxa. A Late Pliocene age is assigned to the palynofloral assemblages recorded from Car Nicobar Island. Two papers on palynoflora of Car Nicobar Island are finalized.

Rich palynofloral assemblages have been recovered from 3 measured stratigraphic sections of Hut Bay Island, Little Andaman. Morphotaxonomic study and photo-documentation of palynofossils recovered from

these sections are completed. Two distinct palynological zones have been recognized on the abundance and distribution of stratigraphically significant palynofossils in the Hut Bay succession. The palynofloral assemblage is also compared with other known Miocene palynofloral assemblages. Analysis of the composition of this assemblage depicts its close similarity with those recorded from Inglis Island. Additionally, detailed morphotaxonomic study of the recovered palynofossils from the measured stratigraphic sections, viz. Phulri Nala section (Strait Island), North-East Coast and Wreck point sections (Henry Island) is completed. Samples from these sections are very rich in diatoms and silicoflagellates. The recovery of palynofossils belonging to pteridophytic spores, gymnosperm and angiosperm pollen is extremely poor in all the sections. Biostratigraphic potential of those recovered palynofossils is also assessed.

Palynological investigation of Long and Inglis formations at Meetha Nala of the Havelock Island have been completed. 21 genera with 37 species, varieties and

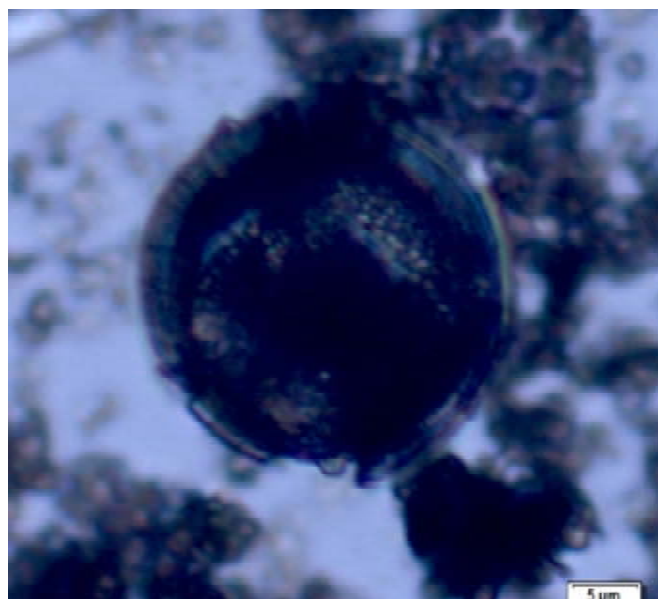
forms of diatoms have been identified. Predominant diatom taxa of the assemblage are *Actinoptychus undulatus*, *Asterolampra punctifera*, *Coscinodiscus* spp., *Gramatophora maxima*, *Rossiella* sp., *Triceratium gallapangense*, etc. The distributional pattern of diatoms in this stratigraphic sequence has been analyzed and interpreted throwing light on its dating potential and environment of deposition. On the basis of comparison of the present assemblage with other diatom assemblages known from Indian Tertiary sediments, a Middle Miocene to Late Miocene age has been assigned to the sediments of Long and Inglis formations in the present area of investigation. A paper on the aspect is finalized. Besides, carried out field work at Portblair, Havelock, Neil and its adjoining areas of Andaman-Nicobar Islands, and collected altogether 116 palynological samples from several measured sections. Survey is carried out at several localities to find out well exposed sections of Tertiary rocks in these Islands for filling gaps in our earlier studies.

Samir Sarkar

**Project 6.4: Taxonomic analysis of calcareous algae from the Cenozoic sediments of Andaman-Nicobar Basin and its implications on palaeogeography, palaeoecology and palaeobathymetry**

Coralline red algae and Halimedaean green algae have been recorded from the Limestone unit of Hut Bay (Little Andaman Island) belonging to Middle Miocene age. Taphonomy and growth-form analysis of Coralline algae, palaeodiversity of algal forms and benthic foraminifera from the late Middle Miocene sediments of Hut Bay Limestone have been done. Identification and statistical analysis of the algal forms from the Car Nicobar Island (Nicobar Group of Islands) based on thin sections have been done on the samples collected from the Kakana Limestone unit (Middle Pliocene Limestone outcropping in the Car Nicobar Island). Facies characterization and palaeoenvironmental significance of reef forming coralline algal sediments from the Middle Pliocene of Car Nicobar Island have been studied.

The expected achievements of the previous year was to record calcareous algae from the Cenozoic sediments of Andaman-Nicobar Basin and other potential sedimentary basins of India for the reconstruction of algal rich facies and to evaluate the role of algal assemblages in palaeogeography, palaeoecology and palaeobathymetry. In view of this calcareous algae have also been studied from four samples and two distinct facies types have been recognized in thin section analysis from the Umlatdoh Limestone Member of the Shella Formation. Diversity, growth-form analysis, taphonomy and palaeoecological implications of Corallanicean Red Algae and



*Thalassiosira* sp. (Dominant Diatom found) from Havlock Island

Halimedaean Green Algae from the Prang Limestone Formation of South Shillong Plateau have been studied.

Benthic and planktonic foraminifera from the Mio-Pliocene sequence of Havelock Island (Andaman & Nicobar Basin) have been isolated. Analyses and Interpretation are in progress. In addition, a field trip is



undertaken in South Andaman Island, Little Andaman Island, Havelock and Neil Islands. In South Andaman, in and around Port Blair region, samples are collected from Wadoor, Chidyatapu, Ross Island and South Point. All the outcrops are measured and the samples are collected systematically at close intervals. In Little Andaman Island (Hut Bay), four outcrops are studied and collected samples

from the measured sections. In Havelock and Neil Islands numbers of outcrops are studied in different cliff sections and samples are collected at very close intervals. Latitudes and longitudes of all sampling locations are observed and noted.

**A.K. Ghosh, Abhijit Mazumder & Pawan Govil**

### Organic Petrology Group

#### **Project 7.1: Biopetrological investigations on the coals of Wardha-Godavari coalfields in relation to coal bed methane**

Carried out coal petrographic (maceral & reflectance) research work, regarding the constitution and rank of 10 coal seams representing Bhupalpalli area of the Godavari Valley Coalfield. The coal samples collected between 106.18 and 300.35 m depth range in bore-hole No. 618 represents nine coal seams. However, samples of only one coal seam, i.e. Seam No. 5, intersected between depth range 415.65 and 416.45 m, have been collected from bore-hole No. 616. Different seams of

this area contain alternate coal bands characterized by vitrinite or inertinite rich constitution. Vitrinite reflectance value ( $R_{o, \text{mean}}$  %) range of the coals in this region ranges from 0.49% to 0.67%. In general, these coals have attained high volatile bituminous C rank. Thus, the depositional site has experienced alternate oxic and anoxic moor condition.

**O.S. Sarate**

#### **Project 7.3: Organic petrological and geochemical characterization of South Indian lignite deposits**

Organic petrological data collected from mine I section of Neyveli lignite have been further studied under normal light in order to depict the distinctive pattern of varied microconstituents in time and space. The study has shown that huminite maceral was predominantly occurring in the section studied. This provides the clue that these lignites could be best used for the extraction of humic acids. Liptinites chiefly constitute spores, pollens, cutinite, suberinite, resins, liptodetrinite also occur in appreciable amount. Alginites are also recorded from these lignites. Inertinites representing the fusinite,

semifusinite, and funginite are also noticed in Mine I section. Huminite versus inertinite maceral distribution suggest the fluctuating oxidative and reductive conditions in the evolution of Neyveli swamp. Pyrites/marcasites which cause the mining problem in the area are recorded in these lignites. The fromboidal characteristics of pyrites recorded from these lignites show the prevalence of euxinic conditions during the development of these seams in the swamp.

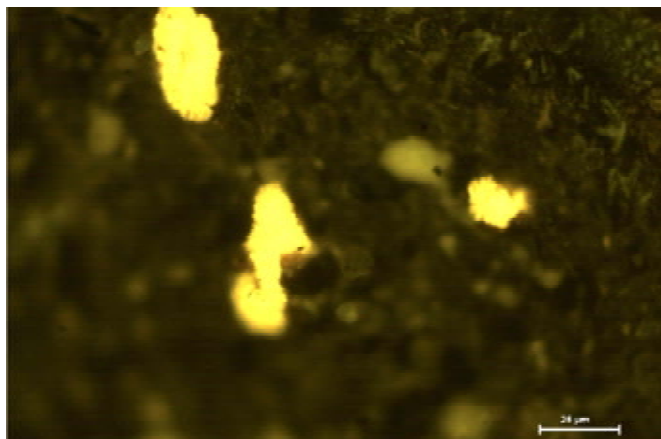
**Rakesh Saxena**

#### **Project 7.4: Organic matter characterization of lignite-bearing successions of western India**

Documented the petrological data of lower Tertiary lignites from Vastan mine (Surat district, Gujarat). These lignites, belonging to the Lower and Upper seams, are found to be rich in huminite macerals (average 57%) followed by liptinites (av. 26%) and inertinites (av. 6%) along with low to moderately high associated mineral matters (av. 11%). Liptodetrinite (av. 12%) and resinite (av. 8%) are the dominant macerals of liptinite group in these lignites. The inertinite group is represented by funginite and semifusinite/ fusinite. Predominance of huminite in general indicates the wood dominated ancient vegetation as the main source for the formation of Vastan lignites. Higher amount of detrohuminite (av. 34%) in lignites, otherwise indicative of tree-less swamps, suggests

the contribution of herbaceous and pteridophytic plants growing profusely in the dense angiospermic forests. The composition of macerals indicates the deposition of lignite in sub-aqueous condition in wet-reducing environment with intermittent exposure and subsidence of the peat surface. High detrital fractions (detrohuminite and liptodetrinite) and low tissue preservation index suggest high biological and bacterial degradation of ancient peat and elevated pH conditions of swamp. The rank of the lignites, determined through reflectance measurement ( $R_{o, \text{mean}}$ : 0.24-0.35%), indicate that the Vastan lignite is less mature and fall in the early diagenetic zone of methane generation.

**Alpana Singh & B.D. Singh**



Alginite (*Botryococcus*) from Vastan Lignite

Studied Tertiary lignites from the Mangrol mine of Surat district (Gujarat) and documented the petrological data. The overall petrographic composition is dominated by huminite macerals (av. 44%) followed by liptinites (av. 40%) and inertinites (av. 9%) with mineral matters ranging from 2 to 13%. Among the huminite group, detrohuminite (attrinite + densinite) is dominant in these lignites followed by structured telohuminite. The liptinite is chiefly represented by liptodetrinite (6-29%) and resinite (6-22%). Semifusinite, funginite and fusinite represent the

inertinite group in order of dominance. Types of huminite suggest that the ancient flora contributing as source for the formation of Mangrol lignites, belong to the floor of the forest, viz. shrubs and herbs, and middle canopy vegetation (trees). The extrapolation of Gelification and Tissue Preservation indices suggest the lignite as limnic of probable back-swamp facies. The rank of the lignites, determined through reflectance measurement ( $R_{r\text{ mean}}$ : 0.27-0.32%) designate the studied lignites to low maturity category.

**Alpana Singh, Mahesh S. & B.D. Singh**

Visited office of the Gujarat Mineral Development Corporation in Ahmedabad and had discussions on occurrences of coal/lignite deposits and mining activities in south Gujarat. Undertook field work in coal-bearing area (Thangarh) of Surendranagar district, and lignite-bearing areas of Bhavnagar (Surkha and Khadsalia mines), Surat (Mangrol mine) and Bharuch (Amod mine) districts, and collected coal, lignite and associated sediments (carbonaceous shale, shale, clay, etc.) for organic petrological and palynofacies studies from working mines as well as bore-hole.

**B.D. Singh & Mahesh S.**

## Fossil Fuel Exploration Research Group

### Project 8.1: Development of Advance Centre of Applied Palynology and Stratigraphy for Fossil Fuel Exploration Research

Efforts have been made to upgrade the facilities to assure full realization of short-term gains and long-term needs of the fossil fuel industry.

**N.C. Mehrotra & team of Scientists**  
(engaged in Palynological & Organic Petrological studies)

Initiated the process to take up the consultancy work on organic petrological aspects (maceral composition and rank) of coal samples, in relation to coal bed methane, received from Central Institute of Mining and Fuel

Research (CIMFR, Barwa Road Campus), Dhanbad.

**B.D. Singh & Alpana Singh**

Processed samples of Himalayan Foot Hills, Vindhyan Supergroup and Krol Belt of Himalaya for the study of palaeobiological remains. Also measured the thermal alteration index of the organic remains in relation to hydrocarbon prospect, and the report has been submitted to Frontier Basins, ONGC.

**Rupendra Babu & Madhav Kumar**

**Thrust Area: MULTI PROXY PARAMETERS FOR QUATERNARY PALAEOCLIMATE RECONSTRUCTIONS, VEGETATION DYNAMICS, RELATIVE SEA LEVEL CHANGES AND ANTHROPOGENIC INFLUENCE (Integrated Approach to Climate Change, Modelling and Sustainable Ecosystems)**

## Quaternary Palaeoclimate Group

### Project 9.1: History of mangrove vegetation in Mahanadi Delta

A 530 cm deep sediment core from the eastern region of Chilka Lake has been palynologically analysed. The results of CHI 51 profile has revealed four climatic

phases during the terminal Pleistocene and across the Holocene. The overall vegetational sequence that has emerged indicates that between 13,607 and 8,842 yrs BP,



there is low recovery of core mangrove taxa. However, peripheral mangrove taxa, such as Fabaceae and *Terminalia* sp. appeared sporadically with moderate frequencies. The vegetational picture of this zone reflects that the sea was at a lower level; but since the climate had begun to get milder, there was initiation of mangrove vegetation in the region during this phase. The subsequent phase between 8,842 to 5,983 yrs BP shows a steep decline in most of the midland and ubiquitous taxa. This zone exhibits predominance of core mangroves, such as Rhizophoraceae followed by *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Xylocarpus granatum* and *Excoecaria agallocha*, which are represented by high frequencies in the middle and then decline at the close of this zone. The palaeofloristic picture of this phase depicts marine influence which was possibly due to rise in sea-level. Proper brackish water environment facilitated the profuse growth and expansion of mangrove vegetation during this time span. This indicates amelioration of climate, which was due to more warmer and moist conditions than the earlier phase.

The succeeding phase between 5,983 and 1,771 yrs BP portrays a sharp decline in mangrove taxa frequencies. It is marked by highly reduced values of

Rhizophoraceae members. Midland taxa and ubiquitous group are represented in better frequencies than the mangrove elements. Thus, the vegetational scenario obtained from this phase shows that the sea spread had ceased resulting in the lowering of sea-level which restricted the growth of mangroves. The last phase between 1,771 yrs B.P. to Recent is characterized by the total absence of core mangroves, except *Avicennia marina*, which is recorded sporadically. The sparse distribution of mangrove associates is also observed. The midland vegetation reaches its zenith and herbaceous vegetation also maintains their good representation. The fresh water taxa, such as *Potamogeton* sp. and *Typha angustifolia* are recorded in high values than the preceding phases. Thus, the total vegetational scenario suggests fresh water depositional environment as indicated by good frequencies of aquatic elements and complete absence of dinoflagellate cysts, though, the climate had turned relatively drier than the previous phase as marked by the disappearance of core mangroves. Anthropogenic activities may also have accelerated the degradation and eventual disappearance of mangroves in the region.

Asha Khandelwal (superannuated w.e.f. 31.08.2009) &  
Shilpa Singh

### **Project 9.2: Evolution of Mangroves and Coastal Vegetation; Its implications in Palaeoclimate and sea-level studies during Quaternary**

A 8000 yrs BP record of relative sea level fluctuations and vegetational changes has been recorded. Total 4-5 intermittent cycles of these changes reveal the status of Middle Holocene transgression followed by regression coupled with deltaic progradation. This process was not continuous but subjected to short term relative sea level rise and fall in the region. Manuscript is under preparation on the aspect from Pedna and Machlipatnam

(2.5 m and 2 m profiles).

A new proxy (fresh water thecamoebians) has been identified with the work carried out from ~7 fresh water lakes nearby Lucknow and its importance in understanding fresh-water palaeoecology and palaeo coastal-wetland changes has been established for the first time from India.

Anjum Farooqui

### **Project 9.3: Multi-proxy palaeoclimatic studies in coastal and marine sediments of western Indian region**

Dinoflagellate productivity of 117 SC26 core has been studied in detail. The study shows low dinoflagellate diversity during 13065  $\pm$  30 cal yr BP. Dinoflagellate assemblage is dominated by *Spiniferites* sp, low land derived organic matter and lack of cyanobacterial content. This is in contrast to the productivity signal at ~11201  $\pm$  30 cal yr BP which shows high dinocyst diversity pattern, abundance of land derived organic matter and high cyanobacterial population. Amongst the dinocyst the

peridinioid dinoflagellates cyst dominates post 11201 cal yr BP. The study indicates high nutrient discharge due to high runoff probably due to intensification in SW monsoon during early Holocene. Low dinocyst diversity and low surface run off at 13065 cal yr BP coincides with the dry phase of younger Dryas event.

Vandana Prasad, Biswajeet Thakur & Rahul Garg  
(superannuated w.e.f. 30.11.2010)

The surface sediments from 17 stations in the Vembanad Estuary have been carried out for accessing the variation in the palynofacies assemblage. Various types of organic matter constituents were characterized. The study shows that the terrestrial organic matter content was higher as compared to marine organic matter. The different stations showed varying frequencies of palynofacies components. The study indicates that owing to variable carrying capacity of streams, differential runoff conditions, the rate of sediment influx during the monsoonal times, salinity changes, display differential productivity signals in these stations. These studies will

be applied in down core sediment study from the adjoining region.

**Biswajeet Thakur, Vandana Prasad & Rahul Garg**  
(superannuated w.e.f. 30.11.2010)

The field work has been carried out in the Kerala off shore region in the cruise SSK-15 in collaboration with NIO, Goa, from the latitudes 7°52.5703" to 9°58.8664" and longitudes 75°15.6372" to 76°56.6595". In the cruise three transects are made and 38 stations are covered and 34 Spade cores (SC) are collected. The length of the spade cores varies from 7 to 40 cms.

**Vandana Prasad**

**Project 9.4: Studies on Quaternary vegetation and climate change in southwestern Madhya Pradesh, based on pollen proxy evidence**

Accomplished pollen analysis of 14 surface samples from Badwani and Pokharni, Harda district, which has revealed the dominance of non-arboreals over the arboreals. Among the trees, *Madhuca indica* emerges to be the prominent element as marked by its consistently high values followed by *Terminalia*, *Holoptelea*, *Sterculia urens*, *Symplocos*, etc. in variable frequencies. The sporadic presence of other trees, viz. *Adina cordifolia*, *Lannea coromandelica*, *Embllica officinalis*, *Tectona grandis*, *Acacia* sp., etc. is ascribed to their low pollen production owing to entomophilous mode of pollination as well as relatively less frequent presence in the forest floristic. Poaceae, Cheno/Am, Tubuliflorae and sedges are the major non-arboreals. The representation of these taxa corresponds with their occurrence in the ground flora. Fungal spores, viz. *Nigrospora*, *Microthyrium* and *Glomus* are also recorded frequently.

Pollen analysed a 1.5 m deep sediment profile from Badwani, Harda district. All the samples have exhibited poor pollen assemblage. The recovered taxa comprise a few trees such as *Madhuca indica*, *Syzygium*, *Holoptelea*, *Acacia*, etc. in extremely low values, whereas the herbaceous elements, viz. Poaceae, Cheno/Am, Cayophyllaceae, Asteraceae, Cyperaceae, etc. are also met with in moderate frequencies. The overall vegetation composition infers the presence of open vegetation in the area during the course of sediment accumulation. Radiocarbon dates for the profile are awaited.

**M.S. Chauhan & Anjali Trivedi**

Finalized a paper entitled *Mid-Holocene vegetation vis-à-vis climate change in southwestern*

*Madhya Pradesh, India*. The pollen sequence deciphers that between 6,000 and 5,409 yrs BP open mixed deciduous forests comprising *Lannea coromandelica*, *Terminalia*, *Madhuca indica*, *Syzygium*, etc. occurred in the region under a warm and less-humid climate, which got transformed into dense mixed moist deciduous forests between 5,409 and 4,011 yrs BP with the initiation of to a warm and humid climate. The mixed forests turned less diversified around 4,011 to 2,178 yrs BP due to prevalence of a warm and less-humid climate again. Since 2,178 yrs BP onwards, the enrichment of forests reflects a warm and more-humid climate.

Accomplished another paper entitled *Pollen rain deposition pattern in tropical deciduous Sal (Shorea robusta Gaertn.) Forests in Shahdol District, southeastern Madhya Pradesh, India*, based on the analysis of 6 surface samples from Khanaudi Village, Shahdol district. The study has revealed the relatively lower frequencies of arboreals in contrast to non-arboreals. *Shorea robusta*, a dominant forest element, is recorded with av. 2% pollen only. The under-representation of *Shorea robusta*, despite being a high pollen producer, could be attributed to poor preservation of its pollen. Other trees viz., *Terminalia*, *Lagerstroemia*, *Embllica officinalis*, *Syzygium*, *Sterculia*, etc., despite occurring appreciably in the forest, are sporadic owing to their low pollen productivity. Grasses, sedges, Tubuliflorae, Cheno/Am, etc. are the major non-arboreals, corresponding with their composition in the ground flora. The consistent presence of Cerealia pollen indicates the proximity of human habitation.

**M.S. Chauhan & Md. Firoze Quamar**

### Project 9.5: Studies on Quaternary vegetation and Climate from Himalaya

Compiled the geochemical and pollen analyses data of sedimentary profiles from various Tals of Kumaun Himalaya, which has revealed the knowledge of total organic matter and corresponding climate existed at the

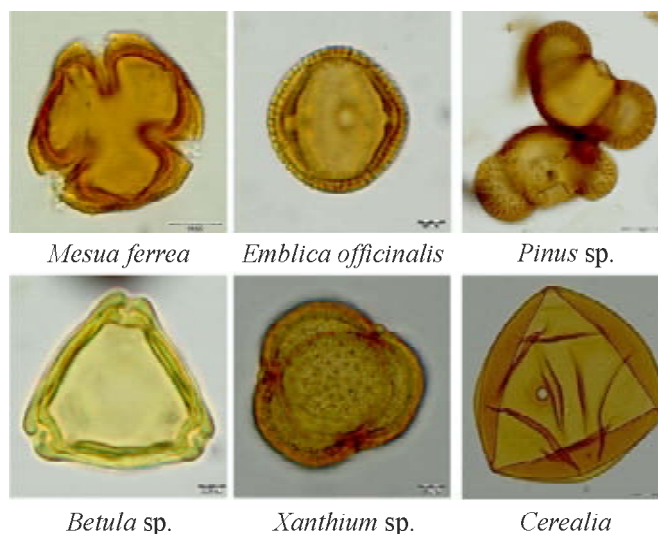
region during late Quaternary. Palaeontological data has revealed molluscan shells from the younger portions; supporting humid conditions during late Holocene.

Asha Gupta (superannuated w.e.f. 31.08.2011)

### Project 9.6 Proxy climatic signals from lacustrine lake sediments of Upper Assam Basin and adjoining foot-hill forests of Arunachal Pradesh (Subansiri District) during Holocene: A comparative palaeoecological assessment

Studied pollen morphology of 30 major tree taxa belonging to semi-evergreen and mixed deciduous forest of Arunachal Pradesh for precise identification of sub-fossil pollen to reconstruct palaeovegetation and climate of the area. Pollen/vegetation relationship is established from Hapoli-Ziro Valley. Study showing the existence of tropical mixed deciduous forest comprising *Schima wallichii*, Magnoliaceae, *Bauhinia* and *Cinnamomum* under warm and humid climatic condition. Also studied the air catches support air borne pollen dispersal with surface sample data. A 2.5 m road cutting soil exposure section from Tarin-Hapoli road has also been pollen analyzed. Palynoassemblage reveal five climatic phases under cool and dry to warm and humid climatic condition. Carbon date is in progress.

Pollen analyzed 25 subsurface samples from different sites of Itanagar wildlife sanctuary. The pollen assemblage depicts predominance of the non-arboreals (55-60%) over arboreals (30-40%) which do not fully cohere with extant vegetation. Incidence of Arecaceae pollen probably belongs to *Arenga* and *Caryota* is significant which is not growing in and around the sanctuary, needs further investigation. An urgent need is



Palynoassemblage from Itanagar Wildlife Sanctuary

required for immediate steps under a well-planned strategy to conserve the rich plant diversity in the sanctuary to trace palaeoclimate of pristine sanctuary in relation to global context.

S.K. Bera & S.K. Basumatary

## Dendrochronology Group

### Project 10.1: Development of long-term high resolution proxy climate record from the Himalayan region

Analysed tree-ring chronologies of *Pinus gerardiana* and *Cedrus deodara* from Kinnaur, Himachal Pradesh to develop climate reconstructions. In addition, the tree ring samples of *Pinus roxburghii*, *Pinus*

*wallichiana* and *Cedrus deodara* have been collected from various sites around Chamoli, Joshimath and Malari, Uttarakhand. The ring-width sequences in 60 samples of *Pinus wallichiana* are crossdated and measured.

R.R. Yadav

### Project 10.2: Analysis of climatic changes based on multi-proxy data during Holocene from Peninsular and Himalayan regions

Spatio-temporal growth variability of 3 *Pinus* species, viz. *Pinus kesiya* (Khasi pine), *Pinus merkusii* (Merkus pine) and *Pinus wallichiana* (Blue pine) along with the existence of species differentiation among the

taxa in northeast India has been carried out. Several statistical analyses are used namely Pearson correlation and multivariate approaches involving UPGMA Cluster Analysis; ordination methods by Principal Component

Analysis (PCA) and Non-metric multidimensional scaling (NMDS) on tree-ring width chronologies from 13 sites. The tree growth-climate relationships are assessed with both correlation and bootstrap response function using regional climate dataset of each sampling sites prepared by averaging nearest grid points of 0.5 x 0.5 degree of CRU TS-2.1 climate dataset. Pronounced species differentiation in the growth pattern among the three *Pinus* taxa is inferred. The observed spatio-temporal variability revealed inter-species tree growth variations are not uniform suggesting no common factor influenced the radial tree growth in this region, which may be related to anthropogenic impact or non-climatic factors. The tree growth-climate relationship showed that climatic factors limiting the radial growth of Pine are mostly similar for intra-species but diverse in inter-species.

*Pinus roxburghii* Sargent (Chir pine) and *Cedrus deodara* (Roxb.) G. Don, (Deodar) in contrast to their normal succession at an altitude gradient, exhibit reversed orientation at Kasol, Kullu, Western Himalaya. Evidences are given for such aberration in succession pattern through the application of standard techniques of dendroecology, viz. cross-dating, chronology development and establishment of tree growth climate relationship. We propose that the availability and amount of soil moisture

during the early part of the growing period has an important role in the growth of both taxa. However, at the lower elevation, higher soil moisture availability for a longer duration from melting of deposited snow of this site make suitable for the growth of deodar. At the upper strata, chir pine confines in habitat with the steep slope, shallow soil depth or almost barren rock surface, low water infiltration along with prevalence of ground fire and such environment is not suitable for the succession of deodar.

**S.K. Shah & Amalava Bhattacharyya**

Macerated sub-surface sediments from a sediment profile of Tripura for phytolith analysis. The preliminary analysis shows phytolith assemblage consists of various forms of cross, bilobate (Panicoideae), short saddle (Chloridoideae), rondel, trapeziform (Pooideae) and bulliform cells belong to grasses. Among the non-grass morphotypes significant frequencies of globular echinate (Arecaceae) and globular granulate (woody dicot) have been retrieved. The recovered phytoliths will be used in reconstruction of the vegetation scenario and climatic analysis. The identification and counting of phytolith assemblages are in progress.

**Ruby Ghosh, S.K. Shah & Amalava Bhattacharyya**

## Palaeoethnobotany Group

### Project 11.1: Palaeoethnobotany: Ancient man, plants and environment in northern and north-western India

Morphological investigation of seed and fruit remains' samples from Chalcolithic site Ahichchhatra, District Bareilly (UP) continued. The samples comprised of carbonized seed and fruit remains of field crops belonging mainly to cereals, legumes/pulses of west Asian origins, viz. *Hordeum vulgare* (Barley), *Triticum aestivum* (Bread-wheat), *Triticum sphaerococcum* (Dwarf-wheat), *Pisum arvense* (Field-pea), *Lathyrus sativus* (Grass pea) and *Lens culinaris* (Lentil); along with indigenous *Oryza sativa* (Rice), *Vigna radiata* (Green gram), *Vigna mungo* (Black gram). In addition to these crop remains reported earlier, *Gossypium* sp. (Cotton) and *Linum usitatissimum* (Linseed) are new finds. *Echinochloa crus-galli* (Sawan-Asian millet), *Setaria* sp. (Foxtail millet), etc. and a number of weeds associated with winter and summer season crops as well as wild taxa, viz. *Eleusine indica* (Goose grass), *Andropogon* sp (Blue stem grass), *Dactyloctenium aegyptium* (Crowfoot grass), *Ischaemum rugosum* (Dhanua), *Poa* sp. (Blue or meadow grass), *Cleome* sp. (Hurhur), *Commelina benghalensis*, *Convolvulus* sp.,

*Carex* sp., *Cyperus* sp. (Flat sedge), *Elaeocharis* sp. (Spikerush sedge), *Fimbristylis* sedge, *Scirpus* sp., *Chenopodium* sp. (White Goose foot/Bathua), *Ficus* sp. (Gular), *Ziziphus* sp (Jujube), *Coix lachryma-jobi* (Job's tears), *Polygonum barbatum*, *Anagallis arvensis* (Pimpernel/Jonkh-mari), *Desmodium gangeticum* (Tick clover), *Indigofera hirsuta* (Indigo), *Panicum* sp. (Panicum grass), *Scleria* sp., *Sida* sp., *Solanum* sp., *Trianthema* sp., *Vicia sativa* (Common-vetch), of palaeoethnobotanical significance are also recorded. The samples investigated have further added data to advanced agricultural practices in this region of Upper Ganga Plain in ancient times.

**Chanchala Srivastava & A.K. Pokharia**

Collected botanical remains from ancient site at Kampil, District Farrukhabad (UP) in collaboration with the excavation team from Department of Ancient Indian History and Archaeology, University of Lucknow under DST project 'Archaeology of Ganga plain'.

**Chanchala Srivastava**



Participated in the excavation and collected botanical remains and samples for palynological and phytolith analyses from the Harappan archaeological sites Khirsara and Kotada-Badli in Kachchh district, Gujarat.

**A.K. Pokharia & Ruby Ghosh**

Maceration of samples already collected from Kumhar Tal near an archaeological site (Ahirua Rajarampur in District Kannauj, UP) of Ganga valley for pollen and phytoliths are in progress.

**Ruby Ghosh** (w.e.f. 29.07.2011)

**Project 11.2: Studies on phytodiversity and ethnobotany of Bilaspur in Chhattisgarh State and Anuppur in Madhya Pradesh State**

Different localities of vegetation and tribal rich areas of Achanakmar, Amarkantak and Bilaspur have been surveyed and collected about 500 plant specimens. All plant specimens are identified as 197 species belonging

to 169 genera and 77 families. Ethnobotanical survey is also conducted in different Baiga dominant areas and documented 400 medicinal plant species used for treatment of various diseases.

**D.C. Saini**

**Isotope and Geochemistry Group**

**Project 12.1: Tectonoclimatic signatures in Ladakh and Lahul sectors of Tethyan Himalaya during Quaternary period: A multi-proxy approach using mineral magnetic, geochemical and geochronological parameters**

The geomorphological landscape of young fold mountain belt can change drastically even within short time scales of few thousand of years. The existence of a 185 km valley lake during the Late Quaternary (~20 ka BP) in the Ladakh Himalayas, occupying the present day Tangtse and Shyok river valleys, covering an area of 1150 sq km is one such example. This lake was the western extension of the present day Pangong Tso lake. The area lies in the active zones of Karakorum Fault (KKF) and Shyok Suture (SS) in NW Trans Himalaya. A slip rate along KKF with the help of stream offset is calculated as 2.6 mm/year. In spite being washed away by the combined effects of active tectonics and intense erosion, the buff colored clay-silt-sand lacustrine facies is well-preserved at few places and is also exposed almost continuously on both banks of the rivers indicative of the existence and extent of this lost lake.

Indus river valley basin situated in NW Indian Himalaya is tectonically unstable, exhibits a complex topography, landscape relief and varied Quaternary sedimentation. A 365 km transect along the valley in Ladakh (Trans Himalayas) has been conducted, which reveals the existence of major palaeolakes that sustained between ~ 17,000-14,000 yrs BP and 10,000-1500 yrs BP. Of the two lakes one was formed post LGM times around 17,000 yrs BP and breached out prior to Older Dryas period indicating of warmer and congenial rainfall and melt water supply between these two globally marked cold episodes. Other lake was formed after the Younger

Dryas and existed till ~1,000 yrs BP indicative of the Holocene warming responsible for its sustenance. These lacustrine sediments and the climate and tectonic activity that may have taken place during this age bracket are studied in details. The major geomorphic landforms are alluvial fans, debris cones, unsorted pedestals, fluvio-lacustrine deposits, scree, talus cone, etc. Ubiquitous mass movements and catastrophic land sliding, due to tectonic activity and abnormally high precipitation has transported the material from steep slopes to valley bottoms and was responsible of forming lakes (preserved as thick piles of fine sediment), while the outburst floods redistributed the sediment down valley.

The water and channel sand samples have been collected from 60 and 32 locations respectively, which includes samples from the entire stretch of Indus, Shyok, Nubra, Tangtse and Zaskar rivers and few first order streams and hot springs. The physical parameters such as temperature, pH, conductivity, dissolved solids, etc are measured in the field itself. The major cation and anions are analyzed at the Environmental Division of CIMFR, Dhanbad. Some trace metals in water samples and all major and trace elements of the sediment samples are measured at School of Environmental Sciences, JNU, New Delhi. The preliminary results show that Indus water is getting their ionic load largely from the silicate rocks; however all other smaller rivers show a mix of contribution from silicate and carbonate sources.

**Anupam Sharma & Binita Phartiyal**



**Project 12.2: Developing and combining physical, geophysical and geochemical methods to make a comparative study of Late Quaternary climate recorded in lake sediments/ deposits from Himalayan regions**

Use has been made of radiocarbon dating in studying a number of sediment and charcoal samples of several Himalayan areas. The data bank on dates for sediments from Himalayan region, including north-east (Phubla, Loktak, Manipur; Manipur- Nagaland border), Nachiketa and Mardunga in Uttarkashi (Uttarakhand) has been further enhanced, supplemented with more C/N data for palaeoclimatic studies and analysed. Published on the applicability of the radiocarbon method to samples from high altitude areas of Spituk-Leh section in Ladakh along the river Indus and Seko-Nasung section in the Spiti River Valley. The study highlighted the care needed in sample

selection and interpretation while dealing with samples from carbonate-rich surroundings. Based on radiocarbon dates on Indian materials of archaeological significance, an analysis and overview of ancient cultures in the northern India is carried out and finalized. The analysis reflects the emerging opinion regarding greater antiquity for Indian cultural sites than usually believed. The radiocarbon dating is also carried out on a number of other samples of archaeological/ palaeoclimatic significance from Himalayan region along with background and standard measurements. Procurement of various essential chemicals, materials and parts is processed.

**C.M. Nautiyal**

**Thrust Area: POLAR AND MAJOR PLANETARY EVENTS (Polar research and record of events such as Tsunamis, Earthquakes and Volcanism)**

**Arctic-Antarctic Research Cell**

**Project 13.1: Quaternary climatic history of Schirmacher and Larsemann Oasis (East Antarctica), Ny Alesund Area (Svalbard, Norway) and surrounding ocean: A multi-proxy approach based on polar lake sediments**

Visited Ny-Alesund, Arctic region for field related studies during mid July- early August. Three broad categories were identified for the present work: i) aeropalynological studies, ii) collection of sub-surface sediments from new profiles, and iii) collection of pollen from the flowers. For aeropalynological studies, as in the previous years, the dispersed air-borne palynomorphs have been monitored to develop the pollen calendar and to have an idea about the deposition of pollen in the modern sediments. The data for the previous expeditions are also being compared.

Sub-surface sediment samples have been collected from two new localities identified during the previous visits. Pit No. 5 (150 cm depth) is dug till the permafrost layer within the moraines near the Stybekken glacial stream. The trial trench is very interesting having varied lithological intercalations such as sand, silt, clay, peat and shells after

90 cm depth. Samples are collected at 5cm intervals for palynological studies and dating ( $^{14}\text{C}$  & OSL). Pit No. 6 (95 cm depth) is dug on the moraine deposit north of Vestrebrogger Glacier near the Italian weather station and NERC research plot. The trench mostly has sand and clay intercalations with accompanying grits. Beyond 95 cm it was not possible to dig as coarse grained morainic boulders are encountered. Samples are collected at 5 cm intervals for palynological studies and dating.

One major aspect of the work involves the collection of polleniferous material from the flowers to prepare the pollen atlas of Svalbard region. Last year we had visited during July, and were just in time to observe the flowers and by mid July most of the plants began to dry up. Therefore, we wanted to update our data and had asked for a June slot. But since we were given a mid July-early August slot instead, so by the time we reached there most

of the flowers had dried off. Besides, surface samples and samples collected from sedimentary profiles during earlier visits are being macerated for the release of palynomorphs and qualitative and quantitative studies of the same are continuing. Permo-Carboniferous sediments were also macerated but were found to be devoid of palynomorphs.

**Ratan Kar & P.S. Ranhotra**

Diatoms have been recovered from the lake samples of Schirmacher Oasis, which are being further studied to understand the impact of environmental factors. This will help to detect changes (if any) in the pristine Antarctic ecosystem.

**Vartika Singh**

**Project 13.2: Gondwana floristics of Wardha-Godavari Basin, India and Trans- Antarctic Mountain, Antarctica: Evolution, biostratigraphy, palaeoecological signatures and palaeophytogeographical implications**

Revised the manuscript on 'An Early Permian *Glossopteris* Flora from the Umrer Coalfield, Wardha Basin, Maharashtra, India' for the journal *Alcheringa*. The assemblage is represented by the orders Equisetales, Glossopteridales and Cordaitales, and comprises *Gangamopteris clarkeana*, 15 species of the genus *Glossopteris*, viz. *G. arberi*, *G. browniana*, *G. communis*, *G. conspicua*, *G. damudica*, *G. indica*, *G. intermedia*, *G. longicaulis*, *G. recurva*, *G. searsolensis*, *G. spathulata*, *G. stenoneura*, *G. syaldiensis*, *G. tenuifolia*, *Glossopteris* sp., the fructification *Scutum* sp.cf. *S. leslium*, a number of leaves belonging to the genus *Noeggerathiopsis* i.e. *N. hislopian* and branched and unbranched equisetalean axes. The flora though, largely comparable with that of the Barakar Formation of the Damodar Basin, with respect to the qualitative and quantitative distribution of the Lower Gondwana elements, exhibits a character of its own and is Artinskian to Kungurian in age. Besides supplementing the knowledge of the flora of the Wardha Basin, this is the first systematic documentation of the *Glossopteris* flora from the Barakar Formation of the area. (jointly with SK Pandita & Bernardes-de-Oliveira).

**Rajni Tewari, Deepa Agnihotri & S.S.K. Pillai**

Revised the manuscript on 'Gymnospermous seeds from the Barakar Formation of Umrer Coalfield, Wardha Basin, Maharashtra'. Platypermic and radiospermic gymnospermous seeds are documented from the top seam of the Barakar Formation, Makardhokra Open Cast Project of the coalfield. A variety of seed types including *Cordaicarpus* sp., *Cordaicarpus zeilleri*, *Samaropsis*

*feistmantelii*, *Samaropsis* sp., *Rotundocarpus ovatus* and a new species, namely *Rotundocarpus mucronatus* are systematically described. The seeds are largely comparable with those described from the Karharbari Formation of the Damodar Basin. This is the first record of these seeds from the coalfield. (jointly with SK Pandita).

**Rajni Tewari, N.C. Mehrotra, S.S.K. Pillai & Deepa Agnihotri**

Finalized detailed systematic description of floral elements of *Dicroidium* from the Triassic sediments of Lashly Formation, Allan Hills, Central Transantarctic Mountains, Antarctica. The plant taxa comprise *Phyllothea greisbachii*, *Phyllothea* sp., equisetalean axes, calamitalean axes, nodal diaphragms, *Dicroidium odontopteroides*, *D. fremouvensis*, *D. dutoitii*, *Umkomasia macleani* – *Pteruchus* sp. and *Heidiphyllum elongatum*. The megafossil assemblage has been compared globally. *Phyllothea griesbachii*, *Phyllothea* sp., *Dicroidium fremouvensis*, *Umkomasia macleani* and *Pteruchus* sp. are the first record from the Allan Hills. (jointly with Sankar Chatterjee).

**Rajni Tewari**

Review of spores-pollen assemblages in Chintalapudi sub-basin and compilation of data have been carried out. Raniganj palynoflora shows dominance of striate disaccates, viz. *Striatopodocarpites*, *Faunipollenites*, and significant presence of *Crescentipollenites*, *Guttulapollenites* and rare occurrence of stratigraphically significant taxa, viz. *Falcisporites*, *Klausipollenites*, *Lundbladisporea*,

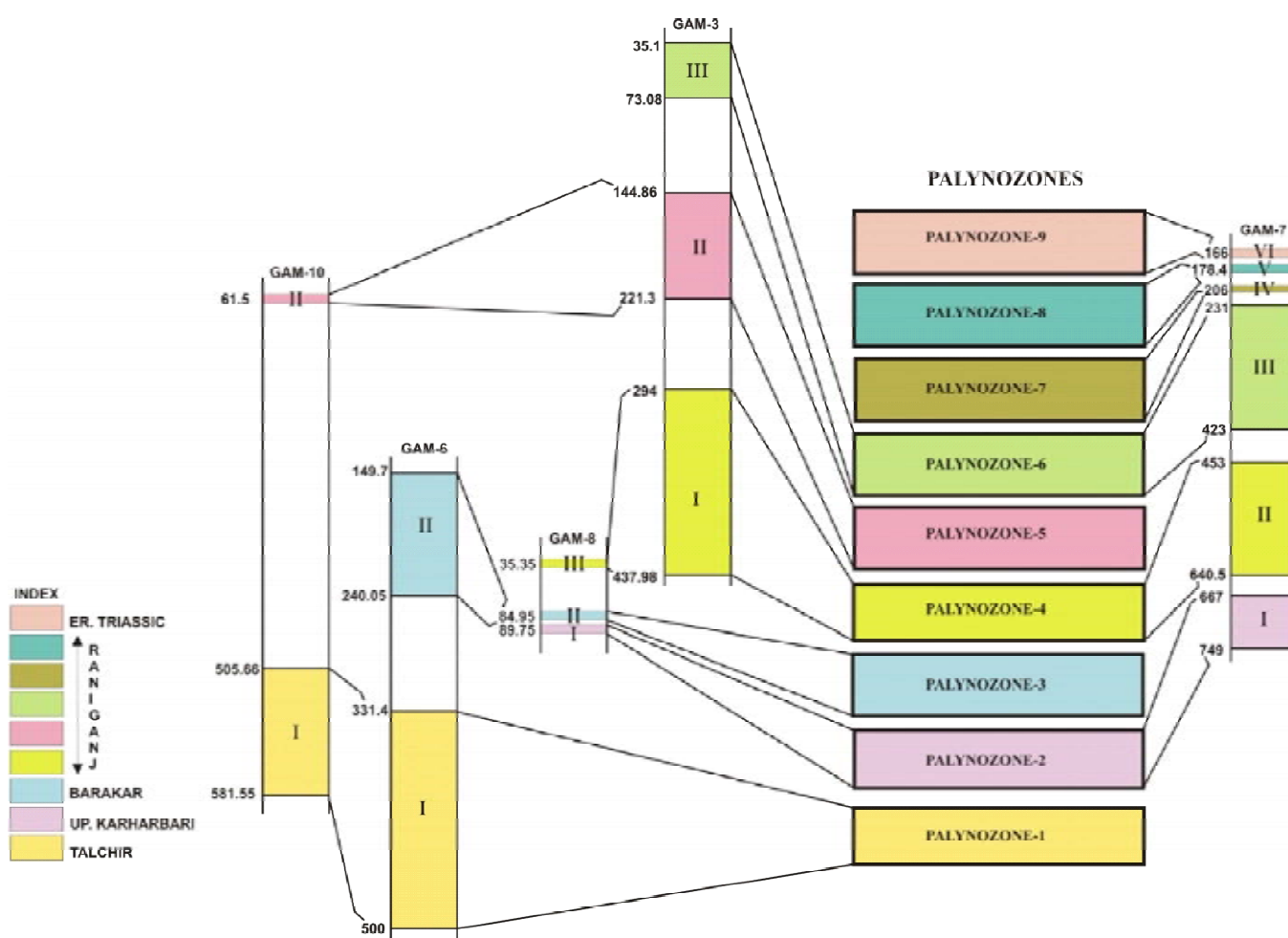
*Lunatisporites*. Early Triassic Panchet palynoflora shows dominance of taeniate, viz. *Lunatisporites*, and cingulate cavate spores, viz. *Lundbladispora* and *Densoisporites*. Presence of Late Permian (Raniganj) and Early Triassic (Panchet) palynoflora indicates presence of Raniganj and Panchet sediments in the sub-basin. Permian Triassic transition is similar to that of Salt Range, Pakistan. In addition, undertook field work in Ramagundam and nearby areas of the Godavari Graben and collected palynological samples, after attending the Field Workshop at Kothagudem.

Neerja Jha

Finalized manuscript entitled 'A palynostratigraphic study of the Umrer Coalfield of Wardha Basin, Maharashtra State, Central India and its Putative correlation with Indian and other Gondwanan palynostratigraphies.

Pauline K. Sabina

Photo-documentation, compilation and finalization of palynological studies have been carried out from Mailaram area of Godavari Graben for palynostratigraphic correlation. A complete palynological succession from Talchir (Early Permian) to Panchet Formation (Early Triassic) has been demarcated.



Palynological correlation of studied bore-holes, Mailaram area

Neerja Jha & Neha Aggarwal

## Thrust Area: FRONTIERS IN PALAEOBOTANICAL RESEARCH (Reconnaissance Projects to aid in development of future research direction)

### Project 14.1: Carboniferous land plants in the Himalaya (Spiti): Phytogeographic and palaeogeographic implications

The studied specimens from the Spiti area include *Asterophyllites* sp., stems, trace fossils, conifer axes and

?Psilophytes axes. The work carried out in this project is being finalized for publication.

**K.J. Singh** [& **S.K. Parcha** (WIHG)]

### Project 14.2: Megaflora and palynology of the Kargil Molasse

Compiled the palaeofloral (leaf impressions, spores-pollen, algal and fungal remains) and gyrogonites of charophytes records recovered from the Kargil and

Tharumsa formations (Kargil Molasse Group) of north-west Ladakh Himalaya.

**R.C. Mehrotra, Madhav Kumar & AK Ghosh**  
[& **Ashok Sahni** (Chandigarh) & **K. Kumar** (WIHG)]

### Project 14.3: Chronology, palaeobotany and magnetostratigraphy of the Rajmahal volcano-sedimentary succession

Compiled the palaeofloral records recovered from the Intertrappean beds of the Rajmahal Basin. The palynoflora from the bed at Moti Jhama yielded long ranging taxa (*Auracariacites*, *Callialsporites*, *Podocarpidites*) occur from Jurassic to Early

Cretaceous. No significant age marker taxa could be observed. Hence precise age could not be defined.

**Archana Tripathi** (superannuated w.e.f. 31.07.2009) & **B.N. Jana** (superannuated w.e.f. 30.06.2009) [& **Kanchan Pande** (IITB) & **G.V.R. Prasad** (Jammu)]

### Project 14.4: Neyveli lignites: Biostratigraphy and palaeoecology

Analysis of samples from Neyveli lignite mine, Tamil Nadu revealed a diversified assemblage of algal and fungal remains, pteridophytic spores and angiosperm pollen. Significant palynotaxa in the assemblage are: *Proxapertites*, *Monocolpopollenites*, *Acanthotricolpites*, *Retipollenites*, *Tricolpites*, *Marginipollis*, *Pelliceroipollis*, *Dermatobrevicolporites*, *Lanagiopollis*, *Tribrevicolporites*, *Retitrescolpites*, *Meliapollis*, *Palaeosantalaceaepites*, *Rhoipites*, *Dipterocarpuspollenites*, *Cruciferoipollenites*, *Verrutricolpites*, *Ctenolophonidites*, *Jacobipollenites* and *Clavaperiporites*. Based on the present day distribution of the families represented (Schizaeaceae,

Cyatheaceae, Gleicheniaceae, Arecaceae, Meliaceae, Rhizophoraceae, Bombacaceae, Araliaceae and Caesalpiniaceae), a tropical climate with plenty of rainfall has been inferred during the sedimentation of Neyveli lignite deposits. A good representation of tropical rain forest elements belonging to Alangiaceae and Ctenolophonaceae with good number of pteridophytic spores indicates tropical climate with plenty of rainfall. The environment of deposition has been deduced as coastal, ranging from back-mangrove to mangrove with a short transgressive phase before the deposition of lignite.

**Rahul Garg** (superannuated w.e.f. 30.11.2010) & **M.R. Rao & Poonam Verma** [& **Ashok Sahni** (Chandigarh) & **R. Nagendra** (Anna Univ, Chennai)]

## Additional Research Contributions

Systematics of the stromatolites of the Proterozoic Kaladgi Basin is attempted. The diversity and distribution of the various stromatolite forms occurring in the Bagalkot Group of the Kaladgi Supergroup have been documented. An assemblage of six taxa is recognized from the Bagalkot Group. The forms *Asperia digitata* (= *Yelma digitata*), *Ephyaltes edingunnensis*, *Eucapsiphora leakensis*, *Kussoidella karalundiensis*, *Pilbaria deverella* and *Yandilla meekatharrensensis* are described. These forms are not recorded from any other Proterozoic Sequence of India of the Palaeoproterozoic age. Similar forms are recorded from Africa, Australia, Canada and China. *Asperia digitata*, a digitate stromatolite, is known from the Proterozoic Sequence of the Palaeoproterozoic age in other parts of the world. Poorly constrained age of the Bagalkot Group of the Kaladgi Supergroup can be ascertained on the basis of the reported assemblage as Late Palaeoproterozoic to Early Mesoproterozoic (Orosirian-Statherian to Calymmian Period).

**Mukund Sharma & S.M. Pandey**

The study on the Owk Shale of the Kurnool Group from the peninsular India reports occurrence of helically coiled microfossil *Obruchevella* Reitlinger. The age of the Kurnool Group is poorly constrained due to the absence of direct radiometric dating and meager palaeobiological data. Occurrence of *Obruchevella* is considered as a typical Vendian marker genus recorded mostly from close to the Precambrian–Cambrian boundary successions. Hence, the present assemblage is important to ascertain the age of the basin. In the Owk Shale, four species of *Obruchevella*, viz., *O. delicata*, *O. parva*, *O. minor* and *O. valdaica* are recorded as organic walled microfossils. Among them *O. valdaica* is the largest in terms of size parameters. On the global scale, the recovered species occur in the Late Neoproterozoic to Early Cambrian sediments. Therefore, the occurrence of microfossil *Obruchevella* in the Owk Shale and known burrow structures in the Narji Limestone suggest Ediacaran age close to the Cambrian for the Kurnool Basin and challenges the recently assigned Mesoproterozoic age of the basin.

**Mukund Sharma & Yogmaya Shukla**

The plant fossil assemblages of Late Permian age recovered from the Tatapani-Ramkola Coalfield pertaining to the equisetalean cones have been described as *Tatapania*—a new genus (fructifications of *Schizoneura*

*gondwanensis*). The megafossil assemblage of Korba Coalfield belonging to genera *Gangamopteris* are also observed for detailed morphotaxonomy and their diversity. For both the studies, manuscripts along with the photo-documentation have been prepared and finalized.

**Anju Saxena & K.J. Singh**

Research papers manuscripts related with the work of Ph.D. thesis dealing with the Holocene palaeoclimate reconstruction based on the macrofaunal assemblage (ostracod and gastropod) and phytoliths have been prepared and are being finalized, other manuscripts are also under preparation.

**Anju Saxena**

Co-ordinated museum activities—day to day work, educating visitors, organizing lectures, making database of Museum holdings, Coordinated publication of exhibits/hand outs/ bilingual Annual Report 2010-11. Coordinated lecture series in the institute.

**A. Rajanikanth**

The bore-core containing plant mega fossil is recovered from the Chintalpudi sub-basin of Pranhita Godavari Valley. The fossils recorded at various depths are mostly *Ptilophyllum* species. Conifers are reported by *Elatocladus* and *Pagiophyllum* species, whereas single species of genus *Pachypteris* has also been reported. Pteridophyte is not been recorded. Overall the flora is correlatable with Gollapalle flora of Godavari Basin, Sehora flora of Jabalpur and flora of Gangapur Formation.

**Neeru Prakash & Neerja Jha**

The flower *Williamsonia* along with Carpolithes (seed) has been reported for the first time from the upper part of the Callovian-Oxfordian of Washtawa Formation (Nara Shale Member). This is an earliest record of genus *Williamsonia* (Middle Oxfordian; based on ammonites and nannofossil evidences). The other forms which are made so far from other Indian basins are of Early Cretaceous age. A paper has been finalized on the aspect.

**Neeru Prakash & Jyotsana Rai**

Samples have been analysed for understanding the palynoassemblages from Supra Barakar and Barakar formations of Talcher Coalfield, Son-Mahanadi Basin. Two palynoassemblages have been recovered through





the quantitative analysis of palynotaxa from the bore-hole TCS-6. The composition with dominance of *Faunipollenites* and sub-dominance of *Scheuringipollenites* has close affinity with Upper Barakar Formation. The high frequency of *Densipollenites*, less frequency of *Striatopodocarpites*, and lack of Raniganj marker species, such as *Lundbladispora*, *Densisporites*, *D. magnicarpes*, etc. indicating more affiliation with Barren Measure Formation rather than the Raniganj Formation.

**K.L. Meena & S.S.K. Pillai**

Microscopic observation and photo-documentation is done on the productive samples from the coal-bearing Barakar Formation exposed in Shivapuri open-cast coal mine near Parasia town, Chhindwara district, Pench Valley Coalfield, Satpura Basin. It is worked out for its spores-pollen content. Approximately 47 m thick Gondwana sediments comprising carbonaceous shales, thin layered shale, clay stone, siltstones, fine to medium grained sandstones and coal seams have shown levels of changing patterns in the spore-pollen groups in the Barakar Formation. Dominance of radial monosaccate pollen taxa (*Parasaccites*, *Plicatipollenites*) along with significant spore species in the lower part of section within 16 m depth infers the strata to the Upper Talchir and Karharbari Formation respectively, of Early Permian age. In the up-section (31 m depth), an abundance of *Striatopodocarpites*, *Indotriradites* and *Scheuringipollenites* is observed hence, the deposits are inferred of that Barakar Formation, late Early Permian in age.

**Srikanta Murthy**

A manuscript on fungal remains from the Denwa Formation, Satpura Basin (MP) and their palaeoenvironment implications has been finalized.

**Srikanta Murthy & M.S. Chauhan**

Investigated carbonized fruits from the Sindhudurg Formation (Miocene) exposed at Kalviwadi Village in the Sindhudurg district of Maharashtra. Fossil fruits showing resemblance with fruits of extant *Pterospermum* Schreb. (Family Malvaceae *s.l.*) are described as *Pterospermum* Miocenium gen. et sp. nov. The phytogeographical distribution and migration of the fossils of *Pterospermum*, in context with Indian subcontinent, is also discussed.

**Rashmi Srivastava, R.K. Saxena & Gaurav Srivastava**

A fossil wood referable to the family Ebenaceae has been recovered from the Miocene sediments of

Neyveli lignite, south India. The fossil wood is characterized by apotracheal parenchyma occurring in 1-2 seriate close, concentric tangential lines at regular intervals and 1-2 seriate heterogeneous xylem rays showing affinity with the extant taxon, *Diospyros malabarica* (Desr.) Kostel., presently occurs in Indo-Malayan region. The present finding indicates the existence of tropical evergreen vegetation under a very humid climatic condition which has been responsible for formation of lignite in the Neyveli area. (jointly with Devi Mukherjee, University of Lucknow).

**Mahesh Prasad**

Recorded well-preserved plant megafossils including woods, leaves and fruits) from Lower Eocene lignite deposits of Vastan mine, Surat (Gujarat). These fossils show close resemblance with 13 dicotyledonous taxa belonging to the families Clusiaceae, Sterculiaceae, Rutaceae, Sapindaceae, Anacardiaceae, Ebenaceae, Combretaceae, Lythraceae and Rubiaceae. The habit, habitat and present distribution of the identified fossils indicate the existence of evergreen to mixed deciduous forest under warm humid climate in the mine area during early Eocene.

**Mahesh Prasad, Hukam Singh & S.K. Singh**

Photo-documentation and systematic studies on palynofossils from Tarkeshwar lignite mine, Surat, Gujarat have been done. Palynofloral assemblage is marked with dominance of angiospermic pollen and fungal remains. Algal cysts and pteridophytic spores are also present in high frequency. Significant spore/pollen genera in the assemblage are: *Lygodiumsporites*, *Biretisporites*, *Todisporites*, *Dandotiaspora*, *Polypodiaceasporites*, *Arecipites*, *Palmaepollenites*, *Longapertites*, *Spinizonocolpites*, *Proxapertites*, *Acanthotricolpites*, *Margocolporites* and *Ctenolophonidites*.

**S.K.M. Tripathi & Hukam Singh**

Absence of datable fauna due to facies constraint in lignite bearing sediments of western India have often posed problems in interpreting the vast fossil remains there. A considerable progress has been made on dinoflagellate cysts study to provide age to these sediments. Dinoflagellate cysts horizons studied from the Naredi Formation, Kutch. Based on the dinocyst data Naredi Formation is assigned the early Ypresian age, broadly corresponding to Ilerdian, representing a time span of ~55-54Ma. (jointly with Rahul Garg & I.B. Singh)

**Vandana Prasad & Biswajeet Thakur**

Palynological investigation is carried out on the Siwalik sediments exposed at Bhalubang and its adjoining areas of Deokhuri Valley, central Nepal. Several palynoassociations have been recognized between 11.5 to 6 Ma. The data has been interpreted and plotted against a chronostratigraphic control based on magnetostratigraphic study. The palynofloral assemblage is dominated by fungal spores and conidia followed by gymnospermous, pteridophytic and angiospermous elements. The spores of Cyatheaceae, Dicksoniaceae, Osmundaceae, Parkeriaceae and Polypodiaceae represent pteridophytes. Among the angiosperms, pollen referable to Arecaceae, Poaceae, Sapotaceae, Mimosaceae etc have been recovered. Members of the family Pinaceae and Podocarpaceae mainly represent gymnosperms. Occurrence of a low rainforest type of vegetation is suggested during the sedimentation of the Lower Siwalik rocks in Early Miocene in the area of investigation. The palynoflora indicates a subtropical humid climate due to the dominant occurrence of fungal spores and conidia.

Cyanobacteria-rich sediments are recorded from the basal part of the Subathu Formation (Early Ypresian) from several measured stratigraphic sections of Uttarakhand, HP and J&K. Two types of Cyanobacterial fabric are documented in this horizon viz., Microbial mats and Cyanobacterial nodules. Palaeoenvironmental reconstruction based on the recovered Cyanobacteria suggests that these sediments were laid down in protected areas of low relief intertidal-supratidal regions during initial transgression of the Subathu Epicontinental Sea. The climate was exceptionally warm and humid followed by mild dry intervals. A paper on the aspect is finalized.

**Samir Sarkar**

The overall characteristics of Indian Tertiary lignites and their optimal utilization have been discussed, on the basis of petrological properties of lignites from Panandhro and Matanomadh fields of Kachchh Basin; Tadkeshwar, Vastan, Amod and Kalol fields of Cambay Basin; Khadsaliya field of Saurashtra Basin; Kapurdi field of Rajasthan Basin; and Neyveli field of Cauvery Basin. The low rank and predominance of huminite macerals suggest for their utilization in thermal power plants and several other industries for heat/ steam generation. In addition to this, fair amount of hydrogen-rich macerals point towards their potential for hydrocarbon generation.

**Alpana Singh & B.D. Singh**

Three bore-holes from Wardha Valley coalfields have been studied for palynological and palynofacies

contents and the recovered palynomorphs are used for inter-basin and intra-basin correlation of the sediments and an emphasis is laid on sporomorph eco-group using the botanical affinity of the palynomorphs which in turn is used for palaeovegetation reconstruction. The abstract based on the above findings entitled 'Coal correlation: A palynological outlook' is documented and accepted in the 6<sup>th</sup> Siberian Early Career Geoscientist Conference" in Novosibirsk, Russia.

Samples from New Majri Open Cast mine have been studied for lithofacies and palynology and palynofacies analyses. Palynomorphs studied assigned the coal seam of NMOC to Lower Barakar Formation, and the lithofacies studies revealed that the sediments were basically deposited as levee deposits and later on as channel and crevasse splay deposits. The studies have been finalized and communicated.

**Mahesh S. & Pauline K. Sabina**

Various sections of Bokaro Basin, viz. Kedla, Kuju, Banwar and Taping area were studied and updated to depict the development of the coal seams in the area. Lugu hill representing the central part of the basin shows more promising zone for coal bed methane resources as it represents the deepest part of Bokaro Basin. Micropetrographic study throws more light in better understanding of CBM potential in the area.

**Rakesh Saxena**

Diverse assemblages of thecamoebians are reported here from the Early Permian Manjir Formation of the northwest Himalaya in India. These thecamoebian tests are found in palynological preparations and are assigned an Early Permian age based on co-occurrence of age-diagnostic palynomorphs. Several of them show very close morphological affinity with extant thecamoebian genera, such as *Amphitrema*, *Arcella*, *Centropyxis*, *Cyclopyxis*, *Cucurbitella*, *Diffugia* and *Trinema*. This fauna lived in shallow-marine environments during the Early Permian deglacial phase of the widespread Late Carboniferous-Early Permian glaciation of Gondwana. The extant forms used for morphological comparison with the fossil forms were recorded from lakes and ponds in various parts of India. This study supports the current hypothesis of minimal evolution in thecamoebian lineages through geological time, and this group of protists has survived through long geological time and several mass extinction events without any significant morphological change. Stratigraphical and palaeontological evidence indicates that this fauna lived in the shallow-marine environments along the northwestern margin of Indian

Gondwana during the deglacial phase of Late Carboniferous-Early Permian glaciation.

#### Anjum Farooqui & Neerja Jha

Pollen analysis of honey sample collected from Lucknow University campus has shown a good assemblage of pollen. Among the pollen taxa, *P. spicigera* (29%), *Prosopis juliflora* (20.8%), *Syzygium cumini* (25%), their *Eucalyptus* sp. (10%) the major source of nectar as marked by frequent presence of their pollen. The overall assemblage shows that these plants were in full bloom during the course of honey production and the honey is of multi-floral nature. *Bombax ceiba* (7%), *Ailanthus excelsa* and *Dodonea*, *Tinospora cordifolia*, etc. were the minor sources of nectar and bee forage as depicted by relatively low frequencies.

#### M.S. Chauhan & Anjali Trivedi

Texture, mineralogy, geochemistry, palynology and magnetic susceptibility study of a 2 m deep sediment core from Padauna Swamp (Amarkantak), Anuppur district (MP) infer that between 8,620 and 7,566 yrs BP a cool and dry climate prevailed with open tree-savannah type vegetation dominated by grasses and followed by sedges, *Artemisia* and members of Chenopodiaceae/ Amaranthaceae with sprinkle of trees viz., *Schrebera*, *Aegle marmelos*, *Sterculia urens*, etc. and thickets of Fabaceae, Acanthaceae and Oleaceae. This is well supported by lower organic over carbonate carbon concentration, coarser texture having relatively low CIA values and presence of some primary mineral in the sediments. Warm and humid climate followed between 7,566 and 6,250 yrs BP. The tree-savannahs were succeeded by open mixed deciduous forests with the invasion of a few more trees, *Madhuca indica*, *Holoptelea*, *Embllica officinalis*, *Mitragyna*, members of Anacardiaceae, etc. A considerable rise in organic carbon generated from the degradation of plentiful biomass along with increase in clay content with signs of kaolinite and increase in immobile over mobile elements with slightly higher CIA values also suggest climatic amelioration.

The presence of ruderal plants such as *Artemisia*, Urticaceae cf. *Cannabis sativa*, ChenoAm, etc. further infers initiation of human activities in the region. Between 6,250 and 2,800 yrs BP, the mixed deciduous forests became more diverse and dense, subduing the extension of grasses and other herbaceous elements. Sporadic incursion of *Shorea robusta* (Sal) in forest floristics was recorded around 5,000 yrs BP. The overall change in the vegetation mosaic reflects that a warm and more-humid

climate prevailed in the region, probably on account of invigoration of southwest monsoon. This observation is further corroborated by other proxy data showing a spurt in organic/inorganic carbon ratio, increase in clay content with matured mineralogy, significantly higher CIA and magnetic susceptibility values. Since 2,800 yrs BP onwards, the modern Sal dominated deciduous forests got established indicating continuation of warm and humid climate including timely arrival of SW monsoon.

#### M.S. Chauhan, Anupam Sharma, Binita Phartiyal & Kamlesh Kumar

A 2 m sedimentary soil profile from Singrimari Swamp dated back to 11,000 yrs BP has documented three climatic phases as inferred from pollen and non-pollen evidence. Manuscript prepared on the aspect.

#### S.K. Basumatary & S.K. Bera

Melissopalynological investigation of 10 samples from Almora district, Uttarakhand shows that the majority of honey samples are bifloral. Study further shows that honeybee preferred *Salmalia malabaricum* for foraging in summer and *Brassica campestris* in winter honey samples attaining at the highest value of 71.23% and 73.97% respectively. Manuscript on the aspect has been finalized.

#### Swati Dixit, S.K. Basumatary, Hukam Singh & S.K. Bera

Palynological observation of one 3.4 m deep sedimentary profile cored from Chayagaon swamp, Kamrup district, Assam has revealed climate vis-à-vis vegetation succession since Late Quaternary supported by contemporary pollen/vegetation relationship in and around the swamp which could be employed as background information for the palaeoclimate studies. Steady occurrence of Cereal pollen species (Poaceae) during 12,450 cal yrs BP is indicative of initiation of pastoral activity since the early Holocene. After 989 cal yrs BP, an alarming change in pollen assemblages, indicating a decrease in sal and its associates namely *Lagerstroemia*, *Lannea*, *Terminalia*, *Syzygium* and *Salmalia*, with a sharp increase in *Melastoma*, *Ziziphus* and *Areca catechu* was occurred. The infestation of major ruderal elements like Chenopodiaceae, *Artemisia*, *Plantago*, Tubuliflorae, and Brassicaceae with cereals hints for forest clearance with large scale farming and anthropogenic soil erosion.

#### Swati Dixit & S.K. Bera

A manuscript entitled 'Modern vegetational distribution and pollen dispersal study within Gangotri glacier valley, Garhwal Himalaya' has been prepared.

Additionally, maceration of sub-surface samples of palaeolake near Dwarahat village, Kumaon, lesser Himalaya has been done (by PSR) and the palynological study is in progress. This work is in collaboration with IISc, Bangalore.

**P.S. Ranhotra & A. Bhattacharyya**

Investigated samples of botanical remains from well stratified layers of NBPW, Pre-NBPW with iron and Pre-NBPW without iron (Chalcolithic) periods of a protohistoric site Raipura in Belan Valley, Sonbhadra district (UP). The site is located very close to Kaimur hills and on a small Nala connecting Belan river. The samples were sent by Dr. Prabhakar Upadhyay of Dept. of A.I.H.C. & Archaeology, BHU, Varanasi for retrieval of seed/fruit remains to be used for AMS dating

**Chanchala Srivastava**

Revised a prior submitted paper entitled 'Pollen and phytoliths from fired ancient potsherds as potential indicators for deciphering past vegetation and climate in Turpan, Xinjiang, NW China' as per the suggestions.

**Ruby Ghosh**

Paper on Normal mode analysis of POCB Modification I with phonon dispersion in the first Brillouin Zone using Urey Bradley force field incorporating interaction of water molecule was published. Further work on thermal degradation of PGGA also progressed.

**Subodh Kumar & C.M. Nautiyal**

Sediment samples have been collected from Chilka Lagoon during the visit to attend the Indian Science Congress at Bhubaneswar (Odisha). Sediment samples have also been collected from the Mandovi Estuary, Goa during the visit to attend the Arctic Team selection Meeting. The study of these samples will provide some important basic data required for the initiation of project work in next plan period.

**Vartika Singh**

Finalized a manuscript on 'An evaluation of the Late Palaeozoic floras of India'. Distribution of the *Glossopteris* floral elements through various Lower Gondwana horizons has been analysed in the light of recent researches.

**Rajni Tewari & S.S.K. Pillai**

A field trip has been undertaken to various Carboniferous (Gund), Permian and Triassic localities (Nishatbagh, Khunamuh, Mamal, Zewan and Pahalgam) of Kashmir region for collection of plant and animal fossils, and rock samples for the recovery of micro- and

megaspores, etc. The Late Carboniferous section showing diamictite base with alternation of shales and sandstones exposed near the Gund village on Jammu-Kashmir national highway is visited and a rich assemblage of plant fossils comprising a variety of lycopsid axes with well-preserved leaf scars are collected. Animal fossils like insect, insect wing, traces, invertebrates belonging to the Annelida group are recorded from the Nishatbagh section exposed 1 km East of Nishatbagh Garden, Srinagar.

Visited the type locality of Mamal Formation situated near Mamal village (Pahalgam) in Liddar valley area. However, plant mega fossils are not found in this area. The samples for the study of megaspores and spore-pollens are collected. Besides, the type locality of Zewan Formation (Late Permian) situated near the Zewan village, Srinagar is visited. Mamal Formation is also exposed in this section. Well preserved animal mega remains like Bivalves, Gastropods, Bryozoans are collected. Equisetalean axes are found from the Mamal Formation of this section. Additionally, the well known Guryul Ravine section of Permo-Triassic boundary exposed near the Khunamuh village, Srinagar is also visited and palynological samples are collected from different intervals of this contact.

Grouping sorting, cleaning and photo-documentation of lycopsid axes collected from Gund Formation (Carboniferous) of Kashmir region has been carried out. The axes have been tentatively categorised on the basis of structure of leaf scars under the genera *Lepidodendron*, *Tomeodendron*, *Sigillaria* and *Archaeosigillaria*. Equisetalean stems along with some stem barks and insect wing have also been recorded from the shales. The samples are macerated for the recovery of megaspores and spores-pollen. Monosaccate spores, mesosporium of megaspores and algal remains belonging to the Chaetophora group are recorded from these samples. Animal fossils belonging to the groups aschelmenthes, annelids, brachiopods and arthropods are recovered from the Carboniferous shales of Nishatbagh Formation (Early Permian), Nishatbagh. Rich charcoalified plant remains indicating occurrences of palaeofire along with spore-pollen grains have also been recorded from samples of Nishatbagh Formation.

**Rajni Tewari, Ram Awatar, Rupendra Babu, S.S.K. Pillai & Deepa Agnihotri** (with S.K. Pandita & G.D. Bhat)

Carried out photo-documentation of animal remains, and prepared and finalized a manuscript on Bdelloid Rotifera reported from Chamba Valley.

**Neerja Jha & Neha Aggarwal**



## Collaborative Work

Recovered for the first time 11 taxa belonging to sponges, animal embryos and acritarchs from the Chambaghat Formation of Krol Group, Lesser Himalaya, Himachal Pradesh.

**N.C. Mehrotra & R. Babu [& V.K. Mathur, S. Shome & S. Nath** (GSI, Northern Region, Lucknow)]

Completed a field Guide book on *Vindhyan basin Son Valley area, Central India*.

**Mukund Sharma [& S. Kumar** (University of Lucknow)]

Contributed to an internet based polling project on nomenclature of *Araucarioxylon* wood participated by different overseas scientists.

**A. Rajanikanth [& Ronny Roessler & Marc Philippe** (coordinators)]

Worked on the CLAMP study on the megaflora collected from Bikaner district, Rajasthan.

**R.C. Mehrotra & Anumeha Shukla [& R.A. Spicer** (Open University, UK)]

Worked and finalized a manuscript based on the CLAMP study on the megaflora of the Makum Coalfield, Assam. The study suggests that the South Asian Monsoon was already established by late Oligocene times at intensity similar to that of today.

**R.C. Mehrotra & Gaurav Srivastava [& R.A. Spicer** (Open University, UK) & **Jian Yang** (Institute of Botany, Beijing, China)]

Investigated carbonized wood samples from Late Quaternary (Holocene) sediments of Kerala. The assemblage consists of six recognizable genera, viz. *Artocarpus* (Moraceae), *Caeya* (Lecythidaceae), *Dipterocarpus* (Dipterocarpaceae), *Diospyros* (Ebenaceae), *Neolamarkia* (Rubiaceae) and *Rhizophora mangle* (Rhizophoraceae). Amongst them, *Rhizophora* (Red mangrove) is a mangrove tree that occurs in the estuarine ecosystem and littoral forests throughout the tropics. These genera are found in the tropical evergreen forests of Western Ghats including Kerala. Further work is being done to finalize the result.

**Rashmi Srivastava, J.S. Guleria & Anumeha Shukla [& K.P.N. Kumaran** (Agharkar Research Institute, Pune)]

Morphotaxonomical study on the fossil leaves from the Siwalik belt of Jawalamukhi area, Himachal Pradesh has been carried out. These have been identified with the

extant taxa, *Dipterocarpus turbinatus* of the family Dipterocarpaceae. This finding is phytogeographically important as it is not found presently in the whole Himalayan foot hills.

**Mahesh Prasad** [& GSI (Chandigarh)]

Rock samples representing a lignite-bearing sequence from the open-cast mine at Matanomadh, Gujarat have been chemically processed for palynological studies. Objectives of these studies are to assess the palynofloral composition and to interpret the palaeoclimate and environment of deposition. The sequence, mainly composed of lignites, shales and calcareous mudstones, yielded rich assemblage consists of pteridophytic spores (7 genera, 10 species), angiosperm pollen (20 genera, 26 species), fungal remains (14 genera, 16 species) and dinoflagellate cysts. The palynoflora is marked with dominance of angiospermic pollen, particularly those having affinity with the family Arecaceae. Profuse occurrence of fungal remains in the assemblage is also noticed. Based on palynomorph contents, the studied sequence is divisible into two palynozones. It is inferred that lower part of the sequences got deposited in a near-shore environment with intermittent marine incursions whereas; the depositional regime of upper part was shallow marine. Tropical-subtropical, humid climate with heavy precipitation during deposition of the sequences is indicated.

**S.K.M. Tripathi [& S. Dutta & co-workers** (IIT Bombay, Mumbai)]

Evolutionary pattern and major diversification amongst flowering plants (angiosperms) during the Cretaceous initiated fundamental changes in terrestrial ecosystems and set in motion processes that generated most of the extant plant diversity. Presence of grass phytoliths in dinosaur coprolites from the Deccan Intertrappean locality near Pisdura, India of late Cretaceous age provided evidence of early evolution and diversification pattern in grass family Poaceae (Prasad et al., 2005). In continuation, recent discovery of fossil cuticular remains from dinosaur coprolites and sediment succession of latest Cretaceous (65 Ma) from the same locality enriched earlier evidence regarding early evolution of Poaceae (Prasad et al., 2011). Based on phylogenetic analyses that combined molecular genetic data and epidermal and phytolith features across the Poaceae, these new fossil forms can be assigned to the rice tribe, Oryzae,

of grass subfamily Ehrhartoideae. The new Oryzeae fossils from India suggest substantial diversification within Ehrhartoideae by the late Cretaceous, pushing back the time of origin of Poaceae and changed the perspective on early diversification in angiosperm as a whole. These results, therefore, necessitate a re-evaluation of current models for grass evolution and palaeobiogeography. This discovery not only pushes the clock back on the evolution of rice crop but also that India could be the place of its origin more than 65 million years ago.

**Vandana Prasad [& C.A.E. Strömberg, A.D. Leaché, B. Samant, R. Patnaik, L. Tang, D.M. Mohabey, S. Ge5 & A. Sahni (multi-institutional)]**

The samples from Ruata Quarry, Turial Bungalow Section and Turial Prayer Point Section representing Bhuvan Formation (in Mizoram) have yielded datable nannofossil assemblages. Though the Bhuvan Formation is broadly mega and micro-fossil lacking thick calcareous sandstone unit and its precise age has been debated for want of fossils. The Ruata Quarry R1 sample is dated NN2 - NN4 Late Burdigalian-Early Langhian of Early-Middle Miocene, whereas R3 number sample is NN11B Messinian i.e. Late late Miocene in age. The Turial Bungalow Section has two productive levels represented by TB3 which is dated NN1 - NN6 Early Aquitanian-Early Serravalian of Middle Miocene age and the TB2 sample is dated NN11B - NN12 Messinian/ latest Tortonian of Miocene/ Pliocene age. Very close sampling at the boundary in this section of Mizoram is required to be done to resolve and calibrate the Mio-Pliocene boundary globally. Only one sample TP3 from Turial Prayed Point section has been dated NN11B of Latest Miocene age.

**Jyotsana Rai [& R.P. Tiwari (Mizoram University, Aizawl)]**

A manuscript entitled 'Calcareous nannofossils from the Ottakoil Formation, Cauvery Basin, South India: Implications on age and late Cretaceous environmental conditions' has been finalized.

**Jyotsana Rai [& Mu. RamKumar, T. Sugantha & K. Anbarasu (Periyar University, Salem)]**

Moderately diversified with low frequency nannofossil assemblage comprising over 20 species are recorded from one (S-13) calcareous marl sample of Ariyalur Formation from Cauvery Basin, situated north of the village Aladi exposed on either side of the road displaying friable limestone beds in a stream section bearing Lat : N11°37'47"; Long: E79°21'4". The recovered nannofossil taxa are of latest Maastrichtian in

age. On the basis of the occurrence of zonal marker taxa *Micula prinsii* the assemblage is assigned to CC 26b (Perch- Nielsen, 1985) corresponding with UC 20d<sup>TP</sup> of Burnett in Bown (1998) of latest Maastrichtian age. It is a low latitude marker and is indicative of latest Maastrichtian age approximately 50,000 years prior to the K/T boundary. Besides this, frequent abundance of *Petrobrasiella? bownii* in both very small and big sizes (3-4 µm to 10 µm diameter) along-with *Ceratolithoides kamptneri*, *Arkhangelskiella maastrichtiana*, *Calculites obscurus* attests to this zonal placement. A high latitude Maastrichtian age genus *Nephrolithus* represented by *N. miniporus* is also present in the assemblage indicating presence of cold water current in Southeastern part of India during latest Maastrichtian time. Reworked Campanian age forms are represented by *Ceratolithoides aculeus*, *Nannoconus* spp. and *Haqius circumradiatus* are also present in the assemblage. The detailed study may provide exact K/T boundary level as Pondicherry Formation of Palaeocene age is exposed in the vicinity.

**Jyotsana Rai & Abha [& Malarkodi (Bangalore University, Bengaluru)]**

The recovered palynofloral assemblage from the Inglis Formation at Kalapathar of Havelock Island, Andaman Sea, is mainly composed of angiosperm and gymnosperm pollen, pteridophytic spores, fungal spores and ascostromata. Algal zygosporos and diatoms have also been recorded in abundance. Some of the important constituents of the palynofloral assemblage are *Polypodiisporites* spp., *Pinuspollenites* spp., *Malvacearumpollis* spp., and *Compositoipollenites* sp. Sponge spicules are predominant in most of the samples. The diatom assemblage is represented by *Diplones* sp., *Biddulphia* spp., *Coscinodiscus* spp. and *Mastogolia* spp. Palynofloral composition suggest an Early Miocene age to the assemblage. The palynoflora has been compared with modern equivalents and it indicates a subtropical humid climate with high degree of rainfall during the deposition of the sequence in the area of investigation. A paper on the aspect is finalized.

**Samir Sarkar (& Bhagyapati Devi (Manipur University)]**

Carried out palynological investigations of the Siwalik sediments of Tanakpur and Nainital and its adjoining areas of Uttarakhand, and recovered rich palynofloral assemblages from several sections of Lower and Middle Siwalik sediments. The palynoflora indicates a tropical-subtropical, warm-humid climate with heavy



precipitation in the present area of investigation. Detailed study is now being done.

**Samir Sarkar & [R.K. Tantua (DGM, Lucknow)]**

Late Eocene Coralline algae from the Prang Limestone unit of Shella Formation in the Jaintia Hill Section have been studied. Further study on facies analysis and palaeoecological interpretation is in progress.

**A.K. Ghosh & Ajanta Sarma (G.C. College, Silchar, Assam)]**

Study of fresh water diatoms and desmids collected from the Burdwan District, West Bengal, based on light microscopic as well as SEM observations has been completed and the paper has been finalized for its submission.

**A.K. Ghosh & J.P. Keshri (University of Burdwan, WB)]**

A combination of petrological, elemental, Rock-Eval pyrolysis, FTIR spectroscopic and Cury-Gas Chromatography-Mass Spectrometry techniques has been applied for detailed characterization of the Early Eocene Vastan lignites (Gujarat). The documentation of data, in relation to lignite's economic potential, is under progress.

**B.D. Singh & Alpana Singh [Suryendu Dutta (IIT Bombay, Mumbai)]**

The resin material from Ratnagiri and Neyveli area were processed for FTIR and Pyrolysis GCMS studies. The work is under progress.

**Rakesh Saxena & Suryendu Dutta & associate (IIT, Mumbai)]**

Palynological study in the sediment cores from Mahanadi Delta—A 20 m sediment core has been studied and a middle Holocene palaeoshore line is identified at 6-7 m depth in the core. Results are in conformation with the earlier records along the east coast documented in the work carried out in the ongoing institute's project work (9.2).

**Anjum Farooqui [Delta Studies Institute (Visakhapatnam)]**

Palynological study in trench samples Kodinar archaeological site—The Late Harappan civilization is existed in Kaj and Kanjetar, Kodinar coastal area. Both the sites reveal fresh water ponding for their sustenance. Vegetational assemblage show evidences of evergreen/semi-evergreen forest indicating low seasonality until the end of Middle Holocene, but later a sudden change in climate towards dry and arid conditions perhaps led to the downfall of Harappans from along the coast.

**Anjum Farooqui & A.S. Gaur (NIO, Goa)]**

Palynological investigation is under going in a 5 m core from SK-129.

**Anjum Farooqui [N. Pattan (NIO, Goa)]**

Under TWAS-CAS Post Doctoral Programme worked on the project entitled "*Quaternary Palaeoclimate study of the West China through the pollen analytical investigation of lake sediments*" jointly with Chinese scientists at Institute of Botany-CAS, Beijing, China. Carried out the chemical processing of 28 samples from a 2.8 m deep sediment core from Shaunhai-Zi Lake, Yunan, west China. The preliminary investigation of 10 samples from the core has depicted the high frequencies of *Pinus*, *Abies* and *Podocarpus*. Among broad-leaved elements *Quercus*, *Betula*, *Alnus*, etc. are recovered in moderate to low frequencies. Fern spores are in abundance. The analysis of remaining samples from the core is in progress.

**Anjali Trivedi [Cheng-Sen Li (Institute of Botany-CAS, Beijing, China)]**

Pollen analyzed of 13 subsurface soils from southwest coast of India. The pollen analysis of peat samples reveal abundant occurrence of Rhizophoraceae, *Sonneratia* and *Avicennia* pollen (core mangrove). The major midland taxa are represented by Oleaceae, Combretaceae, Fabaceae (legumes), Acanthaceae and Meliaceae whereas, Poaceae, Lamiaceae, Urticaceae, Asteraceae, Apiaceae and Chenopodiaceae being ubiquitous are present in low to moderate numbers. Plant derived organic matter includes other non pollen palynomorphs like fern spores, algal and fungal remains including varia. Humid climatic condition accounts for the development of mangrove vegetation, as the abundant rainfall increases the continental drainage.

**S.K. Bera, A. Rajanikanth, Swati Dixit & Kanupriya Gupta [A.C. Narayana (CUSAT, Cochin)]**

Studied 15 squeezed honey samples procured from Bongaigaon district of Assam. The data documentation and preparation of manuscript is in progress.

**S.K. Basumatary, Swati Dixit, S.K. Bera [Munmun Brahma (Kokrajhar College, Assam) & G.C. Sarma (Gauhati University, Assam)]**

The study on agroforestry systems of Bamboo cultivation in Garo Hills of Meghalaya is conducted. Bamboo stands as an ideal species capable of achieving conservation of soil and moisture, restoration of degraded land, livelihood and economic security because of its manifold uses and industrial applications. The study also proves that bamboo can help to reduce our carbon

footprint and fight global warming. It is a crucial element in the balance of oxygen and carbon dioxide in the atmosphere.

**S.K. Basumatary, Kanupriya Gupta, S.K. Bera**  
[& S.K. Acharya & Sneha Bera (BCKB, W. Bengal) &  
M. Ahmad (Goalpara College, Assam)]

Prepared manuscript based on Isotope analysis ( $d^{13}C$  and  $d^{18}O$ ) of tree-ring of *Abies pindrow* collected from forest near to Dokriani Bamak glacier, Uttarakhand.

**A. Bhattacharyya & S.K. Shah [& R. Ramesh**  
(PRL, Ahmedabad)]

Past climate and vegetation history have been analyzed from two profiles collected from Nonkremp close to Shillong, Meghalaya based on pollen data.

**A. Bhattacharyya, S.K. Shah & Sandhya Misra [& Pawel Prokop** Polish Academy of Sciences, Poland)

Studied the tree line dynamics of Himalayan silver fir (*Abies spectabilis* D. Don) based on its tree-ring data and age stand distribution at Langtang National Park, Central Nepal. The study shows that the average tree density of the species in the study area (total 48 plots of 20 m x 20 m) was 236 no/ha while that for sapling and seedling in the study area was 255 and 350 no/ha, respectively. The stand character and age distribution of the species showed a high level of recruitment in the recent decades, with decreased in average age along with increased altitude. Tree-growth climate relationship showed negative response with temperature of March-May. Upward advancement of tree line is expected in the coming recent decades though not necessarily uniform through the line.

**S.K. Shah [& R. Bhujju**, Nepal Academy of S&T, Nepal)]

Two Pleistocene-Holocene sedimentary profiles from Darjeeling Sub-Himalaya have been studied for palaeoclimatic reconstructions using pollen and phytolith proxies.

**Ruby Ghosh [& Subir Bera**,  
University of Calcutta, Kolkata)]

The ongoing collaborative work in Spiti Valley is to study for their sedimentary architecture and chronological parameters. Lithofacies analyses of relict sedimentary sequences located in the rain shadow zone of Tethyan Himalaya shows six different lithofacies. The six different lithofacies identified can be grouped into three lithofacies associations: i) glacial outwash, ii) sedimentation in channel and accreting bars under braided conditions, and iii) formation of lakes due to channel blockage by

landslide activity. Abnormal Monsoon Years at 14-8 ka and 50-30 ka are responsible for the phases of channel damming and lake formation in the valley. A research paper is under review.

**Anupam Sharma & Binita Phartiyal [& Pradeep Srivastava & Yogesh Ray** (WIHG, Dehradun)]

The Spiti river basin in the NW Indian Himalaya (31–33°E:77–79°S), is tectonically unstable, exhibiting a complex topography, landscape relief and varied Quaternary sedimentation. The major geomorphic landforms are fill terraces, strath terraces, alluvial fans, debris cone, fluvio-lacustrine deposits, scree and talus cone are present throughout the valleys. The dynamics of landscape evolution of the region are currently not well understood. An attempt is made by using the geomorphometry approach to access the areas in terms of its neotectonic instability as this basin feeds the river Sutlej. The Spiti and the Parachu basin of the Sutlej valley are mapped and assessed in the valley to elucidate the spatio-temporal scale dependencies of surface have been in news several times in the last decade causing flooding downstream, due to the outburst of glacial lakes and the temporary lakes formed during the land sliding even by the processes active in the region.

The Spiti river (constituting of Spiti and Parachu basins) is examined using and geomorphic field methods (Spiti basin), and OSL chronologies by Phartiyal et al., (2009) are used. During the Quaternary a ubiquitous mass movements and catastrophic land sliding transported material from steep slopes to valley bottoms is seen which was responsible of forming lakes (preserved as thick piles of fine sediment), while the outburst floods redistributed sediment down valley along with affecting life and property downstream. The morphometric approach such as Basin Asymmetry (AF), Topographic Symmetric Factor (T), Stream length Gradient Index (GI) Hydraullic Sinuosity Index (HSI), Topographic sinuosity Index (TSI) and Standard Sinuosity Index (SSI) have helped in understanding tectonic and climatic perturbation. Our observations point towards a tectonically active region with enormous piles of loose, unconsolidated sediment cover which could be disastrous during the slight shift of the climatic and tectonic forces operating in this area.

**Binita Phartiyal [& G.C. Kothiyari** (ISR, Gandhinagar)]

In order to determine the mid Holocene climatic fluctuations, multi-proxy study involving palynology, phytolith, clay mineralogy, geochemistry and magnetic susceptibility are carried out on Wadhavana lake sediments of main land Gujarat area. The 2.3 m sediment profile of



wadhavana lake shows deposition of silty clay with frequent sandy intervals in the lower part followed by predominance of silt in the middle and sandy silt in the upper part. The lower part of the succession shows predominance of evergreen and moist deciduous arboreal pollen taxa, fresh water algae, festucoid grass phytoliths indicating high lake stand and prevalence of winter precipitation leading to cool and moist climatic conditions during ~5,665-4,824 yrs BP. Presence of pollen taxa represented by *Madhuca*, Meliaceae, Asteraceae and abundant micro-charcoal with burnt wheat husk remains provide evidence of Harappan influence during the time span. At 4,824 yrs BP replacement of freshwater algae with cyanobacteria and considerably high values of phytolith aridity indices and considerably low susceptibility values indicates fall in lake level, formation of playa and onset of aridity in this region. The continuous higher values of phytolith aridity indices and absence of pollen provided evidence of extreme moisture deficient conditions in the lake ~4,200~3,500 yrs BP and prevalence of arid climatic conditions in the surrounding region. Monsoon regains its strength ~3,380 yrs BP however the lake level did not reach to its original level. Phytolith studies shows change in seasonality from cool and moist climate of mid Holocene to warm and humid climate of late Holocene with prominent pre-monsoonal warm conditions somewhat similar to present day.

**Vandana Prasad, Anjum Farooqui Anupam Sharma & Binita Phartiyal [& Supriyo Chakraborty (IITM, Pune)]**

Pollen and organic-inorganic carbon analysis of a 2.8 m deep sediment profile from Jalesar Lake, Unnao district (UP) reveals that a little prior and between 42,490 to 13,560 cal yrs BP this region supported grassland largely comprising grasses with scanty trees of *Syzygium* and *Prosopis* under a cool and dry climate. The sediments deposited during 13,560 to 5,260 cal yrs BP are palynologically barren and also coarser in nature may be linked to the upwarping phase of the Ganga Plain, resulting into rapid deposition/erosion and reworking of the sediments including calcrete formation. Between 5,260 and 4,760 cal yrs BP with the immigration of more trees viz., *Holoptelea*, *Acacia*, *Bombax ceiba*, *Aegle marmelos*, etc groves of forest interspersed with grassland got established due to amelioration climate. Interestingly, the debut of *Cerealia* pollen denotes the initiation of cereal-based agricultural practice in the region. Around 4,760 to 3,260 cal yrs BP, the incursion of a large number of trees viz., *Madhuca indica*, *Embllica officinalis*, *Sterculia*, *Adina cordifolia*, besides existing earlier and consistently high organic carbon values implies

that the forest groves became diversified with the onset of a warm and humid climate in response to active SW monsoon. The rising trend of *Cerealia* pollen reflects the acceleration of agricultural practice in the region. Between 3,200 and 1,200 cal yrs BP the forest groves turned sparse owing to reduction in monsoon precipitation leading to prevalence of a less-humid climate in the region. Since 1,200 cal yrs BP the diminishing trend of arboreals signifies further decline in rainfall witnessing a warm and dry climate.

**Anjali Trivedi, M.S. Chauhan, Anupam Sharma & C.M. Nautiyal [& D.P. Tiwari (Dept. of AIH & Archaeology, Lucknow)]**

Work carried out on Makran samples for hazard potential study.

**C.M. Nautiyal [& C.P. Rajendran & Associates (IISc, Bengaluru)]**

Work has been initiated on Lake sediments involving dating as well as major element analysis by ICP-AES.

**C.M. Nautiyal [& P. Singh & P.K. Gautam (Univ. of Pondicherry, TN)]**

Work on charcoal from archaeological sites in Kangra and Kinnaur (HP) is being explored and initiated involving radiocarbon dating, XRD and other geochemical techniques.

**C.M. Nautiyal [& Researchers (from HNBGU, Srinagar & IIT, Roorkee)]**

Detailed systematic studies on floral elements of Weller Formation (Early Permian of Allan Hills, South Victoria Land, Transantarctic Mountains, Antarctica vis-à-vis correlation with flora of Gondwana sedimentary basins of India is in progress.

**Rajni Tewari [& Sankar Chatterjee (Texas Tech University, Lubbock, USA)]**

Finalized a manuscript on 'Palaeobotanical evidence of wildfire in the Upper Permian of India: Macroscopic charcoal remains from the Raniganj Formation, Damodar Basin'. Macroscopic fossil charcoal has been discovered in the carbonaceous shales associated with Seam-VI of Raniganj Formation, Upper Permian. A pycnoxylic gymnosperm wood is described and confirms the occurrence of palaeo-wildfire in this area during the Late Permian. The integration of the data presented in the current study with previously published data for the Raniganj Formation, principally related to the occurrence of (pyrogenic) inertinites within coal layers,

demonstrates that palaeo-wildfires were common events during the deposition of the preserved material. In addition, the presence of charcoal in Permian sediments associated with coal levels at different Gondwana localities demonstrates that wildfires have been relatively common events across the continent during this Period.

**Rajni Tewari & A.K. Ghosh [& A. Jasper, M. Guerra-Sommer, D. Uhl, M.E.C. Bernardes-De-Oliveira & M.I. Secchi (Brazil)]**

Surface sediment samples from the Southern Indian Ocean have been studied to understand oceanographic conditions. Scanning Electron Microscopy of siliceous microfossils has also been done to study detailed morphology. A manuscript based on the siliceous sediments of Southern Indian Ocean has been prepared.

**Vartika Singh [& NCAOR, Goa]**

The anamorphic fungal genus *Monotosporella* (Ascomycota, Sordariomycetes) has been recovered from both a piece of Lower Eocene Indian amber and the surface of extant resin flows in New Caledonia. The fossil was obtained from the Tarkeshwar lignite mine of Gujarat State, western India, and was part of the biota of an early tropical angiosperm rainforest. The amber inclusion represents only the second fossil record of Sordariomycetes, as well as the first fossil of its order (either Savoryellales or Chaetosphaeriales). The fossil fungus is distinguished from extant representatives by

possessing both short conidiophores and small two-septate pyriform conidia, and is described as *Monotosporella doerfelti* sp. nov. Inside the amber, the anamorphs are attached to their substrate, which is likely the degraded thallus of a *Cladonia*-like lichen. The extant New Caledonian species is assigned to *Monotosporella setosa*. It was found growing on semi-solidified resin flows of *Agathis ovata* (Araucariaceae), and is the first record of *Monotosporella* from modern resin substrates. Because of their habitat specificity, it has been suggested that these fungi use liquid resin as their sole nutrient source.

**Hukam Singh [& Scientists (from Germany, USA)]**

A new species of fossil palm stem, *Palmoxylon vastanensis* sp. nov. is recovered from the Vastan lignite mine, Surat district, Gujarat. The detailed anatomy is characterized by highly lacunar ground tissue with very large air spaces indicating that plants were growing in an aquatic or the marshy environment. A detailed study reveals its affinities with the extant arecoid taxa belonging to the family *Arecaceae*. Among them taxa *Areca catachu*, *Oreodoxa (Roystonea) regia* and *Loxococos rupicola*, it closely resembles with *Areca catechu* as both fossil and living species reveal similar anatomical features. Based on the characteristics and affinity, palaeoenvironmental implications have been discussed.

**Hukam Singh & Mahesh Prasad [& E.E. Ruiz (Mexico)]**

## Sponsored Projects

**Project—Analysis of palaeovegetation and palaeoclimate of hominin bearing Quaternary sediments of central Narmada Valley, M.P.** (Sponsored by DST, New Delhi, No. SR/S4/ES/138/2005)

A Ph.D. Thesis incorporating the pollen data generated from the sediments is documented by PV. The project completion report has been finalized and submitted to the funding agency.

**M.R. Rao & Poonam Verma**

**Project—Quaternary sedimentary records of Baroda Window, Mainland Gujarat: A multidisciplinary approach** (Sponsored by DST, New Delhi, No. SR/S4/ES-21/ Baroda Window/P1/ 2005)

The water samples from the Mahi River Basin have been analyzed for their physiochemical and biological (diatoms) parameters. Overall, the water samples are slightly alkaline (pH-7.11-7.97) with low salinity values (136-468 ppm). The TDS values (181-544 ppm) and overall ionic concentration indicate direct control of local lithology in determining the water chemistry. Relatively higher concentration of elements such as Ca, Fe, Mn, Ni etc in samples collected from the Deccan basalt dominated areas compared to regions dominated by felsic rocks corroborates the lithologic control. The distribution of diatoms population shows dominance of fresh water pennate forms represented by *Navicula* spp., *Navicula viridula*, *Pinnularia* spp., *Gyrosigma* sp., *Synedra capitata*, *Cymbella* spp., *Stauroneis* spp. and *Cocconeis* sp. while the centric forms are marked by occasional occurrences of *Cyclotella* sp. only. The diatom population shows significant variation in water bodies of upper and lower reaches of the Mahi River. Multivariate canonical correspondence analysis (CCA) was carried out to establish a relationship between physico-chemical properties and diatom population. The CCA result indicates that the EC,  $\text{HCO}_3^-$ ,  $\text{K}^+$ ,  $\text{NO}_3^-$  and  $\text{F}^-$  are the major chemical variables that influence the diatom distribution in the region. Besides, the contemporary diatom assemblages of different water bodies of upper and lower Mahi River Basin provide recent analogs which can further be applied on much older Pleistocene and Holocene successions for precise palaeoenvironmental and palaeoclimatic interpretations.

The hydro-geochemical study of surface and sub-surface water of Mahi River basin was undertaken to

assess the major ion chemistry, solute acquisition processes and water quality in relation to domestic and irrigation uses. The analytical results show the mildly acidic to alkaline nature of water and dominance of  $\text{Na}^+$  and  $\text{Ca}^{2+}$  in cationic and  $\text{HCO}_3^-$  and  $\text{Cl}^-$  in anionic composition. In general, alkaline earth elements ( $\text{Ca}^{2+} + \text{Mg}^{2+}$ ) exceed alkalis ( $\text{Na}^+ + \text{K}^+$ ) and weak acids ( $\text{HCO}_3^-$ ) dominate over strong acids ( $\text{SO}_4^{2-} + \text{Cl}^-$ ) in majority of the surface and groundwater samples.  $\text{Ca}^{2+}$ - $\text{Mg}^{2+}$ - $\text{HCO}_3^-$  is the dominant hydrochemical facies both in surface and groundwater of the area. The weathering of rock forming minerals mainly controlled the solute acquisition process with secondary contribution from marine and anthropogenic sources. The higher concentration of sodium and dissolved silica, high equivalent ratios of  $(\text{Na}^+ + \text{K}^+ / \text{TZ}^+)$ ,  $(\text{Na}^+ + \text{K}^+ / \text{Cl}^-)$  and low ratio of  $(\text{Ca}^{2+} + \text{Mg}^{2+}) / (\text{Na}^+ + \text{K}^+)$  suggest that the chemical composition of the water is largely controlled by silicate weathering with limited contribution from carbonate weathering and marine and anthropogenic sources. Kaolinite is the possible mineral that is in equilibrium with the water, implying that the chemistry of river water favors kaolinite formation. Assessment of water samples for drinking purposes suggests that the majority of the water samples are suitable for drinking. At some sites concentrations of TDS, TH,  $\text{F}^-$ ,  $\text{NO}_3^-$  and Fe are exceeding the desirable limit of drinking. However, these parameters are well within the maximum permissible limit except for some cases. To assess the suitability for irrigation, parameters like SAR, RSC, %Na, MH, KR and PI were calculated. In general, both surface and groundwater is of good to suitable category for irrigation uses except at some sites where high values of salinity, %Na, RSC, KR and MH restrict its uses.

In order to understand the texture, mineralogy, major and trace element compositions including REE of the sediments deposited in the lower reaches by the Mahi River, a ~8.5 m thick fluvial sediments deposited in tidal flat-estuarine condition near Mujpur was studied in detail for the provenance characterization and understanding surface geological processes. The sediment samples are predominantly of fine sand to silt (lower 5 m); coarse sand increases up the profile. Quartz + feldspar + pyroxene + rock fragments + minor calcite + smectite + illite  $\pm$  chlorite constitute the bulk mineralogy. Comparable CIA (45-60 vs. 50) of bulk samples and the upper continental crust (UCC), and presence of feldspar and smectite suggest that tectonically active Mahi catchment

suffered only minor chemical weathering, in tune with water-starved semi-arid condition. The tectono-climatic condition promoted enhanced erosion (mechanical process), but inhibited weathering (chemical process) in the Mahi catchment. The sediments are less fractionated compared to UCC and average shale (PAAS). The finer sediments have higher concentrations of FeO<sup>t</sup> (d''8.76 wt %), TiO<sub>2</sub> (d''2.41 wt %), Al<sub>2</sub>O<sub>3</sub> (d''15.16 wt %), Cr (d''737 ppm), Ni (d''50 ppm) and total REE at a given SiO<sub>2</sub> (50-52 wt %). Up the profile, SiO<sub>2</sub> increase with increasing quartz, but decrease in TiO<sub>2</sub> (d''1.60 wt %), FeO<sup>t</sup> (d''7.04 wt %), Al<sub>2</sub>O<sub>3</sub> (d''11.68 wt %), Cr (d''~59 ppm) and total REE contents. The ubiquitous UCC-normalized LREE depleted pattern (LREE/HREE <1) indicate mafic sources in the provenance. On the other hand, HREE pattern similar to UCC, but with positive Eu-plateau (presence of feldspar) suggest contributions from quartzo-feldspathic (felsic) sources. Major and trace element abundances and geochemical mass balance calculations suggests that mixing of 70-75 % of average tholeiite (Deccan basalts?) and 25-30 % of >3.2 Ga average basement granitoid Gneiss (Banded Gneissic Complex, BGC) present in the Mahi catchment contributed to the sediments, thereby indicating binary sources for the Mahi sediments. The relative contributions of felsic component may have increased upward with tectonic uplift and availability of deeper crustal rocks for erosion.

A Ph.D. Thesis incorporating the above results is documented by KK. Submitted the Project completion report of the project to the funding agency.

**Anupam Sharma, Vandana Prasad, Binita Phartiyal, Biswajeet Thakur & Kamlesh Kumar [ & S. Chakraborty (IITM, Pune), A.K. Singh (CIMFR, Dhanbad), S. Sensarma (Lucknow Univ.) & P.P. Khanna & N.K. Saini (WIHG, Dehradun)]**

**Project— Late Quaternary vegetational and climatic oscillations as deduced from radiocarbon dates and palynodata of older alluvium sediments on the south bank of the Brahmaputra Plains (Tinsukia & Dibrugarh districts) in east Assam, northeast India** (Sponsored by DST, New Delhi, No. SR/S4/ES-21/Brahmaputra-I/2005 (P-8) 15.03.2007)

Pollen morphology of 110 major tropical-subtropical arboreal taxa belonging to moist deciduous and semi-evergreen forest of Jokai and Jeypore reserve forests, Dibrugarh has been studied. The pollen morphological features and phenological data help in precise ecological status and identification of sub fossil pollen in sediments. Pollen assemblage from Jokai (2,100 yrs BP at 120 cm), Jeypore (4,200 yrs BP at 120 cm), and Jairampur (6,650

yrs BP at 310 cm) sedimentary profiles reflect three fold of climate sequences, viz. semi arid-warm and humid-increasing warm and humid. The establishment of vast low land forest with marshy swamp is evident during 1,200 yrs BP in Jeypore, 700 yrs BP in Jokai and 500 yrs BP in Jairampur reserve forest in Upper Assam. The area is threatened at medium to high level anthropogenic impact as evidenced by the occurrence of degraded palynomorphs along with fungal remains mostly of grass pathogen, viz. *Helminthosporium*, *Alternaria*, *Curvularia*, *Nigrospora*, *Botryococcus*, *Cookeia*, *Glomus*, *Xylaria*, Microthyriaceae, etc., providing clues for pastoral activity and biological degradation of microbiota during sedimentation under mostly warm and moist climate. Assemblage of *Carya alba*, *Rhododendron ellioti* and *Tsuga* pollen from Jeypore reserve forest sediment during 4,200 yrs BP is significant which is not growing presently around the study area. The accumulation of high land plants pollen in assemblage is suggestive of long distance transportation. The occurrence of a typical fern assemblage is suggestive of subtropical to cool temperate in origin.

Air surveyed over two major tea estates (Muttuk & Sessa) in Dibrugarh district using Burkard air sampler display a variety of pollen-spore assemblage. A large number of fungal spores belong to Deuteromycetes & Ascomycetes in both air and tea garden soil establish a reliable agreement between surrounding tea garden community and sedimentation of microbiota. The presence of high land plant pollen support high wind activity for long distance pollen transport. A comparative pollen dispersal studies using spider webs along the forest tiers in Dibrugarh reserve forest is also finalized.

Saraighat river section is dated back to 5.83 Ka BP followed by three climatic phases, viz. relatively cool and dry to warm and moist. Preparation of ms on 'Modern pollen spectra from two wetlands in south bank of Brahmaputra valley, Upper Assam' is in progress. Few marker pollen taxa indicating fluvial activity was documented from the profile. The accumulation of exotic plants pollen (*Rhododendron*, *Betula* & *Corylus*) in assemblage is suggestive of long distance transportation of pollen from high altitude. Ferns are suggestive of drifted subtropical to cool temperate in origin.

A late Holocene pollen sequence under three climatic regimes followed by a barren fluvial zone at 220 cm to 250 cm bottom column (palaeoflood) has been documented from a 2.5 m deep sedimentary profile from Moidamoni of Dibrugarh district in southern bank of Brahmaputra flood plain. The assemblage of *Carya alba*,



*Rhododendron ellotii*, *Tsuga* along with some temperate ferns not growing in study area hints for a migratory connection between India and part of northwest Asia during the time of deposition needs more investigation. The present study suggests a scope for interpretation of palaeoflood episodes hidden in huge older alluvial sediment in flood prone Northeast India.

**S.K. Bera, Swati Dixit & Kanupriya Gupta** (w.e.f. 07-07.2011)

**Project—Magnetostatigraphic, palaeontological and sedimentological studies of some selected sections of Bhuban Formation of Tripura-Mizoram Accretionary Belt** (Sponsored by DST, New Delhi, No. ESS/16/254(4)/2005 dated 20.04.2007)

Data generated on fossil woods from Late Miocene sequence in relation to their palaeoecological and phytogeographical implications is compiled. The completion report of the project is finalized.

**R.C. Mehrotra & Gaurav Srivastava**

**Project—Cenozoic vegetation and climate changes in China and India and their response to the Himalayan uplift** (Sponsored by DST, New Delhi, No. DST/INT/PRC/Proj-1/2008, dated 11.09.2008)

The completion report of the project is finalized and submitted to the DST, New Delhi.

**N.C. Mehrotra, R.C. Mehrotra & D.C. Saini [& Cheng-Sen Li, Yu-Fei Wang & Yi-Feng Yao** (IB, Beijing, China)

**Project—Fluctuation in the Zemu area based on multi proxy records, tree-ring, pollen and isotopic data** (Sponsored by DST, New Delhi, No. ES/91/38/2005, dated May 2008)

A chronology of *Abies densa* close to tree-line belt of Zemu glacier, north Sikkim extending from AD 1759-2010 (252 years) is prepared. The tree growth/climate relationship carried out between this taxa and regional climate shows significant positive correlation with late winter-summer (February-April) temperature and significant negative correlation with late summer (June-September) temperature. Based on the calibration/verification statistics, June-September temperature have been selected for reconstruction which extends from AD 1759-2000. The tree-ring chronology has also been compared with the available glacier data of Zemu glacier and further analysis in this aspect are in progress. Additionally, preliminary cross-dating of tree-ring samples based on 83 cores from 45 trees of *Juniperus recurva* showed possibility of chronology up to 456 years. The

exact calendar year dating of these samples are in progress.

**A. Bhattacharyya, Mayank Shekhar & S.K. Shah**

**Project—Analysis of climatic changes since LGM from south-west continental margin of India using multi-proxy data: pollen, diatom and tree-ring data** (Sponsored by ISRO-IGB, 2009)

Magnetic susceptibility parameters of six sub-surface sediments profiles (3 profiles from Tripura, 2 profiles from Arunachal Pradesh and 1 profile from north Sikkim) from North East India for the reconstruction of climate have been analyzed.

**A. Bhattacharyya, S.K. Shah & Nivedita Mehrotra [& N. Basavaiah** (IIGM, Mumbai)]

A manuscript dealing with vegetational changes during last 3k yr. BP has been based on pollen from a sediment profile analyzed from Pookot Lake Region, Kerala is under preparation.

**A. Bhattacharyya & Sandhya Misra [Prof. R. Shankar & K. Sandeep** (Mangalore University, Karnataka)]

A manuscript dealing with mangrove vegetation history from Kanjani, Thrissur Distt, Kerala covering time span of Mid Holocene period to recent is under preparation based on multi proxy data viz., pollen, diatom and phytoliths.

**A. Bhattacharyya & Sandhya Misra**

Subsurface sediments from a 5.6 m bore-hole core off Goa (BP3-GCR) are under data generation and interpretation for the changing of sea level during Quaternary period using multi- proxy data, viz. pollen, diatom and phytoliths.

**A. Bhattacharyya & Sandhya Misra [& V.K. Banakar** (NIO, Goa)]

Mangrove vegetation changes during Holocene has been reconstructed based on pollen analysis from several sites, viz. Ramayagudem, Pedanindrakolanu, Mahileswaramau and Prattipadu of Kolleru Lake basin, Andhra Pradesh.

Analysis for pollen, diatom, phytoliths and magnetic susceptibility from a 12.0 m core from Ramayagudem site of Kolleru Lake is in progress.

**A. Bhattacharyya & Sandhya Misra [& Prof. K. Nageswar Rao** (Andhra University, Visakhapatnam)]

### Project—Late Pleistocene palynochronostratigraphy in north-eastern part of Cauvery Delta: Implication in palaeoclimatic sea-level studies

(Sponsored by DST, New Delhi, No. SR/S4/ES-264/2007, dated 30.09.2008)

Palynological, geochemical and fresh water thecamoebian study of 5 sediment cores (2-5 m) from Pichavaram estuary, TSpettai and Coleroon estuary is continued which show 2 major phases of climate and relative sea level changes (Phase I- ~5.0-2.0 kyrs: increased diversity of mangroves, strengthened monsoon; Phase II- ~since 1.0 kyrs: low diversity of mangroves, weakened monsoon) since ~5000 kyrs. The mangroves in Pichavaram estuary has existed since ~3500 kyrs revealing either subsidence or no delta progradation during this period. However, the evidence of mangroves and other marine forms show middle Holocene (5-6 kyrs) shoreline extending 12-20 km inland from the present estuary. These changes are attributed to deltaic progradation induced by fall in relative sea level since then. During the last millennium the deterioration in the qualitative and quantitative palynological result from different sites in the studied area is perhaps due to estuarine configurational changes enhanced by geomorphology, climate and anthropogenic pressure. In addition, 52 river bed samples are collected along the coastal areas in north-eastern Cauvery delta during the field work.



1. *Rhizophora apiculata*, 2. *Rhizophora mucronata*, 3. *Sonneratia apetala*, 4. *Sonneratia caseolaris*, 5. *Avicennia marina*, 6. *Excoecaria agallocha*

Anjum Farooqui & Jyoti Srivastava

**Project—Palaeobotanical studies on Indian and Brazilian sedimentary basins with special reference to marine dinoflagellate cysts, Gondwana flora and their applications** (Sponsored by DST, New Delhi, No. DST/INT/Brazil/RPO-24/2007, dated 22.01.2009 & CNPq, Brazil)

Revised and finalized a manuscript on ‘Upper Pennsylvanian lycopsids from interglacial taphoflora of Itararé Group, Paraná Basin, Brazil’. The Pennsylvanian lycopods of the Itararé Group are represented by diverse megafossils, megaspores and microspores. The lycopsid megafossils are described from the third interglacial level of the palaeofloristic succession of the Itararé Group in the northeastern border of the Paraná Basin, from the type locality Volpe ranch, in Monte Mor municipality, SP. The megafossils belong to the taxa *Bumbudendron millani*, *Bumbudendron* cf. *B. paganzianum*, *Brasilodendron pedroanum*, *Brasilodendron* sp., *Leptophloeum* cf. *L. sanctae-helenae*, and *Cyclodendron* sp. The diversity and abundance of the megafossils (sometimes forming coal beds in a glacial context) indicates climatic ameliorations of an interglacial phase of the “time Itararé”. They represent palaeoecological hydrohygrophyllous communities of a fluvatile-lacustrine depositional environment. The biostratigraphical distribution of these taxa and their association with *Paranocladus*, *Ginkgophyllum* and *Buriadia* suggests a palaeofloristic correlation with the *Krauselcladus* - *Asterotheca* Phytozone of northwestern Argentinean palaeofloristic zonation. The lycopytic megaspores recorded earlier from this level suggest a diachronic correlation with the Permian Talchir and Karharbari associations of Indian Gondwanan flora. Comparison with late Paleozoic lycopsids and associated megaspores of Argentina and India are in consonance with the modern studies aiming to achieve knowledge of Gondwana biostratigraphy in a wider perspective. Also finalized a manuscript on ‘Pennsylvanian megaspores from northeastern border of the Paraná Basin, Brazil: Correlation with Indian Gondwana megaspores’.

Rajni Tewari (with Sandra E. Mune & Mary E.C. Bernardes-de-Oliveira)

A manuscript on ‘Stratigraphic ranges of dinoflagellate cysts from Cretaceous petroliferous basins of India and Brazil’ has been finalized.

N.C. Mehrotra & Rajni Tewari (with Mitsuru Arai, Maria Judite Garcia & Mary E.C. Bernardes-de-Oliveira)

Finalized the paper on Monte Mor locality of Parana Basin, Brazil and submitted. Palynological contents of the Monte Mor taphoflora was restudied in surface samples from the upper and lower levels of the coal beds and its interval palynozone position has been reinterpreted and revised. On the basis of presence of *Crucisaccites monoletus*, *Divarisaccus* spp., *Faunipollenites* (= *Protohaploxypinus*) *amplus*, *Faunipollenites* sp.,

*Scheuringipollenites maximus*, *Platysaccus* sp. and *Scheuringipollenites maximus* in the recovered microflora it is suggested that Monte Mor palynoflora belongs to *Crucisaccites monoletus* Interval Zone, which is contrary to the earlier studies which indicated that the Monte Mor palynoassemblage belongs to *Ahrensiporites cristatus* Interval Zone. Also processing of further samples from Santa Catrina State of Brazil has been done for recovery of palynomorphs.

Neerja Jha (with Mary E.C. Bernardes-de-Oliveira, Sandra E. Mune & N.C. Mehrotra)

**Project—Palaeobiological studies from the Ganga Basin and their biostratigraphic correlation with the pre-Tertiaries type sections of Garhwal Himalaya** (Sponsored by ONGC, No. BLKM/Ganga/09-10/BSIP)

A 250 pages report on the palaeobiological aspect has been prepared and finalized for submission to ONGC.

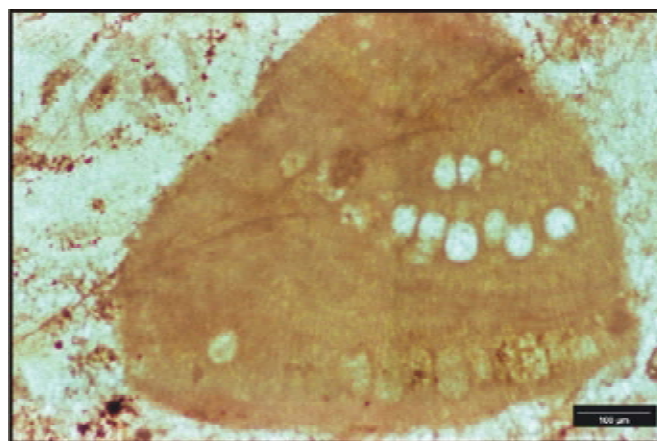
N. C. Mehrotra, Rupendra Babu & V.K. Singh [& P.K. Maithy & G. Kumar]

In continuation of Ganga Basin project, processed samples of Himalayan Foot Hills, Vindhyan Supergroup and Krol Belt of Himalaya. The preliminary report of Himalayan Foot Hill samples has been submitted to Frontier Basins, ONGC.

N. C. Mehrotra & Rupendra Babu [& N.K. Verma, R. Bhoj, A. Nautiyal & U.C. Pradhan (ONGC, Dehradun)]

**Project—Biofacies analysis of Palaeogene and Neogene carbonate sediments in India with special reference to calcareous algae** (CSIR JRF (NET) Fellowship, CSIR Grant No. 09/528 (0016)/2009-EMR-I).

Facies characterization and growth-form, taphonomic and palaeoenvironmental analyses have been completed from the Guitar Formation, Car Nicobar. Five different kinds of biofacies viz., coral-coralline algae grain stone, nummulitic grainstone, foraminiferal-coralline algal wackestone-packstone, foraminiferal-coralline algal grainstone and coralline algal bound stone have been reported. Palaeodiversity and growth-form analysis has been carried out from the Long Formation, Little Andaman Island (Hut Bay). Biostatistical approach of Shannon-Weaver Index is being applied to find numerical probability and equitability indices of the coralline algal populations from the Middle Miocene. The finalization of work is in progress. Proximity of coral reefs and calcareous algae is being studied from the Andaman Islands. A field work has been carried out. Transect and quadrat methods have been applied during the field



*Sporolithon* sp. from Serravallian sediments of Little Andaman (Hut Bay)

survey to deduce the taxonomy of corals and calcareous algae. Special emphasis has been given to the prospective management practices for coral reef conservation and invasion ecology in relation to algae-coral interaction.

Suman Sarkar & A.K. Ghosh

**Project— Studies on Quaternary vegetation, climate change and human habitation in the Central Ganga Plain** (Sponsored by DST, No. SR/WOS-A/ES-18/2009)

Carried out pollen analysis of 10 surface samples from Bari Tal, Lucknow district (Central Ganga Plain). The pollen assemblage depicts the dominance of non-arborescences and relatively low frequencies of arborescences (tree & shrubs). The tree taxa encompassing *Acacia*, *Madhuca indica*, *Holoptelea*, *Syzygium*, etc. are extremely sporadic, reflecting thereby their poor presence in the local floristic coupled with entomophilous mode of pollination. The ground flora is characterized by the preponderance of Poaceae followed by Chenopodiaceae, Brassicaceae, *Xanthium*, Cyperaceae and *Polygonum plebeium* in moderate values. The representation of these taxa in the pollen spectra reflects a close coherence with their presence in the local vegetation. Fungal remains, viz. *Glomus*, *Tetraploa*, *Nigrospora*, etc., are also frequent.

Accomplished chemical processing of a 2.8 m deep sediment profile from Bari Tal, Lucknow district. The preliminary pollen analytical studies has shown the presence of open vegetation comprising grasses, sedges, Chenopodiaceae, Asteraceae with scanty presence of a few trees, viz. *Madhuca indica*, *Holoptelea*, *Syzygium*, Meliaceae, etc. The pollen analysis of the sediment profile is in progress.

Anjali Trivedi



**Project—Hydrological changes in western Himalayan region during the last millennium** (sponsored by DST, New Delhi; No. SR/S4/ES-468/2009)

Tree ring samples of *Pinus roxburghii* from various sites around Purola, Uttarakhand and *Pinus gerardiana* from Kinnaur, Himachal Pradesh have been collected. The samples are cross dated and ring-widths measured.

**R.R. Yadav & B. Sekar**

**Project— Development of long-term high-resolution climate records for western Himalaya, India using multi proxy tree-ring parameters** (sponsored by ISRO-GBP)

Junior Research Fellow appointed in the project is trained to take up the research work under the project.

**R.R. Yadav**

**Project—Tectono-climatic variations during Late-Quaternary in the Tangtse Valley, Ladakh, NW India** (sponsored by DST, New Delhi; No. SR/FTP/ES-123/2009)

As per the objectives several exposed sedimentary profiles in the Tangtse River valley were mapped during one month's field work in that area. The sediments exposed along the valley are lacustrine, aeolian, alluvial plains, colluvial deposits and flood plain deposits. Presence of strath terraces, offset of streams (200-400m); wide valley filled with debris flow, abandoned channels, 2 levels of river terraces (T1-14m and T2-7m) and fluvio-lacustrine sediments at 4280m elevation, all indicate active nature of KKF in the area. The drainage shows a tectonic control and the Gradient Index (GI) values also point to the activity along the fault lines in the area. Lacustrine sediments are exposed along the Tangtse river on both banks almost continuously at about 40-50m above the present day river. The fossil bed of 80 cm was seen. The fossils/subfossils were picked up and were identified up to class level and for further investigation is ongoing in collaboration with Dr. Rajeev Patnaik, Panjab University. This will give us a precise chronology of these deposits as in the Quaternary sediments till now we were not able to get reliable ages due to the low organic content. The samples have been prepared by coning quartering method for LOI data. Samples from ~ 25 m of the section (418 samples) have already been analyzed. The samples were also prepared for mineral magnetic analysis.

**Binita Phartiyal & Randheer Singh**

**Project—Integrated nannofossil-ammonite biostratigraphy of Wagad Island, Kachchh Basin: Palaeoenvironmental and palaeobiogeographic**

**implications** (sponsored by DST, New Delhi; No. SR/S4/ES-521/2010(G))

Initiated work on the project from September 2011. A field excursion to Kachchh area was conducted and samples were collected from (Bharodia section in Kantkot Dome, Patasar shale near Patasar water tank, Chitrod Dome, Shivilakha Dome, Washtawa Dome, Nara Dome) of Wagad Highland. Besides this, Lodrani section of Bela Island, Amarapur section of Khadir Island, Kuar Bet and Sadahra Dome sections in Pachchham Island were also covered and samples from Matanomadh section were also collected.

**Jyotsana Rai & Abha (& Rahul Garg)**

**Project— Biosphere across Vendian-Cambrian and Permian-Triassic Periods and their response to Global Late Proterozoic and Late Palaeozoic glaciations** (DST-RFBR project Research-INT/RFBR/P-102/1 dated 29/08/2011)

One Research Associate has been appointed, under this joint Indo-Russian project. Stromatolite from the Mussoorie Syncline has been sectioned for study and thin sections of the chert nodules are being scanned for ECAP acritarchs.

Permian and Triassic plant assemblages from the Tatapani-Ramkola Coalfield in central India have been worked out and analyzed. The flora was recorded from thirteen different outcrops in the Barakar, Raniganj (Permian) and Panchet (Triassic) Formations. The taxonomical composition of the flora includes 15 genera and 52 species. The composite assemblage demonstrates that the vegetation during the Late Permian was dominated by highly diversified *Glossopteris* flora. Thus, it is inferred that the plant life was only transformed near the vicinity of the Permian-Triassic Boundary (PTB) in the Tatapani-Ramkola Basin and did not become completely extinct.

**Mukund Sharma, K.J. Singh, Rajni Tewari & A.S. Rathore** [*& V.N. Sergeev & S.V. Naugolnykh, GIN, Moscow (Russia)*]

**Project—Analysis of climatic changes during the Quaternary from glacial sites in India based on multi-proxy data** (sponsored by DST, New Delhi; No. DST/CCP/PR/07/2011(G), dated October 2011).

Appointment of project staff (two JRFs and one Project Assistant) has been undertaken. Training to the staff has been imparted regarding maceration of Quaternary sediments. Preparations for field excursion to Chaurabari and Hamtah glaciers have been initiated.

**N.C. Mehrotra, Ratan Kar & A. Bhattacharyya**



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## Deputation to Conferences/Seminars

### Madhav Kumar

- *International Symposium on Palaeontology and Geology & Opening Ceremony of the Palaeontological Museum* held at University of Shenyang (Liaoning), China during May 21-23, 2011.

### K.J. Singh & Rajni Tewari

- *XVII International Congress on the Carboniferous and Permian* held at University of Western Australia, Perth, Australia during July 03-08, 2011.

### N.C. Mehrotra

- *11<sup>th</sup> International Symposium on Antarctic Earth Sciences* held at Edinburgh, Scotland during July 10-16, 2011.

### Anjum Farooqui

- *XVIII INQUA Congress* held at Bern, Switzerland during July 21-27, 2011.

### R.C. Mehrotra

- *XVIII International Botanical Congress* held at Melbourne, Australia during July 22-August 02, 2011.

### Amalava Bhattacharyya

- *Geo Summit-2011 Annual Convention on Geospatial Technologies and Applications* held at Sathyabama University, Chennai during July 27-29, 2011.

### Chanchala Srivastava & C.M. Nautiyal

- *National Seminar on Scientific Dating of Ancient Events Before 2000 BC* organized by I-SERVE and held at New Delhi during July 30-31, 2011.

### Deepa Agnihotri

- *28<sup>th</sup> Annual Meeting of The Society of Organic Petrology (TSOP)* held at Halifax, Canada during July 31-August 04, 2011.

### R.R. Yadav

- *2<sup>nd</sup> Asian Dendrochronology Conference* held at China during August 20-23, 2011.
- *International Conference on Indian Monsoon and Himalayan Geodynamics* held at WIHG, Dehradun during November 2011.

### Ram Awatar, R.C. Mehrotra, Madhav Kumar & Neeru Prakash

- *1<sup>st</sup> International Symposium on Geology and Palaeontology of Yichun* held at Yichun City, China during August 20-25, 2011.

### Shilpa Singh

- *International Conference EMECS-9: Environmental Management for Enclosed Coastal Seas* held at Baltimore, Maryland, USA during August 28-31, 2011.

### Neerja Jha, A. Rajanikanth, Mukund Sharma, Poonam Verma, M.F. Quamar & Swati Dixit

- *National Conference on Science of Climate Change and Earth's Sustainability: Issues and Challenges* held at Lucknow University, Lucknow during September 12-14, 2011.

### A.K. Ghosh

- *10<sup>th</sup> International Symposium on Fossil Algae* held at Babes-Bolyai University, Cluj-Napoca, Romania during September 16-18, 2011.

### C.M. Nautiyal

- *Workshop on Accelerator Mass Spectroscopy using 15 UD Pelletron* held at IUCA, Delhi on September 15, 2011.

### N.C. Mehrotra & Mukund Sharma

- *National Seminar on Geodynamics and Metallogenesis of the Indian Lithosphere* held at BHU, Varanasi during September 22-24, 2011.

### Jyoti Srivastava

- *7<sup>th</sup> International Conference on Asian Marine Geology* held at NIO, Goa during October 08-17, 2011.

### N.C. Mehrotra, Neerja Jha, Rajni Tewari & S.S.K. Pillai

- *XXII Brazilian Congress of Paleontology & 2<sup>nd</sup> Indo-Brazilian Symposium on Glimpses of Gondwana Research* held at Natal (RN), Brazil during October 23-28, 2011.





**R.R. Yadav, Binita Phartiyal, Richa Singh & Monisha Awasthi**

- *International Conference on Indian Monsoon and Himalayan Geodynamics (IMHG)* held at WIHG, Dehradun during November 02-05, 2011.

**Rajni Tewari & Anupam Sharma**

- *National Seminar on Modern and Palaeo-sediments: Implication to Climate, Water Resources and Environmental Changes & 28<sup>th</sup> Convention of Indian Association of Sedimentologists* held at New Delhi during November 24-26, 2011.

**Neerja Jha, Ram Awatar, Mukund Sharma, Alpina Singh, K.L. Meena, M.F. Quamar, Swati Dixit, Gaurav Srivastava, S.K. Pandey & Nilay Govind**

- *World Conference on Palaeontology and Stratigraphy (WCPS-2011)* held at Nakhom Ratchasima, Thailand during November 28-December 02, 2011.

**M.R. Rao, Mukund Sharma, Mahesh Prasad, Jyotsana Rai, Srikanta Murthy, V.K. Singh, Biswajeet Thakur & M.F. Quamar**

- *XXIII Indian Colloquium on Micropalaeontology and Stratigraphy (ICMS) and International Symposium on Global Bioevents in the Earth History* held at Bangalore University, Bangalore during December 09-11, 2011.

**A. Bhattacharyya, A.K. Ghosh & Rubi Ghosh**

- *Seminar on Plant Diversity and Resources: Evolution, Analysis, Stress and Challenges and Phytodiversity: Its Aspects and Prospects* held at Kolkata during December 20-22, 2011.

**Samir Sarkar, Rashmi Srivastava & Vartika Singh**

- *99<sup>th</sup> Session Indian Science Congress Association*

held at Kalinga Institute of Industrial Technology University, Bhubneshwar during January 03-07, 2012.

**Binita Phartiyal**

- *3<sup>rd</sup> Annual Meeting of IGCP* held at Kanpur during January 05-07, 2012.
- *GGHCRI – Geology and Geo-resources of Himalaya and Cratonic Belts of India* held at Nainital during March 10-12, 2012.

**S.K.M. Tripathi, Vandana Prasad, Hukam Singh & Poonam Verma**

- *Vastan Field Workshop* organized by the Palaeontological Society of India and held at Vastan Lignite Mine (Surat) during January 17-19, 2012.

**P.S. Ranhotra**

- *National Symposium and Field Workshop on Geology of Kutch Basin, western India: Present Status and Future Perspectives* held at KSKV Kachchh University, Bhuj during January 26-29, 2012.

**A. Rajanikanth & Swati Dixit**

- *International Seminar on Emerging Threats and Challenges to Biodiversity: Policy Framework for Sustainable Management (ETCOB-2012)* held at Sri Venkateswara University, Tirupati during March 02-04, 2012.

**A.K. Pokharia**

- *International Seminar on Harappan Sites in western India (Gujarat)* held at Deccan College, Pune during March 22-24, 2012.

**Anupam Sharma**

- *National Seminar on Environmental Pollution and its Mitigation Strategies* held at New Delhi during March 28-29, 2011.

## Papers presented at Conferences/Seminars

- Babu R & Singh VK – Megascopic multicellularity in deep time: New evidences from the Proterozoic Singhora Group. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Bera SK- Antarctic Science: Researcher's dream, opportunities, survival and future prospects. *Plant Sci. Res. in Human Welfare*, Kolkata, January 2012.
- Bera SK, Basumatary SK & Gogoi R – Modern pollen and spore assemblage in relation to biodiversity of Itanagar Wildlife Sanctuary, Arunachal Pradesh. *24<sup>th</sup> Ann. Gen. Meet. Indian Phytol. Soc. (Eastern zone) & Nat. Symp. Microorganism & Plant Health*, Guwahati, November 2011.
- Bernardes-de-Oliveira ME, Mune Sandra, Sucerquia Paula, Garcia MJ, Guerra Sommer, Margot, Schimdt IB & Tewari R – Mesophytic Gondwanan paleofloras from Brazil and India: Composition and palaeoclimatic approach. *Indo-Brazilian Symp. Glimpses of Gondwana Research, XXII Brazilian Congr. Palaeontol.*, Natal, Brazil, October 2011.
- Bhattacharyya A & Shah SK – Wood analysis of temporal tree growth variation of tree be suitable in assessment of dynamics of Gangotri glacier? A dendrochronological approach. *Sem. Plant diversity and Resources: Evolution, Analysis, Stress and Challenges and Phytodiversity*. Kolkata, December 2011.
- Dixit S & Bera SK – Late Quaternary climatic fluctuations from Lower Brahmaputra valley of Assam, Northeast India: in context with global climatic events. *World Conf. Palaeontol. Stratigr.*, Thailand, November-December 2011.
- Dixit S & Bera SK – Interplay between pollen and extant vegetation in wetland environ of Lower Brahmaputra floodplain of Assam, India. *Nat. Conf. Science of Climate Change & Earth's Sustainability: Issues and Challenges 'A Scientist-People Partnership'*, Lucknow, September 2011.
- Dixit S & Bera SK – Reconstruction of vegetation vis-à-vis climatic fluctuations since early Holocene in and around lower Brahmaputra flood plain of Assam, Northeast India: based on pollen proxy records. *Int. Sem. Emerging Threats & Challenges to Biodiversity: Policy framework for sustainable management*, Tirupati, March 2012.
- Dixit S, Basumatary SK, Bera SK, Rahman A, Rabha D & Thomas S – Melissopalynological investigations from Goalpara District, Assam. *24<sup>th</sup> Ann. Gen. Meet. Indian Phytol. Soc. (Eastern zone) & Nat. Symp. Microorganism & Plant Health*, Guwahati, November 2011.
- Farooqui A, Naidu TY & Suryanarayana G – Pleistocene record of sea level and vegetation, East coast, India. *XVIII INQUA Congr.*, Bern, July 2011.
- Ghosh AK & Sarkar S – Facies characterization and palaeoenvironmental significance of reef-forming Coralline algae dominated sediments: A case study from the Guitar Formation (Middle Pliocene) of Car Nicobar Island, India. *10<sup>th</sup> Int. Symp. Fossil Algae*, Cluj-Napoca, Romania, September 2011.
- Ghosh AK & Sarkar S – Palaeodiversity of fossil algae and benthic foraminifera with special allusion to taphonomy and growth-form analyses of coralline algae from the Late Middle Miocene sediments of Long Formation, Little Andaman Island (Hut Bay), India. *10<sup>th</sup> Int. Symp. Fossil Algae*, Cluj-Napoca, Romania, September 2011.
- Ghosh AK & Sarkar S – Influence of end Cretaceous mass extinction on the diversity of Coralline Red Algae from India. *Sem. Plant diversity and Resources: Evolution, Analysis, Stress and Challenges and Phytodiversity*. Kolkata, December 2011.
- Ghosh AK & Sarkar S – Fossil calcareous algae from the hydrocarbon-potential sedimentary basins of India. *99<sup>th</sup> Indian Sci. Congr., Earth Syst. Sci.*, Bhubaneswar, January 2012.
- Ghosh R, Parua DK & Bera S – Phytolith spectra from Pleistocene-Holocene sedimentary sequences in Darjeeling Sub-Himalaya and its palaeoclimatic significance. *Sem. Plant diversity and Resources: Evolution, Analysis, Stress and Challenges and Phytodiversity*. Kolkata, December 2011.
- Govind N – Palaeoinformatics–A step towards the modern paleontology. *World Conf. Paleontol. Stratigr.*, Thailand, November-December 2011.



- Jha N – Permian palynology of Godavari Graben, its palaeoclimatic and palaeogeographic implication. *Field Workshop on Godavari Basin*, Kothagudem, August 2011.
- Jha N – Palynofloral pattern through Upper coal measures of Lower Gondwana sequence in peninsular India. *XXII Brazilian Congr. Palaeontol.*, Natal (RN), Brazil, October 2011.
- Jha N – Late Permian palynology of India, its palaeoclimatic and phytogeographic significance. *World Conf. Paleontol. Stratigr.*, Thailand, November-December 2011.
- Kumar M – Record of microscopic charcoal and other fire affected sedimentary organic matter in Early Cretaceous sediments of South Rewa Basin, India. *Int. Symp. Palaeontol. & Geol. in Liaoning, China*, May 2011.
- Kumar M – Palaeoecological and phytogeographical implications of Early Cretaceous miospores assemblages of South Rewa and Satpura Gondwana Basins, Central India. *Int. Symp. Geol. & Palaeontol. in Yichun, China*, August 2011.
- Meena KL – Permian flora reported from Barakar and Supra- Barakar Sediments from Talchir Coalfield, Orissa, Son- Mahanadi Basin, Eastern India. *World Conf. Palaeontol. Stratigr.*, Thailand, November-December 2011.
- Mehrotra RC – Some interesting elements of the Tertiary flora of India. *18<sup>th</sup> Int. Bot. Congr.*, Melbourne, Australia, August 2011.
- Mehrotra RC & Shukla A – *Eucalyptus* in time and Space. *Int. Symp. Geol. & Palaeontol. in Yichun, China*, August 2011.
- Murthy S – Palynostratigraphy of Permian succession in Pench Valley Coalfield, Satpura Basin, Madhya Pradesh, India. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Nautiyal CM – Radiometric dating of records of Ancient Culture- Sites in India. *Nat. Sem. Scientific Dating of Ancient Events before 2000 BC*, New Delhi, July 2011.
- Nautiyal CM – Radiocarbon dating and its application to palaeoclimatic and Archaeological studies, New Delhi, September 2011.
- Pandey SK & Kumar S – Biozonation and correlation of the Neoproterozoic Bhandar Group, central India. *World Conf. Palaeontol. & Stratigr.*, Thailand, November-December 2011.
- Phartiyal B, Sharma A & Singh R – Quaternary sedimentation in Trans Himalaya (Ladakh Sector) NW India: Key to tectonics and paleoclimate. *GGHCRI- Geol. & Geo-resources of Himalaya and Cratonic Belts of India*, Nainital, March 2012.
- Phartiyal B, Singh R, Kothiyari GC & Sharma A – Landscape evolution and geomorphology of the Tangtse River valley (Ladakh), NW Indian Himalaya. *3<sup>rd</sup> Ann. Meet. IGCP*, Kanpur, January 2012.
- Pillai SSK – *Glossopteris* flora from Rawanwara area of Pench Valley Coalfield, Satpura Gondwana Basin, Central India. *Indo-Brazilian Symp. Glimpses of Gondwana Research, XXII Brazilian Congr. Palaeontol.*, Natal, Brazil, October 2011.
- Pokharia AK – Crops and climate: Implications for cropping strategies during 3<sup>rd</sup>-2<sup>nd</sup> millennium BC in Gujarat. *Int. Sem. Harappan Sites in western India (Gujarat)*, Pune, March 2012.
- Prakash N – Diversity and phytogeography of Ginkgoalean leaves in Indian Gondwana. *Int. Symp. Geol. & Palaeontol. in Yichun, China*, August 2011.
- Prasad M – Siwalik (Middle Miocene) flora of Tanakpur area in the Himalayan foot hills of Uttarakhand, India and its palaeoclimatic implications. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Prasad M, Khare EG & Singh SK – Fossil leaf impressions from the Deccan Intertrappean sediments of Chhindwara District, Madhya Pradesh, India and their palaeoclimatic significance. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Rai J, Malarkudi & Singh Abha – Terminal Maastrichtian age calcareous nannofossils preceding K/T mass extinction from Ariyalur Formation, Virdhachalam area, South India. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Rajanikanth A – Relevance of environmental ethics (ee) to sustain planet earth. *Nat. Conf. Science of*

- Climate Change & Earth's Sustainability: Issues and Challenges*, Lucknow, September 2011.
- Rajanikanth A – A new millennium culture to sustain living earth- a holistic perspective. *Int. Sem. Emerging Threats & Challenges to Biodiversity: Policy Framework for Sustainable Development*, Tirupati, March 2012.
- Ram-Awatar – Early Permian palynofossils from the Salto Flysch Formation, Lower Shyok Formation, eastern Karakoram, India. *Int. Symp. Geol. & Palaeontol. in Yichun*, China, August 2011.
- Ram-Awatar – Late Permian palynofossils from the ammonoid bearing bed from Gungri Formation, Spiti Valley, Tethys Himalaya, India. *World Conf. Paleontol. Stratigr.*, Thailand, November/December 2011.
- Rao MR & Verma P – Equatorial forest build up at the early Eocene Climate Optimum: Palynostratigraphy of Vastan Lignite Mine, western India. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Sarkar S – Cyanobacteria rich sediments from the Subathu Formation (Early Ypresian) of Lesser Himalaya, India: Palaeoenvironmental implication. *99<sup>th</sup> Session Indian Sci. Congr.*, Bhubaneswar, January 2012.
- Sharma A & Kumar K – Mineralogical and geochemical evaluation of the Mahi River sediments: implications for source rocks and catchment weathering processes. *Nat. Sem. Modern and Palaeo sediments: Implication to climate, water resources and environmental changes & XXVIII Conv. Indian Assoc. Sedimentol.*, New Delhi, November 2011.
- Sharma A & Kumar K – Geochemistry and quality of surface and sub-surface water of the Mahi River Basin, western India: implications to natural and anthropogenic processes. *Nat. Sem. Environmental pollution and its mitigation strategies*, New Delhi, March 2012.
- Sharma M – Occurrence of the Neoproterozoic and Ediacaran palaeobiological remains in the Purana basins of Peninsular India: Implications for the age of the Kurnool, Bhima and Vindhyan basins. *Nat. Sem. Geodynamics & Metallogenesis of the Indian Lithosphere*, Varanasi, September 2011.
- Sharma M – Precambrian Micro & Macrofossils and Mesoproterozoic Biostratigraphy. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Sharma M & Pandey SK – Ichno-fossils and macrofossils from the Precambrian-Cambrian Marwar Supergroup, India. pp. 73-74. *World Conf. Palaeontol. & Stratigr.*, Thailand, November-December 2011.
- Sharma M & Pandey SK – Fossil lagerstätten and an age assessment of the Nagaur Sandstone, Marwar Supergroup. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Sharma M & Shukla Y – Is the Kurnool Group Mesoproterozoic or Neoproterozoic? Palaeobiological constraints. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Singh Abha & Rai J – Mid-low latitude Cretaceous age nannofossil biozonation from Tanot Bore Well-1, Jaisalmer Basin, Western India. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Singh Alpina & Singh BD – Petrological properties of Indian lignites in context to their utilization. *World Conf. Palaeontol. Stratigr.*, Thailand, November-December 2011.
- Singh K J & Saxena A – Biodiversity of the Palaeozoic rocks in the North West Himalaya, India - A Review. *XVII Int. Congr. Carboniferous & Permian*, Perth, Australia, July 2011.
- Singh S & Khandelwal A – Mangrove ecosystem changes during the Holocene from Chilka Lagoon, East Coast, India. *Int. Conf. EMECS-9: Environmental Management for Enclosed Coastal Seas*, Baltimore, Maryland, USA, August 2011.
- Singh SK, Prasad M & Singh H – Record of palynoflora from Middle Miocene (Lower Siwalik) sediments of Lish Liver section, Darjeeling District, West Bengal and their palaeoenvironmental implications. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Singh VK & Babu R – Permineralized microbiota from



- the carbonate facies of Raipur Group, Chhattisgarh Supergroup: its biostratigraphic implications. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Srivastava AK & Agnihotri D – Coal seam correlation of Indian Gondwana coalfield: A palaeobotanical perspective. *28<sup>th</sup> Ann. Meet. The Society for Organic Petrology*, Halifax (NS), Canada, July-August 2011.
- Srivastava C – Archaeobotanical evidences of ancient cultures in Indian subcontinent before 2000 BC. *Nat. Sem. Scientific Dating of Ancient Events Before 2000 BC*, New Delhi, July 2011.
- Srivastava G & Mehrotra RC – *Mangifera* L. in time and space. *World Conf. Palaeontol. Stratigr.*, Thailand, November-December 2011.
- Terada K, Kagemori N, Mandang Y, Srivastava R & Kagemori Y 2011. What can fossil wood tell us? The identification of fossil woods from the Pliocene of West Java, Indonesia. *177<sup>th</sup> Symp. Sustainable Humanosphere, Wood Culture & Science*, Kyoto, Japan, August 2011.
- Tewari R – Gondwana megaspores of India- architectural radiation, distribution, evolutionary and biostratigraphic significance. *XVII Int. Congr. Carboniferous & Permian*, Perth, Australia, July 2011.
- Tewari R – *Glossopteris* flora from the Umrer Coalfield, Wardha Basin, Maharashtra, India. *Nat. Sem. Modern and Palaeo sediments: Implication to climate, water resources and environmental changes & XXVIII Conv. Indian Assoc. Sedimentol.*, New Delhi, November 2011.
- Tewari R & Pillai SSK – An evaluation of Late Palaeozoic floras of India. *Indo-Brazilian Symp. Glimpses of Gondwana Research, XXII Brazilian Congr. Palaeontol.*, Natal, Brazil, October 2011.
- Thakur B, Prasad V & Garg R 2011. Differential primary productivity pattern in an estuarine setting: A case study from Vembanad estuary. *XXIII Indian Colloq. Micropalaeontol. Stratigr. & Int. Symp. Global Bioevents in the Earth History*, Bangalore, December 2011.
- Varma AK, Chinara I, Mendhe VA & Singh BD – Hydrocarbon generation evaluation through Rock Eval pyrolysis: A case study of Raniganj coal basin, West Bengal, India. *17<sup>th</sup> Conv. Indian Geol. Congr. & Int. Conf. New Paradigms of Explor. Sustain. Mineral Devel.: Vision 2050*, Dhanbad, November 2011.
- Verma P & Rao M R- Vegetation and climate history from Kusumelli Swamp, Sehore district, Madhya Pradesh since Early Holocene. *Nat. Conf. Sci. of Climate Change & Earth's Sustainability: Issues and Challenge*, Lucknow, September 2011.

## Training/Study/Visit in Country/Abroad

### Anjali Trivedi

Visited Institute of Botany, Beijing, China from May 01 to July 31, 2011 under Post Doctoral Fellowship Programme awarded by TWAS-CAS Post Doctoral Programme and worked in collaboration with Chinese scientists on the Quaternary palaeoclimatic studies, based on pollen evidence from Shaun-hai-Zi Lake, Yunan, west China.

### C.M. Nautiyal

Attended Workshop on 'Role of Intellectual Property Rights in Business Perspective' organised by Council of Science and Technology, Lucknow on May 23, 2011.

Attended a Brainstorming Session on 'Dating of Ancient Events' organised by I- SERVE at New Delhi on June 11, 2011.

Attended Brainstorming Session for the XII Plan of National Council for Science Museums held at National Science Centre, New Delhi on July 23, 2011.

Participated in exhibition during Science Expo at Regional Science City, Lucknow during January 19-23, 2012. Besides, attended 3 workshops by and at National Institute for Open Schools, Noida during the year 2011-12.

### Ratan Kar & P.S. Ranhotra

Participated in the 5<sup>th</sup> Indian Arctic Expedition to Ny-Alesund (Svalbard, Norway) from July 14 to August 02, 2011, organized by NCAOR, Goa. During the expedition collected Quaternary sediment samples for palaeoclimatic studies.

RK also attended the Antarctic Project Presentation- *Brain Storming Session* at the National Centre for Antarctic and Ocean Research, Goa from February 24-25, 2012.

### Deepa Agnihotri

After attending the annual meeting of the Society for Organic Petrology (TSOP) in August, 2011 visited Museum of Natural History, Halifax, Nova Scotia, Canada.

### Neerja Jha

Participated in the Field Workshop on Godavari Basin held at Kothagudem from August 17-20, 2001.

### Srikanta Murthy & V.K. Singh

Attended the 7<sup>th</sup> Proficiency Course on Modern Practices in Petroleum Exploration organised by Petrotech Society and held at Keshava Deva Malviya Institute of Petroleum Exploration, ONGC, Dehradun from September 05-09, 2011. VKS also visited and collected palynological samples of Proterozoic age from the type section (Maldeota) and in and around Mussorrie area in one day field trip during the course.

### M.R. Rao

Under the INSA Exchange of Scientists Programme between INSA, New-Delhi and Chinese Academy of Sciences, visited Institute of Botany, CAS, Beijing for a period of 27 days (October 09-November 04, 2011). During this period, palynological studies were carried out on early Eocene to Holocene sediments of north, central and southwest of China and studied the slides of profile samples. The assemblage was dominated by gymnosperm pollen followed by angiosperm pollen/ fern spores. The important genera are: *Ephedra*, *Juglandaceae*, *Cyclocarya*, *Engelhardtia*, *Juglans*, *Platycarya*, *Myrica*, *Pinus*, *Abies*, *Picea*, *Cupressus*, and *Cunninghamia*. Also visited and done the field work in Guangfayong area, Weichang district, Hebei Province, China with Prof. Cheng-Sen-Li and his group and collected the rock samples for palynological investigation. In addition to these, I have also visited Natural History of Museum, Geological Museum, Geozoological Museum and Botanical Garden of Beijing.

Attended the DST sponsored programme on 'Paradigm Shift in Science and Technology' held at National Institute of Advanced Studies, Bangalore during December 12-16, 2011.

### Rajni Tewari

Visited Department of Palaeontology, Guarulhos University, Guarulhos, Brazil in October-November, 2011 under the Indo-Brazil S&T Joint Research Programme. Participated in scientific discussions regarding comparative studies on: i) Gondwana flora of India and Brazil, and ii) palaeofire in Gondwana in both the countries with Brazilian geoscientists particularly Prof. Mary E. Bernardes Oliveira of Institute of Geosciences, São Paulo; Prof. Margot

Guerra Sommer, Federal University of Rio Grande do sul, Porto Alegre; and Prof. Andre Jasper of Central University, UNIVATES, Lajeado, Rio Grande do Sul. The visit provided an opportunity to study the Gondwana flora of Brazil in comparison with India particularly the flora of: i) Cerquihilo Municipality, from Sítio Itapema, São Paulo- from the Itarare Subgroup (equivalent to Talchir/Karharbari flora of India); ii) flora of Irapua from the Rio Bonito Formation, Criciúma, Santa Catarina (equivalent to top of Karharbari/base of Barakar flora of India); iii) flora of Lauromuller from the Rio Bonito Formation; iv) flora of Laras, São Paulo- from the Corumbatai Formation/Estra da Nova (equivalent to Barren Measures Formation of India) and from Caminho do Penta, Santa Catarina from Serra elta Formation (equivalent to the Barren Measures Formation of India). The studies are proving helpful in filling in the gaps of knowledge. Whereas, the Carboniferous flora is not very well known from India from the peninsular region (it is known only from the Himalayan region from Spiti and Kashmir), it is well known from Brazil and corresponds to the earliest Permian of India.

#### **S.S.K. Pillai**

Visited Institute of Geosciences, Sao Paulo University and Department of Palaeobotany, University of Guarulhos, S.P. Brazil from October 29 to November 05, 2011.

#### **Abha**

Attended 3<sup>rd</sup> All India Students Symposium on Geology 'GEOYOUTH-2K11' held at the Department of Geology, Mohanlal Sukhadia University, Udaipur, Rajasthan from November 25-26, 2011.

#### **B.D. Singh**

Attended Training Workshop on the Right to Information Act-2005 (RTI) for Central Public Information Officer and Appellate Authorities in the Ministries/ Departments of Government of India conducted by Department of Personnel and Training on November 28, 2011 at Institute of Secretariat Training and Management, JNU Campus (old), New Delhi.

#### **Vartika Singh**

Visited the National Centre for Antarctic and Ocean Research, Goa and presented the Project in the Arctic Team Selection Meeting for the forthcoming Arctic Expedition in the summer of 2012.

#### **Nivedita Mehrotra**

Participated in National Conference on 'Geology and Society' and Training Program on Disaster Management held at Department of Geology, University of Lucknow, Lucknow from February 29-March 01, 2012.

#### **Administrative Personnel**

##### **S.C. Bajpai**

Attended World Renewable Energy Technology Congress and Expo (WRETC-2011) held at New Delhi from April 21-23, 2011, and presented papers entitled *Creating Zero-Emission Buildings* and *Renewable Energy Sources for Powering Telecom Towers*.

Attended 2<sup>nd</sup> International Conference on National Solar Mission held at Mumbai in April 2011 and presented paper entitled *Hybrid Photovoltaic Thermal (PV/T) Technology for Building Integrated Application*.

Attended National Seminar on Green Energy and ICT Solar Energy Empowerment of Rural India held at RGIIT, Amethi from August 20-21, 2011, and presented paper entitled *Low Energy Architectural Possibilities in Buildings*.

Attended CII's Conference-Cum-Exposition on Renewable Energy- Fueling the Future held at Lucknow from September 09-10, 2011, and presented paper entitled *Grid-connected Solar Projects- Opportunities and Challenges in UP*.

Attended National Conference on Science of Climate Change and Earth's Sustainability: Issues and Challenges held at Lucknow from September 12-14, 2011, and presented paper entitled *Sustainable Habitat and Climate Change*.

Attended National Seminar on Enlightened Leadership for Corruption-free India (from October 21-23, 2011) and Energy Conservation Day Seminar (on December 14, 2011) held at Lucknow.

Attended National Capacity Building Initiative ISO 50001, Facilitator's Workshop on Energy Management System held at Lucknow on November 12, 2011, and delivered lecture on *ISO 50001 Energy Management System*.

## Lectures Delivered

### N.C. Mehrotra

- *Evolution of Landscape and Climatic Variations in the Schirmacher Oasis, East Antarctica during Holocene* at 11<sup>th</sup> International Symposium on Antarctic Earth Sciences, Edinburgh (July 2011)
- *High Impact Palynology in Hydrocarbon Exploration in Petroliferous Basins of India with recent achievements from Frontier Areas* (Foundation Day Lecture, Indian Geological Congress) at BHU, Varanasi (August 11, 2011).

### M.R. Rao

- *Palaeopalynology and its Applications* at DST sponsored programme on Paradigm shift in Science and Technology, Bangalore (December 2011)

### Chanchala Srivastava

- *Up-keeping of Garden etc.* at Indian Council of Philosophical Research, Academic Centre at 3/9, Vipul Khand, Gomti Nagar, Lucknow (April 29, 2011); under Training programme imparted to Group 'D' employees of ICPR.

### S.K. Bera

- *Antarctic Science: Researcher's Dream, Opportunities, Survival and Future Prospects* at Seminar on Plant Science Research in Human Welfare, Bidhannagar College, Kolkata (January, 2012).

### Jyotsana Rai

- *Reminiscence of Jurassic Climate in India recorded by Calcareous Nannofossils* (keynote lecture) at the Humboldt Kolleg and International Conference 'Earth Future' held at Periyar University, Salem (September 2011).
- *Calcareous Nannofossils- The David Size and Goliath Applications* at the Geology Department, Anna University, Chennai (September 12, 2011).
- *Kya hote hain Fossils* (Radio talk) broadcasted on November 29, 2011.
- *Kahan gaye Dinosaur* (Radio talk) broadcasted on June 14, 2011.

### Rashmi Srivastava

- *Origin and Development of Indian Forests:*

*Palaeobotanical evidences* at INSPIRE Internship Programme, Integral University, Lucknow (November, 2011).

### C.M. Nautiyal

- Lectures (7) under *Disaster Management* at UP Academy for Administration and Management (during 2011-12).
- *Scientist and Journalist: Bridging the Gap* at Workshop by Vigyan Prasar & Sevak, Indian Institute of Mass Communication, New Delhi (May 04, 2011).
- *Communicating Climate Change* at Workshop by Vigyan Prasar & Sevak, Indian Institute of Mass Communication, New Delhi (May 05, 2011).
- Brain Storming Session by I- SERVE at New Delhi (June 11, 2011).
- *The Right to Energy: The Right Energy in the Changing Climate* at SN Tripathi Memorial Seminar, Lucknow (August 23, 2011).
- *Bridging the Gap* at Workshop by Vigyan Prasar & Sevak, Amity University, Lucknow (September 09, 2011).
- *Ozone- Depletion: The Alarm for Earth* at Regional Science City, Lucknow (September 28, 2011).
- *Isotopes and Dating* (3 lectures) at campuses of Amity University (Gurgaon, Lucknow, Jaipur) during Inspire camps under a scheme of DST, New Delhi (December 2011).
- *A Flight with Isotopes: From Ocean to Sky* at Inspire programme, Integral University, Lucknow (December 16, 2011).
- *Earthquake* (2 lectures) at State Disaster Management Association, Lucknow (November 23, 2011 & March 04, 2012)
- *Hindi mein Vigyan Praudyogikhee lekhan* at Training Institute, GSI (January 19, 2012).
- *Clean Energy Alternatives and Nuclear Energy* on Science Day at DIET under DSC, Lucknow (February 28, 2012).
- *Water and Food Security* at Ramswaroop Engineering College, Lucknow (March 22, 2012).



**A.K. Ghosh**

- *End Cretaceous Mass Extinction and Diversity of Coralline Red Algae from India* (Invited lecture) in the Seminar on Plant diversity and Resources: Evolution, Analysis, Stress, Challenges and Phytodiversity, on the Birth Centenary of Prof. A.K. Ghosh organized by Botanical Society of Bengal & CAS in Botany, University of Calcutta, Kolkata (December 2011).
- *Evaluation of the past Climate using Plant Fossils and Effect of Major Mass Extinction Events on the Diversity of Plants* (two lectures: as a Resource Person) at UGC Refresher Course on Plants and Environment, Department of Botany, University of Allahabad (February 03 & 04, 2012).

**Ratan Kar**

- *Deciphering the Quaternary Climatic History of*

*the Arctic Region: Multi-proxy approach with special reference to Palynology and Palynology vis-à-vis Glaciology: Interpretation of Climatic Changes and Glacial Fluctuations* (two lectures) at Vidyasagar University, West Bengal (March 05, 2012).

- *Application of Palynology in Coal Exploration: Case study from Tatapani-Ramkola Coalfield, Chhattisgarh* at Vidyasagar University, West Bengal (March 06, 2012).

**Swati Dixit**

- *Late Quaternary Vegetation Succession and Climate Change in Northeast India: based on Pollen Proxy Records* (Dr. B.S. Venkatachala Memorial lecture) at BSIP, Lucknow (January 02, 2012).

### By outside scientists in the Institute

**Prof. Robert A. Spicer**, Department of Earth Sciences, Open University, Milton Keynes, UK

- *Adventures in a Late Oligocene Tropical Delta* (May 13, 2011)

**Dr. Sankar Chatterjee**, Paul Whitfield Horn Professor of Geology & Curator of Paleontology, Texas Tech University, Lubbock, Texas (USA)

- *Shiva Impact, Deccan Volcanism and the Mass Extinction* (July 29, 2011)

**Dr. Serge V. Naugolnykh**, Geological Institute of Russian Academy of Sciences, Moscow, Russia

- *Permian Period and the Paleo-geopark of the Urals: State-of-the-art and Perspectives* (November 16, 2011)

**Dr. Chris Mays**, School of Geosciences, Monash University, Victoria, Australia

- *Forestlands of the Aurora Australis: South Polar (75-80°S) Mid-Cretaceous Greenhouse Environments and Floral Ecosystems* (January 06, 2012)

**Prof. Cheng-Sen Li**, Institute of Botany, Chinese Academy of Sciences, Beijing, China

- *Palaeobotanical Researches in the Institute of Botany, Beijing* (February 15, 2012)

**Prof. Yu-Fei Wang**, Institute of Botany, Chinese Academy of Sciences, Beijing, China

- *Neogene Climate Changes in North China* (February 15, 2012)

**Prof. Robert A. Spicer**, Department of Earth Sciences, Open University, Milton Keynes, UK

- *Arctic Plant Fossils and Introduction to a new Online Resources* (National Science Day Celebration Lecture; February 24, 2012)

**Prof. R.P. Tiwari**, Head, Department of Geology, Mizoram University, Aizawl, India

- *Palaeobiology and Depositional Environment of Cenozoic Succession of Mizoram* (National Science Day Celebration Lecture; February 24, 2012)

## Consultancy/Technical Assistance Rendered

The **Radiocarbon Laboratory** also served as a national facility for researchers from various organizations and workers across the country for dating materials like sediments, charcoal, shells and other carbonates, etc. under consultancy. Scientists from the following organizations availed of the consultancy services:

Anna University, Chennai  
Archaeological Survey of India (Bhopal, Patna & Chennai)  
Banaras Hindu University, Varanasi  
Centre for Earth Science Studies, Thiruvananthapuram  
Calcutta University, Kolkata  
Darjeeling University  
Deccan College, Pune  
Dibrugarh University, Assam  
Geological Survey of India, NR, Lucknow  
MS University, Vadodara  
National Bureau of Soil Science and Land Use Planning, ICAR, Nagpur  
National Centre of Biological Sciences, TIFR, Bengaluru  
National Institute of Abiotic Stress Management, ICAR, Bhopal  
PG Institute of Archaeology, Colombo, Sri Lanka  
Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram  
University of Lucknow, Lucknow  
UP State Archaeology Department, Lucknow

The electron microscopes equipped in **SEM unit** are being used as a central facility. The facility has also been provided to other institutions in spare times. The unit has provided consultancy in investigating the ultra structural morphology and micro-analysis of samples received from about 87 researchers of following organizations/ universities:

Department of Physics, Lucknow University, Lucknow (Nanofilm/ powder/polymer, etc.- 71)  
Department of Botany, Lucknow University, Lucknow (Leaf, pollen grains- 29)  
National Botanical Research Institute, Lucknow (Botanical, microbiological samples- 65)  
Banaras Hindu University, Varanasi ((Pharmaceuticals/ algae- 6)  
Central Drug Research Institute, Lucknow (nanomaterial/ pharmaceuticals samples- 32)  
Saraswati Dental College, Lucknow (Dental materials- 11)  
CSM Medical University, Lucknow (Tooth/ dental materials- 25)

Babu Banarsi Das National Institute of Technology and Management, Lucknow (Teeth/ pharmaceuticals- 25)  
Central Institute for Plastic Engineering and Technology, Lucknow (Polymer beld samples- 10)  
Sant Gadge Baba Amravati University, Amravati (Botanical samples- 31)  
Department of Physics, Agra College, Agra (Powder materials- 9)  
Indian Institute of Toxicology Research, Lucknow (Natural polymer, metal alloy, fly ash, fish gills, nannomaterials- 22)  
Career Post Graduate College of Dental Sciences, Lucknow (Dental material samples- 18)  
Central Institute of Medicinal and Aromatic Plant, Lucknow (Botanical samples- 8)  
UP Dental College and Research Centre, Lucknow (Dental material samples- 29)  
Integral University, Lucknow (Nano material/crystal samples - 19)  
Kothiwal Dental College and Research Centre, Moradabad (Teeth/ dental material- 26)  
Allahabad University, Allahabad (Leaf/ spores, woods- 28)  
Amity University, Lucknow (Pharmaceuticals - 7)  
Bundelkhand University, Janshi (Pharmaceuticals- 10)  
Aligarh Muslim University, Aligarh (Steel/ metal alloy- 36)  
HNB Garhwal University, Srinagar (Pharmaceuticals- 2)  
Mayssore Vishwavidhyalaya, Mayssore (Leaf, pollen- 6)  
Madan Mohan Malaviya Engineering College, Gorakhpur (Pharmaceuticals- 6)  
Shri Ram Murti Smarak College of Engineering and Technology, Bareilly (Pharmaceuticals- 7)

**Samir Sarkar** provided scientific assistance to Mr. S. Roy, Research Scholar of Geology Department, IIT, Bombay.

**Ram Awatar** provided consultancy services to Geology Department, Ranchi University, Ranchi on the palynological study (dating and correlation). Also imparted training in Gondwana palynology to Ms. Tarit Sanga, Research Scholar of the university.

**Alpana Singh** provided guidance in observation and quantitative estimation of macerals (both under normal and fluorescence modes) and in measurement of huminite reflectance on Panandhro lignite samples to Mr. Sandip Singh, Research Scholar of Kurukshetra University, Kurukshetra for a period of two weeks (in June 2011)



Provided guidance in observation and quantitative estimation of macerals (both under normal and fluorescence modes) and in measurement of vitrinite reflectance on Lakhanpur coal samples to Ms. Prabha Sharma, Research Scholar of Vikram University, Ujjain (during her thrice visits).

**B.D. Singh** provided scientific assistance in observation of coal microconstituents (both under normal and fluorescence modes) and in measurement of vitrinite reflectance on coal, shale and associated sandstone samples to Ms. Itishree Chinara, Research Scholar of ISM, Dhanbad for a period of two weeks (in May 2011).

Provided guidance in observation and quantitative estimation of macerals (both under normal and fluorescence modes) and in measurement of vitrinite reflectance on Bistrampur coal (Son Valley) samples to Ms. Anjana Vyas, Research Scholar of Vikram University, Ujjain (during her thrice visits).

**B.D. Singh & Alpana Singh** provided scientific assistance in measurement of vitrinite reflectance, to assess the rank of Karanpura coals (Damodar Valley), to Mr. Parashar Mishra, Research student of CIMFR (Digwadih Campus), Dhanbad for a period of one week (in May 2011).

**M.S. Chauhan** imparted training to Mrs. Deepika Tripathi, Research Scholar, Allahabad University, Allahabad regarding the maceration techniques used in Quaternary palynology and pollen morphological studies of modern plants (during October-November,

2011). Also imparted training to Mrs. Alka Srivastava, Associate Professor, DAV P.G. College, Kanpur regarding the pollen morphological studies of flowering plants (during May-June & December-January, 2011).

**Anjum Farooqui** guided Dissertation (B.Tech-Biotechnology, VI Semester) project on Biogenic silica- An inspiration to nanotechnology of Ms Saumya Jain of Amity University, Lucknow.

Imparted training in palynological study and sediment processing (two-three weeks) to three students (JRFs)– Ms Greeshma Gireesh A.G. of Delta Studies Institute, Andhra University, Visakhapatnam; and Ms Paramita Saha and Ms Dola Chakraborty of School of Oceanography, Jadavpur University, Kolkata.

**Anjum Farooqui & Jyoti Srivastava** provided consultancy services to GSI, Jaipur in Quaternary palaeoclimate study on the Sambhar lake sediments profile. The report has been submitted which included the results of palynological study, two figures (pollen spectrum) and two photoplates.

**S.K. Basumatary** provided consultancy services to GSI, Guwahati on pollen analysis of 15 surface samples from different forests of Assam, and forwarded the report.

**P.S. Ranhotra** imparted training on Tertiary palynological studies to Ms Lalitha S., Research Scholar of Earth Science Department, Pondicherry University, Pondicherry (in December-January).

## Recognition

### R.R. Yadav

Elected as Fellow, Academy of Sciences, Bangalore.

Elected as Fellow, National Academy of Sciences, Allahabad.

### M.R. Rao

Chaired a Technical Session at the XXIII Indian Colloquium on Micropaleontology and Stratigraphy and International Symposium on Global Bioevents in the Earth History held at Bangalore University, Bangalore (in December 2011).

### A. Rajanikanth

Chaired a Session of the International Seminar on Emerging Threats and Challenges to Biodiversity: Policy Framework for Sustainable Development, ETCOB 2012 held at Sri Venkateswara University, Tirupati (in March 2012).

### Mukund Sharma

Delivered a Key Note Address and Chaired a Session at the XXIII Indian Colloquium on Micropaleontology and Stratigraphy and International Symposium on Global Bioevents in the Earth History, Bangalore (in December, 2011).

### Jyotsana Rai

Chaired Poster Session and Co-chaired a Technical Session at the XXIII Indian Colloquium on Micropaleontology and Stratigraphy and International Symposium on Global Bioevents in the Earth History held at Bangalore University, Bangalore (in December 2011).

### Rajni Tewari

Co-Chaired Special Session on 2<sup>nd</sup> Indo-Brazilian Symposium on 'Glimpses of Gondwana Research' during XXII Brazilian Congress of Paleontology held at Natal (RN), Brazil (on October 27, 2011).

### A.K. Ghosh

Chaired a scientific session in the 10<sup>th</sup> International Symposium on Fossil Algae held during September, 2011 at Department of Geology, Babes-Bolyai University, Cluj-Napoca, Romania.

### Ratan Kar

Visiting Professor, Vidyasagar University, West Bengal (in March, 2012).

### Biswajeet Thakur

Awarded 3<sup>rd</sup> Best Poster on the paper entitled 'Differential primary productivity pattern in an estuarine setting: A case study from Vembanad Estuary, displayed at XXIII ICMS, Bangalore during December 2011.

### Deepa Agnihotri

Awarded 'Best Student Paper Award-2011' and 'Student Travel Award-2011' at the 28<sup>th</sup> Annual Meeting of The Society for Organic Petrology (TSOP) held at Halifax, Canada during July-August, 2011.

### Swati Dixit & Shilpa Singh

Awarded 'Dr. B.S. Venkatachala Memorial Medal-2012' for the outstanding pieces of research work in Palaeobotany under research students category of BSIP, Lucknow.



Dr. B.S. Venkatachala Memorial Medal Awardees



## Representation in Committees/Boards

### N.C. Mehrotra

- President, The Palaeobotanical Society of India, Lucknow.
- Chief Editor, *The Palaeobotanist*.
- Member, Council of the Geological Society of India, Bangalore.
- Member, Indo-French Technical Association, New Delhi.
- Member & Indian Correspondent for Newsletter, American Association of Stratigraphic Palynologists.
- Member, Governing Council, National Centre for Antarctic & Ocean Research, Goa.
- Chairman, Local Advisory Council, Regional Science Centre, Lucknow (Ministry of Culture).
- Member, Geoscience Advisory Council, Ministry of Mines, Government of India

### Ram Awatar

- Treasurer, The Palaeobotanical Society, Lucknow.

### R.K. Saxena

- Chief Editor, The Palaeobotanical Society of India, Lucknow.

### R.R. Yadav

- Member, Editorial Board, *Himalayan Geology*.
- Member, Editorial Board, *Phytomorphology*.

### Rupendra Babu

- Liaison Officer SCs/STs employees, BSIP.
- Corresponding Member, International Working Group-IGCP Project-493: The rise and fall of Vendian Biota.

### Madhav Kumar

- Member, Executive Council, The Palaeobotanical Society, Lucknow.

### R.C. Mehrotra

- Councilor, Executive Council, The Palaeobotanical Society, Lucknow.
- Convener, Smart Administration Cell, BSIP.

### Mahesh Prasad

- President, BSIP Employee Co-operative Credit and Thrift Society, Lucknow.

### Jyotsana Rai

- Member, International Nannoplankton Association.
- Member, Core Scientific Committee, 9<sup>th</sup> International Congress on the Jurassic System (to be held in 2014).

### A. Rajanikanth

- Joint Editor, Publication Unit & BSIP Annual Report.

### Mukund Sharma

- Joint Editor, BSIP Newsletter & Miscellaneous Publications, BSIP.
- Convener, Research Development Cell, BSIP.
- Member, Executive Committee, The Palaeontological Society of India, Lucknow
- Member, Executive Committee, The Society of Earth Scientists, Lucknow.

### Alpana Singh

- Member, Bureau of Indian Standards, Solid Mineral Fuel Sectional Committee- PCD-7.4: Methods of Analysis Subcommittee.
- Member, The Society for Organic Petrology (TSOP).

### B.D. Singh

- Associate Member, International Committee for Coal and Organic Petrology (ICCP).
- Principal Member, Bureau of Indian Standards, Solid Mineral Fuel Sectional Committee- PCD-7.4: Methods of Analysis Subcommittee.
- Member, Coordination Committee for the establishment of Birbal Sahni Memorial Fossil Park and Museum, Dept. S&T, Govt. of Jharkhand, Ranchi.
- Member, Board of Examiners (Ph.D. Thesis), Vinoba Bhave University, Hazaribagh.
- Member, Research Planning and Coordination Cell, BSIP.



### **Chanchala Srivastava**

- Executive Member, Indian Society for Prehistoric and Quaternary Studies, Pune.

### **Rashmi Srivastava**

- Editor, *Geophytology*.
- Councilor, Executive Council, The Palaeobotanical Society, Lucknow.
- Editorial Board, Indian Journal of Scientific Research, Varanasi.

### **Rajni Tewari**

- Editor, *The Palaeobotanist*.
- Member, Executive Council, The Palaeobotanical Society, Lucknow.
- Convener, Women's Forum, BSIP.

### **C.M. Nautiyal**

- Member, National Committee on Archaeological Sciences.
- Member, Local Advisory Committee, Regional Science City, Lucknow.
- Advisor, Coordination Committee, National Children's Science Congress, UP.
- Member, National Executive Committee, The Society of Earth Scientists.
- Member, Committee constituted by NCSTC-Network for evaluation of State Coordinators-2011.
- Convener, *Symposium on Climate Change and Geo-hydrology*, BSIP (August 2011).

### **Anjum Farooqui**

- Executive Member, International Society of Environmental Botanists.

### **Anupam Sharma**

- External Expert, Committees for the Assessment of Progress made by two JRFs at School of Environmental Sciences, JNU, New Delhi.

### **Ratan Kar**

- Assistant Editor, *The Palaeobotanist*.
- Organizing Secretary, *Symposium on Climate Change & Geo-hydrology*, BSIP (August 2011)

### **Binita Phartiyal**

- Member, Jury at the Earth Sciences for 6<sup>th</sup> Uttarakhand State Science & Technology Congress (USSTC) 2011, Almora.

### **Anju Saxena**

- Co-Editor, e-Journal *Earth Science India*.

### **S.C. Bajpai**

- Editor, Journal of Chemical, Biological and Physical Sciences (an International Peer Review E-3 Journal of Sciences).
- Group Leader, Society for Energy Engineers and Managers' UP State Level ECBC Sub-Committee on Lighting and HVAC AC Systems, Lucknow.
- Guest Faculty, M.Sc. Programme on Renewable Energy, Dept. of Physics, University of Lucknow.

## Doctoral Degree Awarded

Name	Subject	Date	University	Supervisor	Title of Ph.D. Thesis
S.K. Basumatary	Botany	June 07, 2011	Lucknow University	Dr. S.K. Bera	Quaternary vegetational history and climate in and around Garo Hills, Meghalaya, northeast India
S.S.K. Pillai	Botany	July 08, 2011	Lucknow University	Dr. A.K. Srivastava	Study towards the knowledge of <i>Glossopteris</i> flora of India
Deepa Agnihotri	Botany	August 05, 2011	Lucknow University	Dr. A.K. Srivastava	Contribution to the study of <i>Glossopteris</i> flora of India
Gaurav Srivastava	Botany	August 05, 2011	Lucknow University	Dr. R.C. Mehrotra	Palaeofloristics of northeast India and its implications based on megaremaines
Yogmaya Shukla	Botany	August 05, 2011	Lucknow University	Prof. P.K. Mishra Dr. Mukund Sharma	Palaeobiology of Terminal Proterozoic Bhima Basin, Karnataka
Swati Dixit	Botany	September 01, 2011	Lucknow University	Dr. S.K. Bera	Studies on palaeovegetation and climate changes in tropical forests of lower Brahmaputra Valley of Assam, northeast India
Neha Goel	Botany	September 01, 2011	Lucknow University	Dr. Neerja Jha	Palynostratigraphy, correlation and palaeoenvironment of Gondwana sediments in Godavari Graben, Andhra Pradesh
Md. Firoze Quamar	Botany	September 01, 2011	Lucknow University	Dr. M.S. Chauhan	Reconstruction of Quaternary vegetation succession and climate change in central India, based on pollen proxy records
Anumeha Shukla	Botany	September 01, 2011	Lucknow University	Dr. J.S. Guleria	Cenozoic flora of north-western Peninsular India
Shilpa Singh	Botany	September 01, 2011	Lucknow University	Dr. Asha Khandelwal	Late Quaternary evolution of mangrove vegetation in relation to palaeoclimate and sea-level changes at Chilka Lake, Orissa, India
Sheikh Nawaz Ali	Geology	September 01, 2011	Lucknow University	Dr. Rameshwar Bali Dr. S.K. Bera	Late Quaternary palaeoclimatic study using different proxies along the upper reaches of Pindar Valley, Kumaun Himalaya
Poonam Verma	Geology	December 2011	Lucknow University	Prof. M.P. Singh Dr. M.R. Rao	Analysis of palaeovegetation from Quaternary sediments of central Narmada Valley, Madhya Pradesh

## Units

## Publication

### Journal— *The Palaeobotanist*

This year was the Diamond Jubilee Year of BSIP's flagship journal *The Palaeobotanist*. Two numbers of Diamond Jubilee Volume of the journal were published. The first 60(1) was 'Diamond Jubilee Special Publication' on 'Indian Fossil Fungi' and the second 60(2) was 'Diamond Jubilee Publication' containing peer-reviewed research papers related to palaeobotany and allied fields. They were released on the occasion of Founders' Day on November 14, 2011 as a fitting tribute to Prof. Birbal Sahni's 120<sup>th</sup> Birth Anniversary.

### Annual Report

BSIP Annual Report was published bilingually in Hindi and English containing pertinent information related

to research work carried out in the Institute under different research projects during the period 1st April 2010-31st March 2011. Besides, conference participation, awards, research papers published/accepted, training/deputation, Foundation/Founders' Day celebration, reports of different Units, annual accounts and related aspects with relevant graphics and photographs were included.

### Miscellaneous

Invitation cards for Foundation Day, Founders' Day and other programmes organised from time to time were printed. Biographical profiles and abstracts of lectures given by eminent speakers on various functions were printed. Identity Cards for staff and pensioners were also printed.





## Library

Library is committed to provide world class information support to its users and fulfill its mission to facilitate creation and dissemination of knowledge. Besides holding an excellent collection mainly including palaeobotany and its allied subjects (63794) of books, journals, reprints, thesis, reports, etc, it also provides online access of many journals, databases through its own subscription and by National Knowledge Resource Consortium (NKRC) of CSIR-DST. Through the support of information Communication Technology, library has provided widespread and inclusive access of Palaeobotanical knowledge to its users. To achieve this objective it is continuously modernizing its collection, services and facilities.

All back issues of the journal *Palaeobotanist* are digitized and soon will be hosted on the institute's website. Barcoding of literature is completed. Weekly service of *New Arrivals* having content pages of journals/ books displayed and *News Clipping* having scientific contents from Newspapers are being regularly communicated to users by e-mail. Libsys software supports all in- house operations like Cataloguing, circulation, serial control and binding management. The holdings are accessible by OPAC (Online Public Access Catalogue). OPAC is searchable by Author, title, accession number, subject and several other fields. New literature procured is continuously added to the database.

The current holdings of library are as under:

Particulars	Additions during 2011-12	Total
Books	49	5,984
Journals (bound volumes)	246	16,241
Reprints	-	40,097
Reference Books	2	341
Books in Hindi	56	495
Ph.D. Thesis	10	102
Reports	-	46
Maps & Atlases	-	61
Microfilm/ Fisches	-	294
Compact Disk	-	74

Currently the library is receiving 167 journals (96 through subscription and 71 through exchange). There are 159 registered card holders using the library facilities.

### Exchange Facility

Library has sent out the following literature to

individuals and institutions from the collection kept for exchange purpose. Library has also received journals and reprints through exchange.

Institutions on exchange panel with the journal <i>Palaeobotanist</i>	40
Journals received on exchange basis	71
Reprints of research papers purchased for exchange	1

### e-Journals

Web based access of the journals is available over the Institute's LAN from the following publishers—Elsevier (Science Direct: <http://www.sciencedirect.com/>), Cambridge University Press (<http://www.cambridge.org>), IOP Science [<http://iopscience.iop.org> (through CSIR-DST Consortium)], Macmillan Publishers Limited (Nature: <http://www.nature.com/nature/index.html>), Oxford University Press (<http://www.oxfordjournals.org/>), AAAS (Science: (<http://www.sciencemag.org/>), Taylor and Francis (<http://www.tandf.co.uk/journals/>), Indian journals.com (<http://indianjournals.com/ijor.aspx>), Web of Science (<http://apps.isiknowledge.com>), and Online access of GeoRef database (<http://search.proquest.com/science/?accountid=145004>).

### Other Facilities

**Lamination**— To preserve the old and rare literatures, lamination and photocopying of such publications is being regularly undertaken.

**Photocopying**— Photocopy facility of relevant scientific literature is being extended to institute scientists, as well as to outside scientific institutions/ universities on their demand.

**Inter-Library Loan Service**— Institute is part of a Local Library Network facilitating the availability of books on loan for BSIP Library users on request.

The following Institutions/Organizations availed the library facilities:

School of Oceanographic Studies, Jadavpur University, Kolkata, West Bengal

School of Studies in Earth Sciences, Vikram University, Ujjain, Madhya Pradesh

Department of Library & Information Science, Lucknow University, Lucknow



## Museum

The Museum is an integral part of the researches in the institute holding type and figured specimens. Besides, Museum repository is a treasure house of fossil collections made by the scientists. The Museums plays a pivotal role in popularizing palaeobotanical researches through participating and organizing exhibitions, Institute's celebrations like Science Day and also serve academic need of various Universities/Colleges/Schools by gifting away fossil specimens/slides with in India and overseas. Museum participated in the Science Expo organized by the Science City, Regional Science Centre, Lucknow from February 01-05, 2012. The displayed material was appreciated by many eminent higher officials of Uttar Pradesh Government and thousands of college students, teachers and general public visited BSIP display stall. The outreach of museum activities got widened by such involvement.

Research material collected by the scientists of BSIP during the year from 167 localities of the country under various institutional and sponsored/ collaborative projects got registered and specimens/slides/compact discs pertaining to 21 research papers were stored in the valuable collections of Museum. The Working Cell in the Museum was utilized by Overseas scientists- Dr. Stephen McLoughlin, Department of Palaeobotany, Swedish Natural History Museum, Stockholm, and Mr. Roberto Innuzzi, Department of Palaeontologia and Stratigraphia Institute of Geosciences, Rio Grande do sul, Brazil to study research specimens. Database of BSIP Museum Locality/field details for the last ten years has been prepared.

### Museum Holdings

Particulars	Addition during 2011-2012	Total
Type and figured specimens	69	7,731
Type and figured slides	441	14,038
CD/Negatives	18	22

Samples/specimens collected by the scientists during the field work under various projects:

Project	Specimens	Samples
Project- 1	-	111
Project- 2	269	113
Project- 3	-	431

Project- 4	1069	82
Project- 5	44	388
Project- 6	-	254
Project- 7	-	7
Project- 9	-	61
Project- 11	-	221
Project- 12	-	857
Project- 13	159	-

Samples deposited under Sponsored/ Collaborative Projects:

CSIR Net Project No. 9/528 (0016)/ 2009-EMR-1	: 67
D.S.T. Project No. SR/S4/ES-264/2007	: 532
D.S.T. Project No. SR/S4/ES-21/ Brahmaputra-I/2005	: 26
Misc. Project. Assessment Based on New Report	: 74
Newly Proposed Project on Palaeozoic of Kashmir	: 74 (Specimens)

### Specimens / Slides gifted

- Science City, Regional Science Centre, Aliganj, Lucknow (UP)
- R.L.B. Memorial Senior Secondary School, Survodaya Nagar, Lucknow (UP)
- Department of Botany, U.P. College, Varanasi (UP)
- Department of Botany, St. Barchmans College, Changanachery, Kottayam (Kerala)
- Dr. D.S.N. Raju, Pragati Marg, J.N. Road, Rajahmundry (Andhra Pradesh)
- Sri C. Narasimha, 46- Searle Street, Auckland 1072, New Zealand
- Prof. Sun Ge, Palaeontological Museum of Liaoning, University of Shenyang, China

### Institutional Visitors

- Forest Training Institute Trainees, Kanpur, UP (visited three times)
- CST M.P. Bhopal- group of students and teachers
- Department of Botany, D.N P.G. College, Meerut, UP (Faculty & Students)
- Department of Botany, Jiwaji University, Gwalior, MP (Faculty & Students)
- Aligarh Muslim University, Aligarh, UP (Faculty & Students)

Department of Botany, Ashutosh College, Kolkata, WB (Faculty & Students)  
 Raj Narayan Jaiswal Inter College, Nagam, Lucknow, UP (Faculty & Students)  
 Ram Pal Trivedi Inter College, Gosaiganj, Lucknow, UP (Faculty & Students)  
 Sri Baldev P.G. College, Baragaon, Varanasi, UP (Faculty & Students)  
 Tilak Vidyalaya, Mahanagar, Lucknow, UP (Faculty & Students)  
 Raj Kumar Inter College, Alamnagar, Lucknow, UP (Faculty & Students)  
 Institute of Archaeology, New Delhi (Trainees)  
 Department of Botany, University of Kashmir, Kashmir, J&K (Faculty & Students)

#### Overseas Visitors

Dr. Keith Luzzi, Montclair, New Jersey, USA  
 Dr. David Grimaldi, American Museum of Natural History, New York, USA  
 Dr. Paul C. Nascim Bene, American Museum of Natural History, New York, USA  
 Prof. Kuldeep Kumar, Bond University, Australia  
 Dr. Stephen Mc Loughlin, Department of Palaeobotany, Swedish Natural History Museum, Stockholm, Sweden  
 Prof. Roberto Innuzzi, Department of Palaeontologia and Stratigraphia Institute of Geosciences, Rio Grande do sul, Brazil

#### Individual Visitors

Shri Manish Mohan Gore, Vigyan Prasara, Noida (UP)  
 Shri Vinod Negi, CPPRI, Saharanpur (UP)  
 Drs. A.K. Verma & R.M. Gairola, SAC, ISRO, Ahmedabad (Gujarat)  
 Dr. Jyoti Rao, Mumbai (Maharashtra)  
 Shri Shiv Kumar, Jr. Hindi Translator, DST, New Delhi  
 Shri Rahul Kumar, Department of Pharmaceutical Sciences, Srinagar, Garhwal (Uttarakhand)  
 Shri Rajesh Kumar, Scientist DST, New Delhi  
 Shri R.K. Jaiswal & Shri D.K. Sant, Research Scholars, BHU, Varanasi (UP)  
 Prof. S.N. Chakhaiyar, Dept. of Botany, Magadh University, Bodh Gaya (Bihar)

Shri Tareq Ahmed Wani, VPO Sopat district, Kulgam (J&K)  
 Drs. V.V.L.N. Sharma & R. Sandhya Rani, Khammam (AP)  
 Dr. D.P. Singh, Botany Department, Patiala (Punjab)  
 Dr. Shalini Sharma, MIET, Meerut (UP)  
 Dr. Pallavi P. Ulhe, Karanja, district, Wardha (Maharashtra)  
 Dr. Ritu Goswami, Dept. of Botany, DAV College, Batala (Punjab)  
 Dr. Rajni Jain, Lecturer, Jaipur (Rajasthan)  
 Dr. Minakshi Buch, Junagarh (Gujarat)  
 Dr. S.B. Jain, GVISH, Amravati (Maharashtra)  
 Dr. Prasanjit Mukharjee, KHM College, Pakur (Jharkhand)  
 Dr. Md. Sarfaraj Ahmad, Gopeshwar College, Hathwa, Gopalganj (Bihar)  
 Shri M.K. Singh, Lecturer, S.M.D. College, Jabalpur (MP)  
 Dr. S.N.P. Sinha, G.D.M. College, Nalanda (Bihar)  
 Dr. Siddhant, Dept. of Botany, M.M. Chandi, Nalanda (Bihar)  
 Shri Minal Jain, Sardar Patel University, Vallabh Vidyanagar, Anand (Gujarat)  
 Drs. Sonali Chaturvedi & Archita Srivastava, Erwing Christian College, Allahabad (UP)  
 Ms. Amita & Shri Dev Dutt, M.J.P.R. University, Bareilly (UP)  
 Shri Samrat Bora, Department of Botany, Guwahati University, Guwahati (Assam)  
 Prof. G.O. Chaudhary & Prof. H.M. Shaikh, NNC College, Kusumba, District Dhule (Maharashtra)  
 Prof. R.D. Patil, Dept. of Zoology, VN College, Shahada (Maharashtra)  
 Shri Gajdish Pataskar, 1101/1, Ward No. 25, Rampur, Korba (Chhattisgarh)  
 Shri V.K. Asthana, (RFO), Nawabganj, Unnao (UP)  
 Shri Nikhil Relan, New Delhi  
 Ms. Arun, Sujata, Poonam, Sujata, Department of Botany, Shivaji University, Kolhapur (Maharashtra)  
 Dr. Mitali Mishra, Lecturer in Botany, N.S.M. City College, Cuttak (Orissa)



## Herbarium

About 485 Angiosperm plant specimens, 72 Bryophytes, 70 Pteridophytes, 45 lichen and 10 seeds have been added to the repository.

### Holdings

Particulars	Addition during 2011-2012	Total
<b>Herbarium</b>		
Plant specimens		
Angiosperms	485	24,324
Bryophytes	72	72
Pteridophytes	70	70
Lichen	45	45
Leaf specimens	-	1,167
Laminated mounts	-	66
of venation pattern		
<b>Xylarium</b>		
Wood blocks	-	4,158
Wood discs	-	68
Wood cores	25	7,415
Wood slides	40	4,318
Palm slides	-	3,195
(stem, leaf, petiole, root.)		

Particulars	Addition during 2011-2012	Total
<b>Sporothek</b>		
Polleniferous materials	-	3,016
Pollen slides	20	12,284
<b>Carpothek</b>		
Fruits & seeds	10	4,274
<b>Museum Samples</b>		
Medicinal & food plant	-	91

### Visitors:

Mr. Ashwini Kumar, B.N. College, Meerut

Prof. Arish M.S., University of Madras, Chennai

Dr. Rohini, Council of Science & Technology, Bhopal

Prof. Kailash Agarwal, Department of Botany, University of Rajasthan, Jaipur

Dr. Jugdesh Patslar, Zizivisha Committee, Korba, Chhattisgarh

## Scanning Electron Microscopy

The prime objective of the unit is to provide a dedicated service to all scientists of the Institute. This well maintained instrument is also providing better services to other universities and research institutions on minimum payment basis. The unit has two scanning electron microscopes: i) Leo 430, and ii) Philips 505. The Leo 430 is equipped with Back Scattered Electrons (BSE) mode of imaging with mapping and the line scanning at 180° rotation. The elemental analysis of the object is possible through energy dispersive x-ray analysis EDAX (Energy Dispersive System/EDS). Both microscopes are fitted

with digital image system allowing high resolution, high magnification imaging of a wide range of specimens applied to various disciplines, e.g. plant and animal tissues; plant and animal fossils; earth, material, leather and chemical sciences; pharmacy; microbiology; plastic and metallurgical materials; dental and textile researches, etc. These electron microscopes require specialized preparative procedures. In addition to the standard techniques, the unit also offers sample freeze-drying at the critical point for analysis of delicate material.



## Electronic Data Processing

Internet Connection 13 MBPS (1:1) with Radio link facility from Software Technology Park of India, Lucknow is running in the Institute. Proxy, Mail and DNS Servers are successfully running and provides 24 hours Internet facility to the Institute Staff. At present 160 Computers are connected with the LAN.

Institute has procured one Cisco Switch Layer 3 (3560), four Layer 2 switches (2960s) for networking and two Digital Pen Tablet (iball) for tracing the images.

Computer Section has upgraded the Cyberoam Version CR200i Unified Threat Management (UTM) to stop the spamming, virus and unauthorized access at the Gateway level.

Institute's web site (<http://www.bsip.res.in>) has been redesigned and launched in the Institute's Server. Computer Section is maintaining website and doing updation regularly. Intranet website has also been launched for Institute users and various utility forms are uploaded in PDF and word format. Wireless Internet Connectivity has been running within the campus.



In addition, Payroll, Form 16 and Pension packages are also modified as per the requirements of the Account Section. Computer Section is providing help to the scientists in preparing the Multimedia presentations, charts, graphs, lithologs and diagrams for their scientific publications and documentation.

## Reservations and Concessions

The Institute is following General Reservation Orders of the Government of India as applicable to Autonomous Bodies and amended from time to time for the reservations and concessions of Scheduled Castes

(SC), Scheduled Tribes (ST), Other Backward Classes (OBC) and Physically Handicapped Persons for the posts meant for direct recruitment in Group 'A', 'B', 'C' and 'D' as per Govt. of India Orders.

## Status of Official Language

The Institute is constantly striving to attain the set target for official language implementation. The Institute participated in the meeting of Nagar Rajbhasha Kaaryaanvayan Samiti during the year 2011-12. Scientists and Technical Officers/Employees of the institute also took active part in science communication in Hindi through various media. These included popular Science Lectures in various institutions/Schools; radio talks interactions during exhibitions and popular science articles.

### Inspection

Sri Prem Singh, Joint Director (Official Language) and Sri Shiv Kumar from Ministry of Science & Technology, New Delhi visited the Institute during July 19-20, 2011 on official inspection for Official Language and interacted with members of Official Language Implementation Committee of the Institute and inspected the progress of work in Official Language visiting various sections and made valuable suggestions.

### Hindi Fortnight

Hindi Pakhwara (September 10-26, 2011) was inaugurated by Dr. Vikram Singh, Vice Chancellor, Noida International University, Gautam Buddh Nagar, U.P. on 10 September 2011 in which he shed light on *Paryaavarana ka Swaroop*. Dr. N.C. Mehrotra, Director, welcomed the guests and Dr. C.M. Nautiyal, Member Secretary, read a brief report of the activities.

During Hindi Pakhwara, forty-five staff members participated in a series of competitions including *Spot the Errors*, *Hindi Typing (Computer)*, *Essay* and the newly introduced *Research Highlight Presentation by Young Scientists*. The Director encouraged the competitors during the competitions too. Kavi Sammelan was also organized on 23<sup>rd</sup> September in which 5 guest poets participated. Prize distribution was held on 26<sup>th</sup> September in the main auditorium, in which Hindi books of reputed authors were given away as prizes.

Various competitions were organized for regular employees and other workers at Institute. The winners were:

<i>Spot the Errors</i>	: I – Dr. Deepa Agnihotri, II – Mr. P.K. Mishra, III – Ms Priyanka Srivastava
Encouragement	: Mr. T.K. Mandal, Mr. Y.P. Singh, Mr. Syed Rashid Ali

*Essay* : I – Mrs. Sandhya Misra,  
II – Mr. Randheer Singh,  
III – Mr. Suman Sarkar

*Typing* : I – Mr. Rahul Gupta,  
II – Mr. Saheb Lal Yadav

### Research Highlight Presentation by Young Scientists:

Dr. (Mrs) Yogmaya Shukla, Dr. (Ms) Swati Dixit, Dr. Gaurav Srivastava, Mr. S.K. Pandey, and Mr. G.K. Singh made presentations of their research work in Hindi on September 20, 2011.

### Hindi Workshop

Hindi Workshops were organized on the following subjects. The workshops were followed by lively discussions related to the topics of talks and related terminology.

*Rajbhasha Neeti evam uska Kaaryaanvayan* [by Sri Prem Singh, Joint Director (Official Language), DST, New Delhi] on July 20, 2011.

*Shabd Nirmaan ki Prikriyaa tatha Rajbhasha ka Mahattva* [by Dr. Vijay Kumar Karna, Head of the Department (Sanskrit), Vidyaant Hindu PG College, Lucknow] on December 26, 2011.

*Vijnan mein Paaribhashik Shabdawali* [by Dr. Srikrishna Tiwari, Scientist, NBRI, Lucknow] on March 30, 2012.

### Deputation to Workshop

Mr. N.B. Tewari, Mr. Ashok Kumar, Mrs. Kavita Kumar, and Mr. R.K. Mishra of the Institute participated in the Hindi Workshop organized by Nagar Rajbhasha Kaaryaanvayan Samiti, Lucknow at CDRI, Lucknow during June 27-28, 2011.

### Hindi Encouragement Prizes (for the year 2010-11)

- I – Dr. B. Sekar and Mr. R.L. Mehra
- II – Mrs. Kavita Kumar, Mrs. Pennamma Thomas & Mr. N.B. Tewari
- III – Dr. S.S.K. Pillai, Dr. S.K. Singh, Mrs. V. Nirmala, Mr. Gopal Singh & Mr. R.K. Awasthi

### Miscellaneous

The computers of the Institute with net facility have access to multi-lingual Software. The process of making



forms bilingual is near completion. Annual Report of the Institute was published in Hindi also. Abstracts in Hindi of all the research papers were also published in the international journal of the Institute '*The Palaeobotanist*'. In adherence to the section 3(3) of the Official Language Act 1963, efforts are continued to improve

correspondence in Hindi.

The Quarterly and Half Yearly reports to DST and Nagar Rajbhasha Kaaryaanvayan Samiti respectively were prepared and regularly sent. Thus the Institute continues in its efforts towards implementations of the Official Language policy.



A view of Hindi Pakhwara celebration



## Staff

### Director

Dr. Naresh C. Mehrotra

### Scientists

#### Scientist 'G'

Dr (Ms) Vijaya (retired w.e.f. 30.09.2011)

#### Scientist 'F'

Dr (Mrs) Neerja Jha

Dr Ram Awatar

Dr Mulagalapalli R. Rao

Dr Samir Sarkar

Dr Ramesh K. Saxena (retired w.e.f. 31.07.2011)

Dr Rama S. Singh

Dr Surya K.M. Tripathi

Dr Ram R. Yadav

#### Scientist 'E'

Dr Rupendra Babu

Dr Samir K. Bera

Dr Amalava Bhattacharyya (retired w.e.f. 31.01.2012)

Dr Mohan S. Chauhan

Dr (Ms) Asha Gupta (retired w.e.f. 31.08.2011)

Dr Madhav Kumar

Dr Bhagwan D. Mandaokar

Dr Rakesh C. Mehrotra

Dr (Mrs) Neeru Prakash

Dr Mahesh Prasad

Dr (Mrs) Jyotsana Rai

Dr Annamraju Rajanikanth

Dr Dinesh C. Saini

Dr Omprakash S. Sarate

Dr Rakesh Saxena

Dr Mukund Sharma

Dr (Mrs) Alpana Singh

Dr Bhagwan D. Singh

Dr Kamal J. Singh

Dr (Mrs) Chanchala Srivastava

Dr (Mrs) Rashmi Srivastava

Dr (Mrs) Rajni Tewari

#### Scientist 'D'

Dr (Mrs) Anjum Farooqui

Dr Amit K. Ghosh

Dr Kindu L. Meena

Dr Chandra M. Nautiyal

Dr (Mrs) Vandana Prasad

Dr Anupam Sharma

Dr Gyanendra K. Trivedi

#### Scientist 'C'

Dr. Ratan Kar

Dr (Mrs) Binita Phartiyal

Dr Anil K. Pokharia

#### Scientist 'B'

Dr Sadhan K. Basumatary

Dr Krishna G. Misra

Dr Srikanta Murthy

Dr S. Suresh K. Pillai

Dr Parminder S. Ranhotra

Dr (Mrs) K. Pauline Sabina

Dr (Mrs) Anju Saxena

Dr Santosh K. Shah

Dr Hukam Singh

Dr (Ms) Vartika Singh

Mr Veeru K. Singh

Mr Biswajeet Thakur

#### Birbal Sahni Research Scholar

Mrs Neha Aggarwal (relieved w.e.f. 31.05.2011)

Ms Deepa Agnihotri (relieved w.e.f. 29.04.2011)

Mr Md. Firoze Quamar (relieved w.e.f. 22.04.2011)

Mrs Abha Singh (tenure completed w.e.f. 02.04.2011)

Mr. Gaurav K. Singh (resigned w.e.f. 03.10.2011)

Ms Shilpa Singh (relieved w.e.f. 24.04.2011)

#### Technical Personnel

#### Technical Officer 'D'

Mr P.K. Bajpai (retired w.e.f. 30.09.2011)

Mrs Indra Goel (retired w.e.f. 30.06.2011)

Mr P.S. Katiyar

Dr E.G. Khare

Mr T.K. Mandal

Dr B. Sekar (retired w.e.f. 30.09.2011)

Mr V.K. Singh

(The names are in alphabetical order according to 'surnames')



**Technical Officer 'C'**

Mrs Reeta Banerjee  
Mrs Sunita Khanna  
Mrs Kavita Kumar  
Mr Chandra Pal  
Mr Prem Prakash  
Mr V.P. Singh  
Mr Y.P. Singh  
Mr Avinesh K. Srivastava

**Technical Officer 'B'**

Mr Madhukar Arvind  
Mr Subodh Kumar  
Mr R.L. Mehra  
Mr R.C. Mishra  
Mr Pradeep Mohan  
Mr V.K. Nigam  
Mr Keshav Ram

**Technical Assistant 'E'**

Mr S.R. Ali  
Mr Chandra Bali  
Mr D.S. Bisht  
Mr D.K. Pal  
Mr Dharendra Sharma  
Dr S.K. Singh  
Mr C.L. Verma  
Dr S.M. Vethanayagam

**Technical Assistant 'D'**

Mr Sumit Bisht  
Mr. Nilay Govind  
Mr Avanish Kumar  
Mr M.S. Rana  
Ms Kirti Singh  
Mr S.C. Singh  
Mr Ajay K. Srivastava

**Technical Assistant 'B'**

Mr Pawan Kumar  
Mr Om Prakash

**Technical Assistant 'A'**

Mr. J. Baskaran  
Mr. A.K. Sharma  
Ms Richa Tiwari  
Mr. Ram Ujagar

**Administrative Personnel**

**Registrar:** Dr Suresh C. Bajpai

**Accounts Officer**

Mr D.K. Dutta (resigned w.e.f. 01.04.2011)  
Mr. N.B. Tewari (permanent absorption w.e.f. 02.04.2011)

**Private Secretary**

Mrs M. Jagath Janani (on deputation w.e.f. 29.09.2011)  
Sri Murukan Pillai (officiating w.e.f. 28.10.2011)

**Section Officer**

Mrs Ruchita Bose (officiating w.e.f. 05.03.2012)  
Mr Hari Lal (officiating w.e.f. 29.02.2012)  
Mrs V. Nirmala  
Mr Koshy Thomas (officiating w.e.f. 29.02.2012)  
Mrs Pennamma Thomas (officiating w.e.f. 29.02.2012)

**Accountant**

Mrs Swapna Mazumdar (officiating w.e.f. 29.02.2012, case under consideration)

**Assistant**

Mr Mishri Lal (officiating w.e.f. 29.02.2012)  
Mr S.S. Panwar (officiating w.e.f. 29.02.2012)  
Mr Rameshwar Prasad (officiating w.e.f. 29.02.2012)  
Mr Gopal Singh  
Mr K.P. Singh  
Mrs Renu Srivastava (officiating w.e.f. 29.02.2012)  
Mr N.Unni Kannan (officiating w.e.f. 29.02.2012)

**Hindi Translator**

Mr Ashok Kumar

**Upper Division Clerk**

Ms Chitra Chatterjee  
Mrs Sudha Kureel (w.e.f. 05.03.2012)  
Mrs Shail S. Rathore (retired w.e.f. 31.07.2011)  
Mr Avinash K. Srivastava  
Ms Manisha Tharu (w.e.f. 05.03.2012)

**Lower Division Clerk**

Mr. Rajesh K. Mishra

**Driver**

Mr Nafis Ahmed ('IV')  
Mr D.K. Mishra ('III')  
Mr M.M. Mishra ('III')  
Mr P.K. Mishra ('II')  
Mr V.P. Singh ('III')

**Multi Tasking Staff****Attendant 'IV' (Technical)**

Sri K.C. Chandola

**Attendant 'III'**

Sri Kesho Ram

(The names are in alphabetical order according to 'surnames')

Sri Haradhan Mahanti  
Sri Prem Chandra  
Sri Ram Deen  
Sri Ram Singh  
Sri Shree Ram

#### Attendant 'II'

Sri K.K. Bajpai  
Smt. Maya Devi  
Sri Hari Kishan  
Sri Kailash Nath  
Sri Dhan B. Kunwar  
Sri Mani Lal Pal  
Sri Ram Dheeraj  
Sri Mohammad Shakil  
Sri Bam Singh  
Sri Kedar N.Yadav (under suspension w.e.f. 25.05.2011)

#### Attendant 'I'

Sri R.K. Awasthi  
Smt. Beena  
Sri Deepak Kumar

Sri Vishwanath S. Gaikwad  
Sri Inder Kumar  
Km. Nandani  
Smt. Ram Kali  
Sri Ramesh Kumar  
Sri Ravi Shankar

#### Mali

Sri Ram Chander ('I')  
Sri Ram Kewal ('I')  
Sri Mathura Prasad ('I')

#### Sponsored Project Personnel

Mr Kamlesh Kumar, SRF  
(tenure completed w.e.f. 31.03.2012)  
Mrs Sandhya Misra, SRF (w.e.f. 02.04.2011)  
Mr Suman Sarkar, SRF (w.e.f. 01.08.2011)  
Ms Jyoti Srivastava, JRF  
Ms Swati Dixit, JRF (relieved w.e.f. 31.05.2011)  
Mr Gaurav Srivastava, Project Assistant  
(relieved w.e.f. 31.05.2011)



A view of farewell to retired staff

## Appointments

Dr. Amalava Bhattacharyya, Emeritus Scientist w.e.f. 01.02.2012.

Dr. Abhijit Mazumder, Scientist-C w.e.f. 21.07.2011.

Dr. Pawan Govil, Scientist-B w.e.f. 21.07.2011.

Dr. (Mrs.) Poonam Verma, Scientist-B w.e.f. 22.07.2011.

Dr. (Mrs.) Anjali Trivedi, Scientist-B w.e.f. 28.07.2011.

Dr. (Ms) Ruby Ghosh, Scientist-B w.e.f. 29.07.2011.

Dr. (Mrs.) Neha Aggarwal, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. (Ms.) Deepa Agnihotri, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. (Ms.) Swati Dixit, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. Md. Firoze Quamar, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. (Mrs.) Anumeha Shukla, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. (Mrs.) Yogmaya Shukla, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. (Ms.) Shilpa Singh, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Dr. Gaurav Srivastava, Birbal Sahni Research Associate w.e.f. 31.05.2011.

Mr. Santosh Kumar Pandey, Birbal Sahni Research Associate w.e.f. 06.06.2011.

Dr. S. Mahesh, Birbal Sahni Research Associate w.e.f. 28.06.2011.

Ms. Kanupriya Gupta, Birbal Sahni Research Scholar w.e.f. 23.03.2012.

Mr. Harinam Joshi, Birbal Sahni Research Scholar w.e.f. 27.03.2012.

Dr. B. Sekar, Consultant w.e.f. 03.10.2011.

### Sponsored Project Personnel

Dr. Arjun Singh Rathore, Research Associate w.e.f. 23.11.2011.

Dr. Shambhu Kumar, Senior Research Fellow w.e.f. 09.05.2011.

Ms. Monisha Awasthi, Junior Research Fellow w.e.f. 06.05.2011 (resigned w.e.f. 16.12.2011).

Mr. Gaurav Kumar Mishra, Junior Research Fellow w.e.f. 09.05.2011.

Mr. Deepak Kumar Gond, Junior Research Fellow w.e.f. 09.05.2011.

Mr. Mayank Shekhar, Senior Research Fellow w.e.f. 13.06.2011 (tenure completed w.e.f. 31.03.2012).

Ms. Kanupriya Gupta, Junior Research Fellow w.e.f. 07.07.2011 (relieved w.e.f. 22.03.2012).

Mr. Randheer Singh, Junior Research Fellow w.e.f. 18.07.2011.

Ms. Nivedita Mehrotra, Junior Research Fellow w.e.f. 01.08.2011.

Ms. Richa Singh, Junior Research Fellow w.e.f. 05.08.2011.

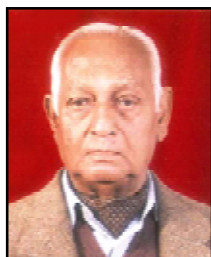
Ms. Abha, Junior Research Fellow w.e.f. 22.11.2011.

Ms. Archana Singh, Project Assistant w.e.f. 07.06.2011.

Mr. Raja Ram, Project Assistant w.e.f. 26.03.2012.

Mr. Saheb Lal Yadav, Field Assistant w.e.f. 25.04.2011.

### Obituary



Dr. M.N. Bose, FNA, Ex-Director passed away on 27.04.2011.



Dr. R.N. Lakhanpal, FNA, Ex-Distinguished Scientist passed away on 19.01.2012.

## AUDIT REPORT

**to the  
Governing Body  
of the  
Birbal Sahni Institute of Palaeobotany  
Lucknow**

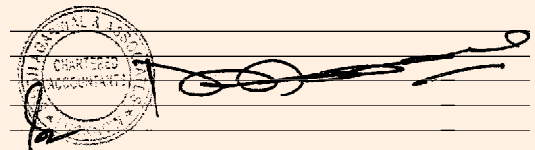
We have audited the attached Balance Sheet of Birbal Sahni Institute of Palaeobotany, Lucknow, as at 31st March 2012 and also the Income & Expenditure account and Receipt & Payment account for the year ended on that date annexed thereto. These financial statements are the responsibility of the Institute's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with auditing standards generally accepted in India. Those Standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statement. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

Further to our comments in the Annexure "A" attached, we report that :

- (i) We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit;
  - (ii) In our opinion, proper books of account as required by law have been kept by the Institute so far as appears from our examination of those books;
  - (iii) The Balance Sheet and Income & Expenditure account and Receipt & Payment account dealt with by this report are in Agreement with the books of account;
  - (iv) In our opinion and to the best of our information and according to the explanations given to us and the said account give the information, in the manner so required, and give a true and fair view in conformity with the accounting principles generally accepted in India;
- a) In the case of the Balance Sheet, of the state of affairs of the Institute as at 31st March, 2012;
  - b) In the case of the Income & Expenditure Account, of the surplus/deficit for the year ended on the date, and
  - c) In the case of Receipt & Payment Account, of the receipts & payments of the Institute for the year ended on that date.

**For Singh Agarwal & Associates**  
*Chartered Accountants*



Mukesh Kumar Agarwal  
FCA, DISA (ICAI)  
Partner  
Membership No. 073355

Place : Lucknow  
Date : 03<sup>rd</sup> September, 2012



## ANNEXURE - 'A'

### Comments / Audit Observations on Accounts of Birbal Sahni Institute of Palaeobotany, Lucknow by the Chartered Accountants and Actions taken by the Institute

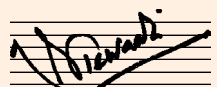
S No.	Comments/Observations by the Chartered Accountants	Actions taken by the Institute															
01.	<p><b><u>ACCOUNTS:</u></b></p> <p>The Institute is getting separate grants for Plan &amp; Non-Plan expenses based on the budgets approved by the DST. During the year under report, the Institute has allowed to use Plan head funds for Salary etc instead of Non-Plan budget. Further, as per delegation of financial power rules and rule 16.01 of Bye-laws, no re-appropriation shall be made from fund provided under Plan Heads to Non-Plan Heads but during the year, the funds under Plan-head was used for expenditures under non-plan heads.</p>	<p><i>Transfer of funds from Plan to Non-Plan is made with approval of the Governing Body and communicated to DST, New Delhi. This is in view of non availability of sufficient funds under the Non-Plan Head to meet obligatory expenses.</i></p>															
02.	<p>Advances (capital head) unsettled and pending for recovery / adjustment as on 31.03.2012 under different heads, since long, are to be properly taken care of at the Institute level for early adjustment thereof. Details of which are as under:</p> <table border="1"> <thead> <tr> <th>Particulars</th><th>Year</th><th>Amount (₹)</th></tr> </thead> <tbody> <tr> <td>BOOKS &amp; JOURNALS</td><td>2007-2008</td><td>643.65</td></tr> <tr> <td></td><td>2008-2009</td><td>183.90</td></tr> <tr> <td></td><td>2009-2010</td><td>2853.00</td></tr> <tr> <td></td><td>2010-2011</td><td>256942.68</td></tr> </tbody> </table>	Particulars	Year	Amount (₹)	BOOKS & JOURNALS	2007-2008	643.65		2008-2009	183.90		2009-2010	2853.00		2010-2011	256942.68	<p><i>Efforts are being made to settle the outstanding advances. Sometime, the books and journals get delayed in publications and hence, they are not received in time in the library of the Institute.</i></p>
Particulars	Year	Amount (₹)															
BOOKS & JOURNALS	2007-2008	643.65															
	2008-2009	183.90															
	2009-2010	2853.00															
	2010-2011	256942.68															
03.	<p>The Institute made all desired efforts and implemented much awaited 'Double entry system of accounting' at the Institute during the year 2011-12. However, within the limitations, during the current financial year 2011-12 final accounts have been prepared and compiled on the basis of 'Single Entry System of Accounting' and efforts were made to reconcile the same with Final Accounts from 'Double entry system of accounting'. Due to this, various Errors and Omissions were identified and the same have been suitably taken care. The details of the said adjustments are as under:</p> <ul style="list-style-type: none"> <li>In the Balance Sheet of GPF as on 31/03/2011, outstanding balance was ₹ 6,41,17,967.99, whereas as per balance sheet, GPF fund as per Schedule III, it was mentioned as ₹ 6,11,17,967.99. The difference of ₹ 30,00,000.00 was on account of wrong entry in Advances out of GPF. The same was rectified and the opening balance was increased by the said amount.</li> <li>In GPF Balance Sheet on Asset side, balance was ₹ 6,11,17,968/- whereas in the Schedule 9, it was taken as ₹ 6,08,65,177/-. The difference of ₹ 2,52,791/- was on account of opening TDS which was not included in the Schedule "9". The same was rectified in the current year.</li> <li>In Pension Fund, as on 31/03/2011 in schedule 3, the balance was ₹ 9,09,16,302/-, whereas in schedule 9, it was ₹ 9,10,90,195/-. The difference of ₹ 1,73,893/- was on account of TDS of 2010-2011 not added to Pension Fund in Schedule 3. So, the same was rectified in current year.</li> </ul>	<p><i>Noted for compliance.</i></p>															

S No.	Comments/Observations by the Chartered Accountants	Actions taken by the Institute
	<ul style="list-style-type: none"> <li>In Donated Fund, the fixed deposits amounting to ₹ 3,25,943/- was matured on 20/10/2010 and was renewed with the total maturity amount, but interest accrued on these deposits on maturity was not accounted for in books. As a result, the fixed deposits were understated by ₹ 73,911/- (interest amount). The interest was accounted for in current year to arrive at correct value.</li> <li>In Reserve Fund, ₹ 1,05,00,000/- was shown as "other approved securities" as on 31/03/2011, whereas the said amount was transferred from "Reserve fund" to "BSIP A/c no. 666" but the same was wrongly taken as "other approved securities". The same was rectified during current year".</li> <li>₹ 38,75,674/- was added to "Furniture &amp; Fixtures" during the year 2010-2011, but instead of adding the balance of "Furniture of Fixtures". It was deducted in the 'Library Books' resulting in understatement of 'Furniture &amp; Fixtures' and 'Library Books' by the said amount. So, for rectification of the same, ₹ 38,75,674/- was added both to "Furniture &amp; Fixtures" and "Library Books".</li> <li>As on 31/03/2011, balance in saving account was ₹ 47,77,017/-, whereas the same was stated as ₹ 33,57,854/- in the schedule 11 of the balance sheet. Further. The balance of saving account includes ₹ 29,657/- on account of balance in donated fund account but the same was separately shown in schedule - 9. Hence, balance in Saving Account was understated by ₹ 13,89,506/-.</li> <li>A sum of ₹ 66,169/- was received on account to Group Insurance of Mrs. Usha Bajpai in 2010-2011 and was not paid to her. The same was wrongly included as "Miscellaneous Income" in previous year. The said amount was paid to her during current year and is separately reflected in Schedule 21.</li> <li>Service Tax is being recovered on consultancy receipts. Compliances, if any, on account of Service Tax be checked and complied with by the Institute.</li> <li>The net effect of all the adjustment mentioned above on account of conversion of single entry system to double entry system is ₹ 12,80,249.36 which is mainly on account of TDS wrongly included in Income in Schedule 14 in 2010-2011. The said amount is separately disclosed in Schedule 21 of current year.</li> </ul>	
04.	Double entry system of accounting' implementation in its true spirit requires dedicated efforts from all concerned but the same appears to be lacking. Now, single entry system of accounting should compulsorily be stopped and changed system be adopted to avoid duplicity of accounting; Maintenance of Accounting records, Cash / Bank Book, Ledgers (including stores records) etc need to be strengthened and reconciliation of Ledger balances is required to be made on regular basis due to implementation of double entry accounting system.	<i>Annual Account has been finalized as per Accrual Basis of Accounting for the financial year 2011-2012. In order to implement Accrual basis of Accounting, the efforts are being made for the members of staff to undergo necessary training to enable them to pass bills, maintain Cash Books, Ledgers, etc.</i>
05.	The Institute has invested most of the funds in to the Term Deposits with Banks and financial institutions. Institute is following cash basis of accounting. However, during the current year, the Institute has accounted for TDS and Interest to the extent of TDS only based on certificate / document provided by the respective Banks. Interest other than TDS is being accounted for on cash basis as and when received on maturity or otherwise. The said change will correct the practice hitherto being adopted and ease the compliance of the Income Tax Department accordingly.	<i>Application for refund of TDS has already been submitted to the authority concerned.</i>

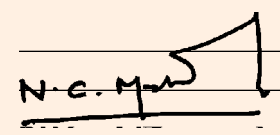


S No.	Comments/Observations by the Chartered Accountants				Actions taken by the Institute	
	TDS amounting to ₹ 22,36,175/- is pending for refund/ adjustment with Income Tax Department. Mainly this issue is pending for want of Exemption Certificate from ITD which is pending at their end and being followed up by the Institute. However, serious efforts are required to be made by the Institute to recover said amount; <u>Fund wise TDS Details are as under:</u>				Application duly approved/ recommended by local jurisdiction and Department of Scientific and Industrial Research, New Delhi has been submitted to Member, I.T., North Block, New Delhi. Clarifications asked on receipt of the application have also been submitted. The matter is pending with CDBT, New Delhi.	
	Financial Year	GPF	CPF	Pension		Total (₹)
	2011-12	161,052.00	16,927.00	581,873.00		759,852.00
	2010-11	354,549.00	18,167.00	475,352.00		848,068.00
	2009-10	125,377.00	2,238.00	108,904.00		236,519.00
	2008-09	116,654.00	0.00	2,223.00		118,877.00
	2007-08	21,033.00	0.00	2,880.00		23,913.00
	2006-07	28,916.00	0.00	71,663.00		100,579.00
	2005-06	86,188.00	0.00	62,179.00		148,367.00
		893,769.00	37,332.00	1,305,074.00		2,236,175.00
06.	<b><u>LIBRARY AND PUBLICATION:</u></b> On scrutiny of records of the priced publication of the Institute, it has been observed that during last several years, the Institute had brought-out publications on different subjects with an objective to sell-out the same, in the market. Looking at the stock position of these priced publications as on 31.03.2012 including the reserved stock; it appears to be on higher side. A practical assessment has to be made for the quantity to be got printed together with its economics etc so that wastage and blockage of Institute funds can be avoided.				An internal committee consisting of senior scientist, administration and accounts has been constituted to look into the stock of priced publications of the Institute, current sale policy on priced publications and the policy on the pricing of the publications and suggested the remedial measures of implementation.	
07.	<b><u>EMPLOYEES PROVIDENT FUND (GPF / CPF):</u></b> The investment of GPF includes ₹ 1,24,800/- unadjusted amounts of premium paid on RBI Bonds, which were redeemed in the year 2006-07 & remains pending for suitable adjustments. Finance & Building Committee of the Institute vide its meeting held on September 09, 2007 made no objection on this matter. After decision of Finance & Building Committee & confirmation of General Body and as per ATR on Chartered Accountants Report for the year 2009-10 decision was taken by the Institute to transfer such amount to Expenditure Account; Even after such decision the said amount is not yet adjusted.				The matter was discussed in the Finance and Building Committee meeting held on March 16, 2012 and the matter has been referred to DST to relevant details for advice. After receiving the advice of the DST, suitable adjustment shall be made.	
08.	CPF funds are kept invested by the Institute at par with GPF funds and requires to be dealt with according to the rules in this regard by depositing the same with concerned Statutory Authorities. Institute must make effective efforts / steps in completing the remaining formalities for the same.				CPS/NPS is required to be remitted to NSDL, Mumbai for which all the necessary formalities (Consent of Govt., Registration with NSDL for allotment of DDO No., PAO No., Tin and I. Pin No., etc.) have already been completed up to date. Statement of Subscription to be transferred has already been handed over to the Bank. The bank has assured to transfer the sum very shortly after completing some internal formalities.	

S No.	Comments/Observations by the Chartered Accountants	Actions taken by the Institute
09.	<b><u>STORES AND WORKS &amp; BUILDING:</u></b> Maintenance & up-gradation of Fixed Assets register & Stores register needs to be strengthened. The value of fixed assets as per fixed assets register and stores register must match with the value in the fixed assets schedule. Proper reconciliation needs to be done and registers to be updated on regular basis.	<i>Noted for compliance.</i>
10.	Physical Verification of the assets is not being done on time. Physical verification of Non-Consumable assets for the year ended 31.03.2012 was done in June 2012 to August, 2012. While verification no summary of Fixed Assets were being prepared. Only a certificate has been issued that "Physical Verification has been done as per books and no discrepancies have been noticed". No Checking Marks were available on fixed assets register.	<i>The Physical Verification exercise is taken up after completion of financial year and scientists, technical staff are generally assigned to take up the physical verification exercise. Some time delays occurs due to scientific and technical staff members on field or assigned some other duties. However, the suggestions of Chartered Accountants are noted for compliance.</i>
11.	Physical Verification of the Consumable Items for the year 2011-12 was done in July & August, 2012. While verification no Summary of Assets/Working Sheet were being prepared. Only a certificate has been issued that "Physical Verification has been done as per books and no discrepancies have been noticed". No Checking Marks were available on Assets Register.	<i>The Physical Verification exercise is taken up after completion of financial year and scientists, technical staff are generally assigned to take up the physical verification exercise. Some time delays occurs due to scientific and technical staff members on field or assigned some other duties. However, the suggestions of Chartered Accountants are noted for compliance.</i>
12.	Proper Record / Stock Register is to be maintained in every department for items issued to them from stores.	<i>Noted for compliance w.e.f. current financial year.</i>
13.	<b><u>LEGAL CASES AND CONTINGENT LIABILITY:</u></b> List of Legal Cases was provided to us but amount of 'Contingent Liability', if any, is not mentioned. As per list provided to us, 14 cases are pending but updated position is yet to be provided. Reporting of 'Contingent Liability' is also to be done by the Institute through 'note to accounts'.	<i>The updated position of legal cases was provided. However, the contingent liability as suggested by the Chartered Accountants shall be provided through 'note to accounts' in future.</i>

  
 (N B Tiwari)  
 Accounts Officer

  
 (Suresh C. Bajpai)  
 Registrar

  
 (Naresh C. Mehrotra)  
 Director



## Form of Financial Statements (Non-Profit Organizations)

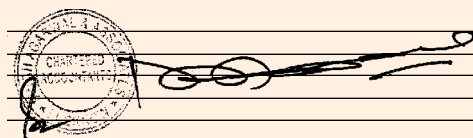
## Birbal Sahni Institute of Palaeobotany, Lucknow

Balance Sheet as at March 31, 2012

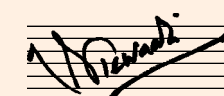
Fig. in Rupees

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	Current Year	Previous Year
CORPUS/CAPITAL FUND	1	114,089,874.67	145,197,686.38
RESERVES AND SURPLUS	2	48,010,903.00	36,460,903.00
EARMARKED/ENDOWMENT FUNDS	3	187,857,038.99	157,239,725.00
SECURED LOANS AND BORROWINGS	4	0	0
UNSECURED LOANS AND BORROWINGS	5	0	0
DEFERRED CREDIT LIABILITIES	6	0	0
CURRENT LIABILITIES AND PROVISIONS	7	7,522,995.64	139,118.94
<b>TOTAL</b>		<b>357,480,812.30</b>	<b>339,037,433.32</b>
ASSETS			
FIXED ASSETS	8	102,870,104.88	106,369,493.33
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS	9	187,857,038.99	157,160,827.99
INVESTMENTS-OTHERS	10	44,915,514.00	54,381,108.00
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	21,838,154.43	21,126,004.00
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)			
<b>TOTAL</b>		<b>357,480,812.30</b>	<b>339,037,433.32</b>
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

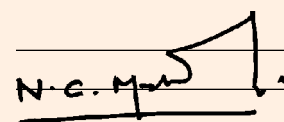
For Singh Agarwal & Associates  
Chartered Accountants



Mukesh Kumar Agarwal  
(Partner)

  
(N B Tiwari)  
Accounts Officer

  
(Suresh C. Bajpai)  
Registrar

  
(Naresh C. Mehrotra)  
Director

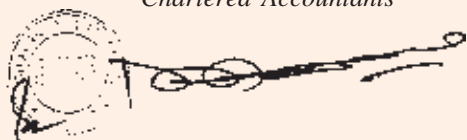
# Birbal Sahni Institute of Palaeobotany, Lucknow

## Income and Expenditure Account for the period / year ending March 31, 2012

Fig. in Rupees

<b>INCOME</b>	<b>Schedule</b>	<b>Current Year</b>	<b>Previous Year</b>
Income from Sales/Services	12	708,955.00	864,958.00
Grants/subsidies ( OB, Deposit A/C and Transfer from Cap. Fund)	13	186,550,000.00	186,778,000.00
Fees/Subscriptions	14	-	1,331,963.00
Income from Investments (Income on Invest. From earmarked/endow. Funds transferred to Funds)	15	2,584,406.00	2,361,664.00
Income from Royalty, Publication etc.	16	2,72,715.00	102,202.00
Interest Earned	17	1,216,285.00	2,043,299.00
Other Income/adjustments	18	932,065.00	603,772.00
Increase/(decrease)in stock of Finished goods and works-in-progress	19	-	-
<b>TOTAL (A)</b>		<b>192,264,426.00</b>	<b>194,085,858.00</b>
<b>EXPENDITURE</b>			
Establishment Expenses	20	143,786,387.00	129,159,290.00
Other Administrative Expenses etc.	21	31,001,463.86	22,022,103.50
Expenditure on Grants, Subsidies etc.	22	-	-
Interest	23	-	-
Depreciation (Net Total at the year-end-corresponding to Schedule 8)		16,134,386.85	17,250,463.12
<b>TOTAL (B)</b>		<b>190,922,237.71</b>	<b>168,431,856.62</b>
Balance being excess of Income over Expenditure A-B		1,342,188.29	25,654,001.38
Transfer to Special Reserve (Specify each)		11,550,000.00	10,500,000.00
Transfer to/from General Reserve to Pension Fund		20,900,000.00	19,000,000.00
<b>BALANCE BEING SURPLUS/DEFICIT CARRIED TO CORPUS/CAPITAL FUND</b>		<b>31,107,811.71</b>	<b>3,845,998.62</b>
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

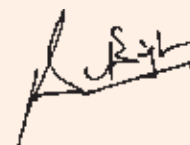
For Singh Agarwal & Associates  
Chartered Accountants



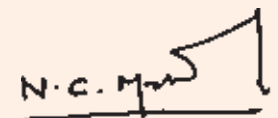
Mukesh Kumar Agarwal  
(Partner)



(N B Tiwari)  
Accounts Officer



(Suresh C. Bajpai)  
Registrar



(Naresh C. Mehrotra)  
Director



## Form of Financial Statements (Non-Profit Organizations)

## Birbal Sahni Institute of Palaeobotany, Lucknow

## Receipts and Payments Account for the period / year ended March 31, 2012

Fig. in Rupees



RECEIPT			PAYMENTS		
	Current Year	Previous Year		Current Year	Previous Year
I. Opening Balances			1) Expenses		
a) Cash in hand		446.00	a) Establishment Expenses(Corresponding to Schedule 20)	143,786,387.00	129,159,290.00
b) Bank Balances			b) Administrative Expenses(Corresponding to Schedule 21)	29,655,046.00	22,022,104.00
i) In current accounts	0	0			
ii) In deposit accounts					
iii) Endowment deposits					
iv) Salary Account	4,777,017.00	2,760,232.00			
II. Grants Received					
a) From Government of India	186,550,000.00	186,778,000.00	II) Payments made against funds for various projects		
b) From State Government			(Name of the fund or project should be shown along with		
c) From other sources(details)	650,000.00		the particulars of payments made for each project)		
(Grant for capital & revenue exp.			Symposium Exp.	348,262.00	
To be shown separately)					
d) Deposit Account					
III. Income on Investment from			III. Investments and deposits made		
a) Earmarked/Endow. Funds			a) Out of Earmarked/Endowment funds		
b) Own Funds ( Utilized)			b) Out of Own Funds ( Investments-Others)	22,673,425.00	29,500,000.00
IV. Interest Received			IV. Expenditure on Fixed Assets & Capital Work-in-Progress		
a) On Bank deposits	757,704.00	1,281,134.00	a) Purchase of Fixed Assets	2,450,821.00	5,897,045.00
b) Loans, Advances etc.	458,581.00	762,165.00	b) Expenditure on Capital Work-in-Progress		
V. Other Income (specify)			V. Refund of surplus money/ Loans		
i) Sale proceeds of Publications	272,715.00	102,202.00			
ii) Miscellaneous Income	4,432,065.00	334,790.00	a) To the Government of India		
iii) Sale of Services ( Consultancy)	708,955.00	864,958.00	b) To the State Government		
iv) Group Insurance	521,520.00	320,736.00	c) To other providers of funds		
VI. Amount Borrowed			VI. Finance Charges (Interest)		
VII. Any other receipts (give details)			VII. Other Payments (Specify)		
(Pension Contribution)	1,889,925.00	18,000.00	i) Advances to Staff	1,566,421.00	1,735,837.00
Transfer from Reserve Fund	1,550,000.00		ii) Earnest Money Refunded		20,000.00
			iii) Advances to Parties	3,869,289.00	2,570,724.00
			iv) Group Insurance	587,689.00	254,567.00
I) Recovery of Advances	2,372,934.00	2,842,154.00			
ii) Earnest Money Deposit	2,000.00	10,000.00	VIII. Closing Balances		
iii) FDR Matured	0	0	a) Cash in hand	0	
iv) Recovery from Parties	72,751.00	0	b) Bank Balances		
			i) In current accounts	0	0
			ii) In deposit accounts		
			iii) Saving account	78,827.00	4,915,250.00
			iv) Endowment deposit account		
			v) Excess Expenditure		
<b>TOTAL</b>	<b>205,016,167</b>	<b>196,074,817.00</b>		<b>205,016,167.00</b>	<b>196,074,817.00</b>

For Singh Agarwal &amp; Associates

Chartered Accountants

Mukesh Kumar Agarwal  
(Partner)

(N B Tiwari)  
Accounts Officer

(Suresh C. Bajpai)  
Registrar

(Naresh C. Mehrotra)  
Director

