

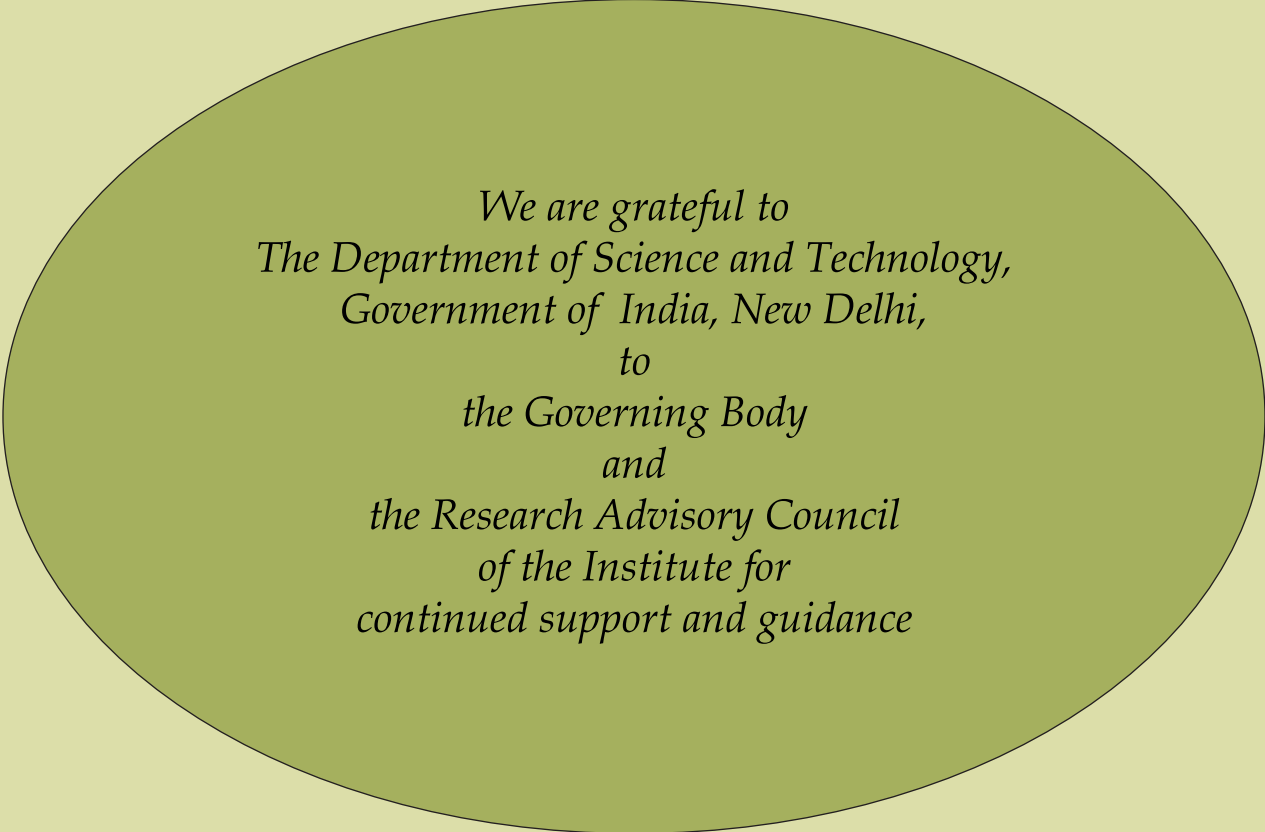
ANNUAL REPORT

2012-2013

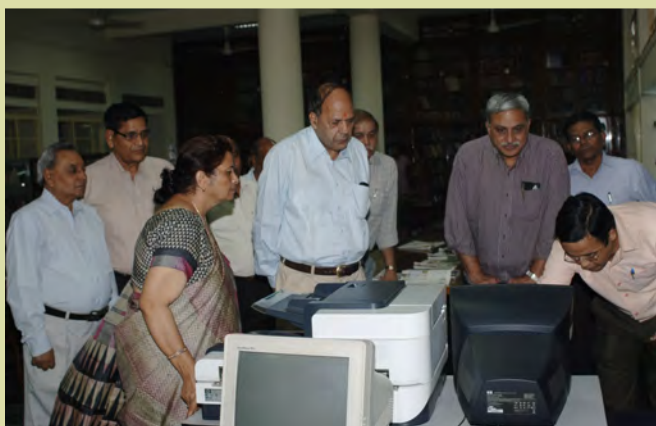


BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW

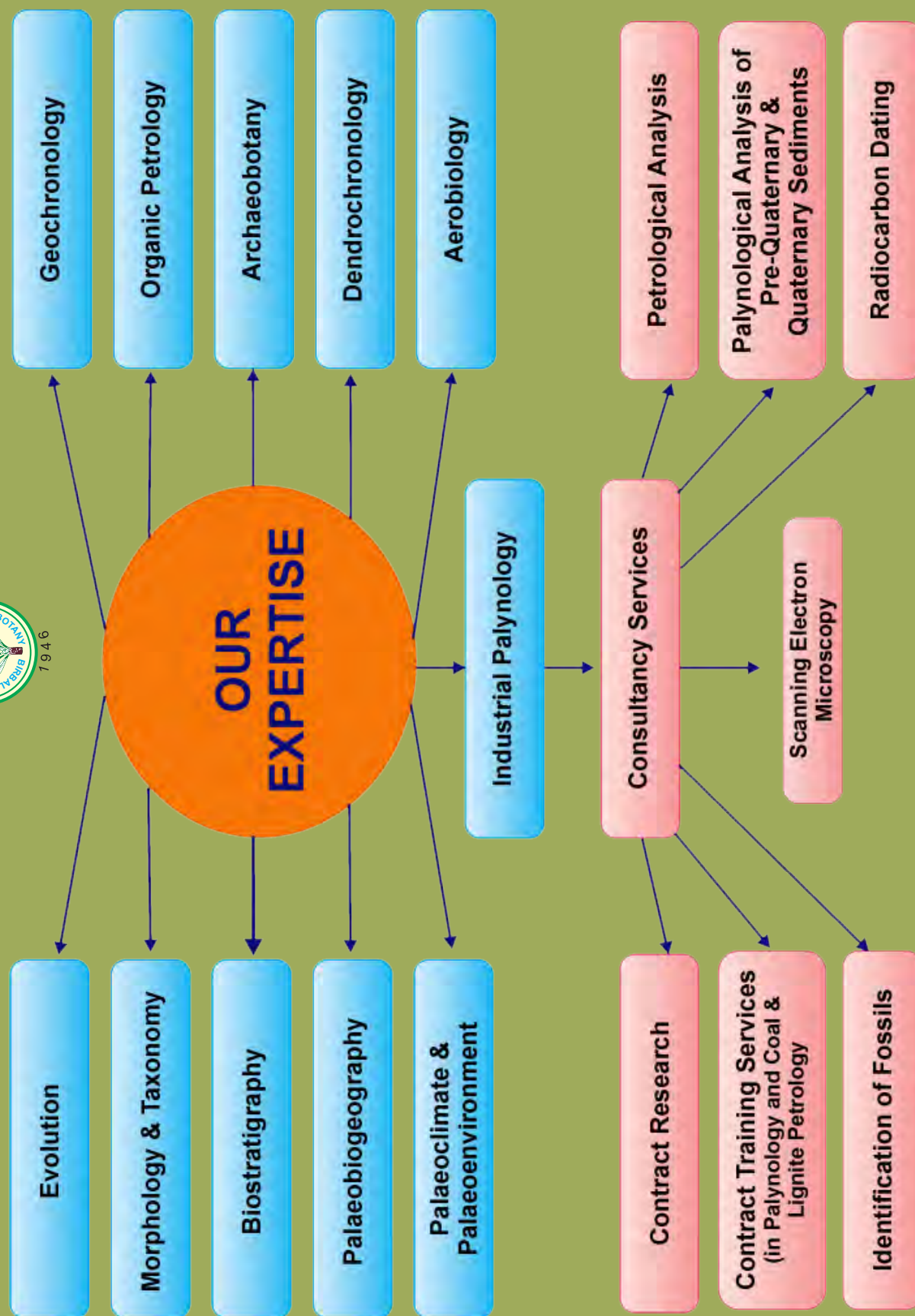
An Autonomous Institute under Department of Science & Technology
Government of India, New Delhi



*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*



Visit of Dr. Shailesh Nayak, Secretary MoES and Chairman GB to the Institute



Annual Report

2012-2013



BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW

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

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November 2013



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BSIP at a *Glance*

Prof. Birbal Sahni, FRS established the Institute in the year 1946 for development of the science of palaeobotany visualizing its potential to understand the origin and evolution of plant life, and to use the knowledge of fossil plants in resolving various geologic problems, including exploration of fossil fuels. The institute is named after him as the Birbal Sahni Institute of Palaeobotany (BSIP). It is devoted to develop both basic and applied aspects of palaeobotany, and has adopted an integrated and multidisciplinary approach for fulfilling its aims and objectives:

- to develop palaeobotany, including palaeopalynology, in all its botanical and geological aspects,
- to constantly update the data for interaction with allied disciplines,
- to co-ordinate with other knowledge centres in areas of mutual interest, such as early life, exploration of fossil fuels, vegetation dynamics, climatic modelling, conservation of forests, etc., and
- to disseminate palaeobotanical knowledge.

BSIP main mission is to achieve excellence in R&D work through a dedicated scientific team and continuous development of palaeobotany through integrated scientific approach with innovative ideas in basic and applied research; interpret the data gathered in relation to plant life evolution and geological processes and to understand environmental evolution through time.

Research areas:

Initially, the Institute laid emphasis on fundamental aspects of Indian fossil floras. Later, the research activities were diversified to include biostratigraphic dating, correlation of surface and subsurface sediments, and exploring areas favourable for fossil fuel deposits. The main research work is concerned with the understanding of plant evolution through geological time. Emphasis has been made to derive knowledge about the diversification of Precambrian life, diversity, distribution and inter-basinal correlation of Gondwana and Tertiary floras, coal/lignite quality and to understand the interaction between the climate and change of vegetation in Quaternary Period.

The palaeofloristic scenario of bygone era helps us figuring out the past climatic and environmental changes. But it is important to tag these climate change events to a time scale. Scientists also study tree-rings to deduce paleomonsoon/climate. Dating and study of samples of archaeobotanical interest is critical to understand the evolution of culture and civilization. Work is also done on the organic petrology to evaluate the quality of lignites/ coals for their economic utilization, besides depositional conditions. The samples for all these studies are collected from all over the globe including polar (Arctic/ Antarctic) regions.

The museum of the Institute is a rich repository of fossils collected from India and received from all over the world. A special attraction is the foundation stone with 77 fossils embedded by Prof. Sahni which was laid by Pt. Jawaharlal Nehru in 1949. The Institute boasts of one of the richest collection of literatures on the subject. It has a herbarium for offering comparison between the past and present vegetation. It also has the radiocarbon dating laboratory, the only such national facility in the country. The Institute holds national/international scientific meets time to time, and publishes catalogues, atlases, etc. on special occasions, besides an international journal *The Palaeobotanist* periodically. The Institute is presently functioning as an autonomous research organization under the Department of Science and Technology (DST) Ministry of Science and Technology, Government of India.

“here we study not only fossil plants but also the rocks in which they are found”

– Birbal Sahni (April 03, 1949)

Foreword



It gives me immense pleasure to present the 2012-13 Annual Report of the Birbal Sahni Institute of Palaeobotany (BSIP), a unique institution with a long history of research in basic and applied aspects of palaeobotany (fossil botany) and allied disciplines. The basic objectives being pursued at this institute have remained the same as envisaged originally but the approaches and applications have constantly evolved to respond to new scientific challenges as well as to emerging societal concerns. I feel honoured to be associated with this institute of international repute.

The science of palaeobotany must embrace various other disciplines if it is to increase the scope of its impact and, for this reason, plans are afoot to strengthen the infrastructure at BSIP, especially the facilities for analytical instrumentation including stable isotope, elemental and organic geochemistry, optically stimulating luminescence (OSL) dating, to name a few. The new thrust is sure to increase the rigor of ongoing research at BSIP through multiproxy and quantitative approaches that will allow a deeper understanding of the past biota and its climatic, ecological, biogeographic and evolutionary aspects. The research projects under the XII Five Year Plan have been modified to reflect the new thrust to a certain extent.

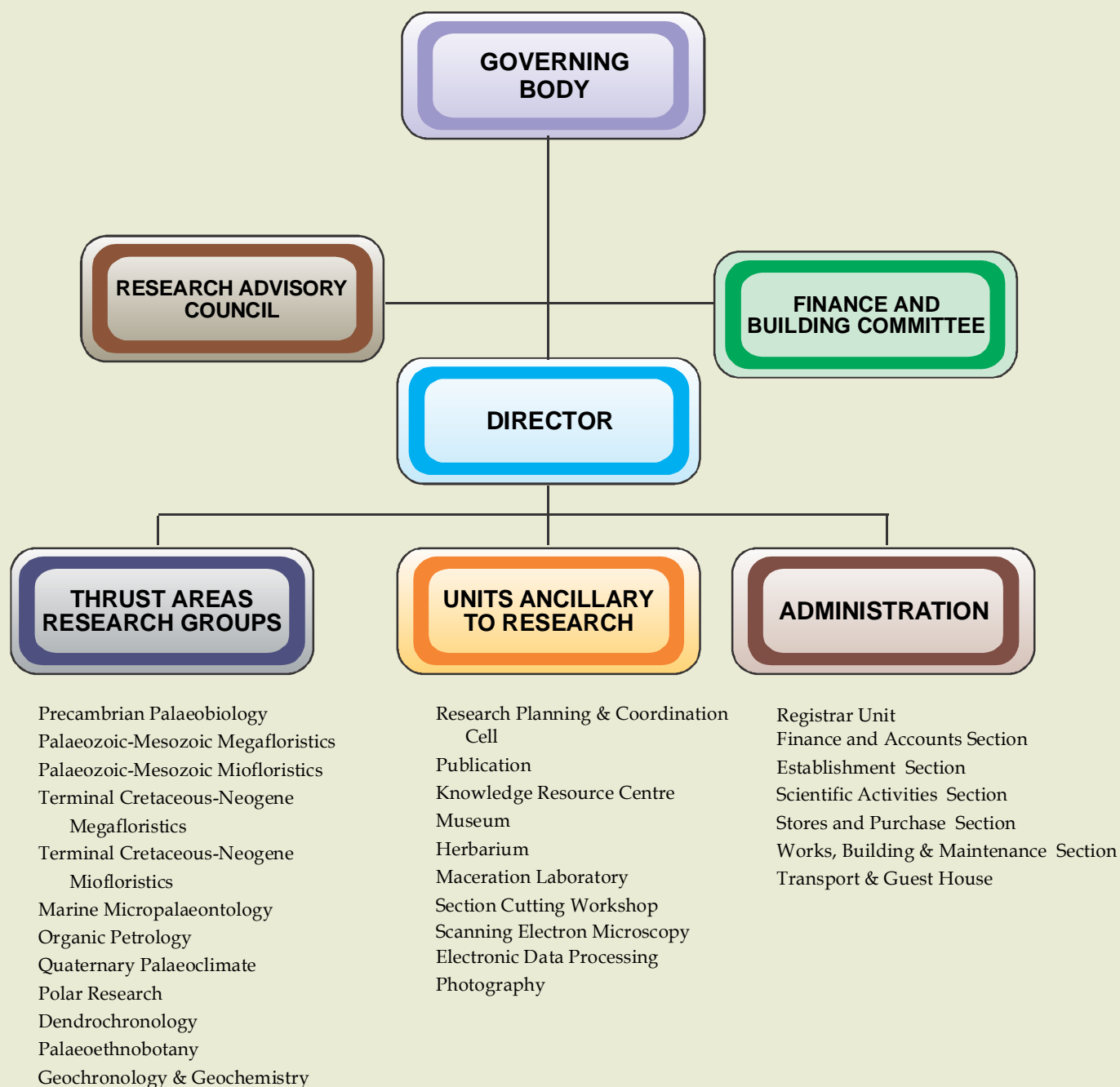
The constant support and guidance from the Department of Science and Technology (DST), the Governing Body and the Research Advisory Council have been the source of our strength. We express gratitude and look forward to their continued support.

This document reflects our aspirations and endeavours. It has been brought out with dedicated efforts of the Research Planning and Coordination Cell (RPCC) with generous support from scientists and various sections of the Institute. I record my best wishes for all of them, with hopes that together, we will be able to make a dent in our chosen areas of fundamental and applied studies in palaeobotany and related disciplines.

(Sunil Bajpai)
Director

Organization Structure

Department of Science & Technology
Birbal Sahni Institute of Palaeobotany
(Autonomous Institute)



Vigilance Officer
Dr. C.M. Nautiyal, Scientist-E

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

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

Research Highlights

Birbal Sahni Institute of Palaeobotany (BSIP) is devoted to development of both fundamental and applied aspects of Palaeobotany and allied Earth System Sciences, especially focusing on past plant life, palaeoclimate and palaeobiogeography. Research on Palaeobotany and allied disciplines is being conducted on sedimentary sequences from Archaean to Recent (3200 Ma to 400 AD) with an integrated and multidisciplinary approach. To achieve the targets of the XII Five Year Plan, 12 research projects have been initiated under the umbrella of seven identified Thrust Areas:

1. Early life and environment: Evidence from Indian Precambrian basins.
2. Phanerozoic terrestrial and coastal ecosystems: Biostratigraphical, palaeoenvironmental, palaeoecological, palaeogeographical and geodynamic aspects.
3. Integrative marine micropalaeontology: Focus on high resolution biostratigraphy, sea level changes, palaeo-oceanographic and palaeoclimatic events.
4. Organic petrology: Characterization of solid fossil fuel for depositional and utilizational aspects.
5. Quaternary palaeoclimate reconstructions, vegetation dynamics and relative sea level changes.
6. Domestication of plants, early farming and ecosystem dynamics during Holocene/ Anthropocene.
7. Geochronological and geochemical parameters for the high resolution dating, correlation, palaeoclimatic, tectonic and provenance studies.

Some of the significant outcome of scientific research during the year 2012-2013 is summarized as under:

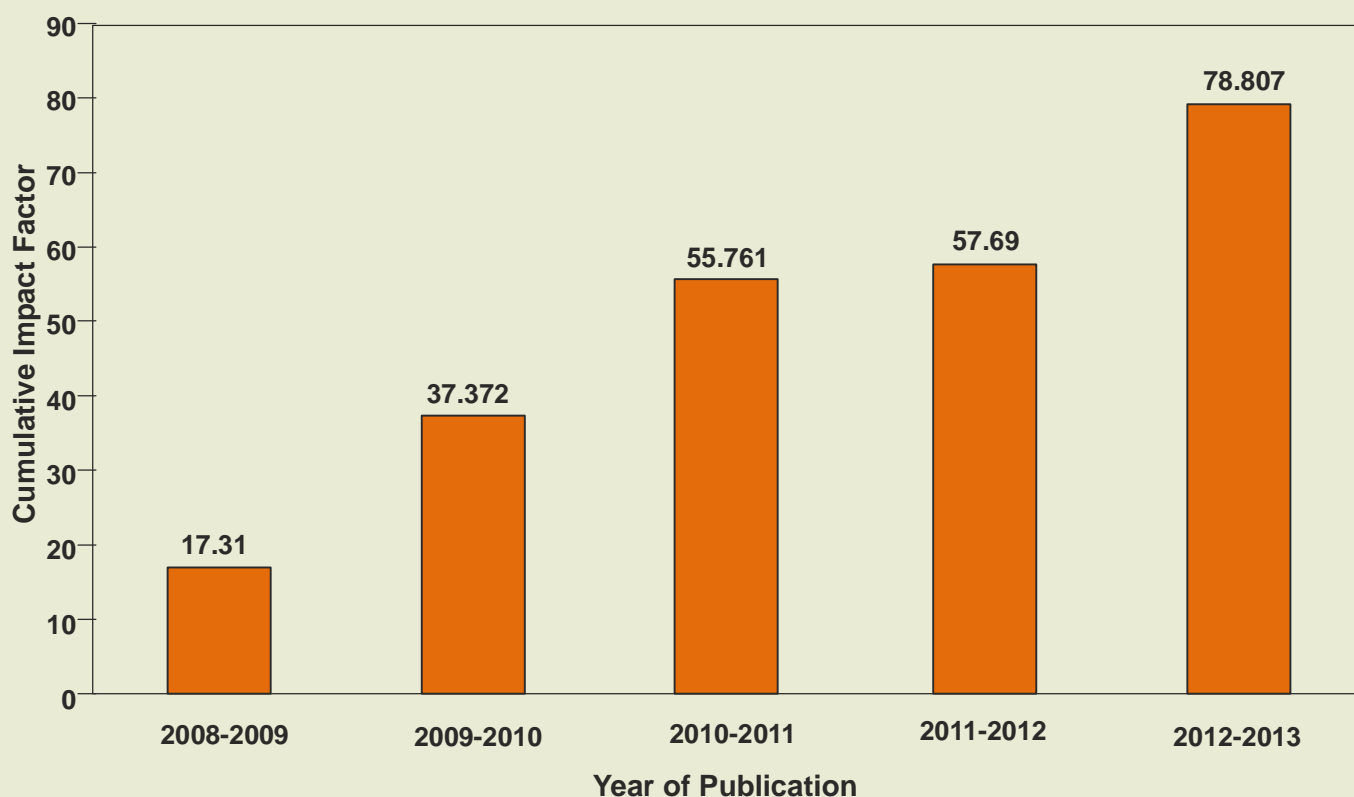
- Study of microfossils from the Owk Shale of Kurnool Group discounts its Mesoproterozoic age and supports the Neoproterozoic age for the Kurnool Basin.
- Occurrence of taxonomically resolved eukaryotes from the Chhattisgarh Supergroup suggests the presence of Meso-Neoproterozoic boundary within the Chandrapur Group.
- Placed all leafless articulate stems fossil records from the Indian Gondwana sediments, earlier described as equisetaceous/ equisetalean stems/axes, under the genus *Paracalamites*.
- Recovered distorted, cracked, twisted, perforated wood pieces and broken/cracked pollen-spores of early Permian age from the Nishatbagh Formation in Kashmir region provide compelling evidence of palaeofires.
- Presence of rich and diverse *Dicroidium* flora shows the persistence of greenhouse conditions from the end Permian through the Triassic period in the polar regions of Antarctica.
- Comparative study of Raghavapuram flora with other Indian Mesozoic floras helped to bring out floral differences and distribution of various taxa in the east coast during the Early Cretaceous time.

- Documented the spore-pollen assemblages from the Palaeozoic sequences of Godavari Valley, Mand-Raigarh, Ib-River, East Bokaro and Raniganj coalfields in order to work out their significance in biostratigraphical and palaeoenvironmental interpretations.
- Described a new fossil leaf *Alphonsea* (Custard apple) of the family Annonaceae from the Late Oligocene sediments of Makum Coalfield (Assam). This is the first authentic record of this taxon from the Tertiary rocks of South Asia and it indicates the Indian origin and subsequent migration to SE Asia in contrast to the commonly held belief that it was introduced into India from South America by European sailors.
- Recovered the fossil wood genus *Dalbergia* for the first time from the Tipam Group of Mizoram, India, adding to taxonomic diversity.
- Identified two new fossil fruits of the families Fabaceae and Rhamnaceae from Lower Siwalik sediments of Himachal Pradesh.
- Record of the Palm fossil fruit (*Cocos*) from Seoni district (MP) further confirms marine incursions in the central India.
- Dated the Kapurdi lignite-bearing sequences (Rajasthan Basin) as Late Palaeocene-Early Eocene, and Matasukh lignite deposits as Early Eocene, based on palynofossils records.
- Concluded that the deposition of Matanomadh lignite successions (Kachchh Basin) took place in fluctuating conditions through lacustrine, swampy, marshy and deltaic environments, based on palynofossil assemblages.
- Found evidence of swampy, marshy and deltaic conditions near the coast under tropical regime during the deposition of Surkha lignite deposits, Saurashtra Basin.
- Suggested a temporal gap between the Bilkhawthlier-Rengtekawn (Late Oligocene) and overlying Bhuban Formation (Early Miocene) exposed in north-eastern Tripura, based on the differences in palynological assemblages.
- Documented palynofloral change across the Cretaceous-Tertiary (K/T) in a section near Anjar, Gujarat.
- Compared the palynofacies assemblages of Lakadong Sandstone successions from Jathang and Ranikor-Barsora areas to decipher sea level fluctuation and to evaluate the possible role of Early Palaeogene warm climate in the development of Late Palaeocene-Early Eocene facies architecture in Khasi hills, Meghalaya.
- Proposed that a global eustatic rise coupled with local tectonics during the Pleinsbachian-Aalenian boundary interval could be twin reasons for early Jurassic calcareous nannofossil records, based on studies from the Kaladongar Formation (Patcham Island) exposed in Kuar Bet Islet in Kachchh Basin.
- Discovered a new outcrop of late Middle Miocene sediments belonging to Long Formation in the Kalapathar area of Little Andaman Island.
- Found evidence of marine incursion at various levels of the sediment core in the Vembanad estuary, Cochin region, based on the presence of copepod egg envelopes, foraminiferal test linings, and dinocysts.

- Studied Permian coal from Kothagudem sub-basin (Godavari Basin), Cretaceous coal from Thangad (Saurashtra Basin) and Tertiary lignites from Mangrol and Amod (Cambay Basin) areas for their characterization and depositional conditions.
- Predicted partial coherence between modern pollen rain and extant vegetation due to differential pollen productivity, dispersal and deposition in and around Panchratna reserve forest (Goalpara district), western Assam. The surface pollen data could be used in interpretation of palaeovegetation and palaeoclimate in the region.
- Appreciable encounter of culture pollen taxa (*Cerealia*, *Alternanthera*, *Cannabis sativa*, etc.) implies the proximity of the cultivated land around Simariya Tal in Chhindwara district.
- Record of *Cerealia* and other culture pollen taxa reflects the proximity of human habitation to the lake (Chaudhari-ka-Tal) site in central Ganga Plain, Raebareli district, UP.
- Inferred that the climate changed gradually towards aridity leaving an impact on vegetation (particularly mangroves) which was largely enhanced by anthropogenic activity in the Visakhapatnam harbor area.
- Indicated that the pollen of local vegetation is more dominant than the pollen of regional vegetation in the Sajnekhali Island of Sundarbans. The local pollen is strongly related to the proximity of source vegetation.
- Compiled the multi-proxy data on the glacial lakes of the world's highest pass (Khardungla) at South and North Pulu, which will throw light on the variation in the westerly intensity pattern in the Trans-Himalayan region.
- Noticed 2-4 climatic phases since ca. 46.6 Ka to present day by using palynomorphs and non-pollen palynomorphs preserved in two sections of eastern sub-Himalayan foothill region of Jalpaiguri district (WB).
- Recorded dispersed organic matter in abundance throughout a 1 m trial-trench profile from Kolhamna Lagoon, Ny-Alesund, Svalbard.
- Ring width chronologies of *Pinus gerardiana* and *Cedrus deodara* from different sites of western Himalaya have been used to develop drought indices extending back to AD 1310.
- Reconstructed summer month's (March-April) discharge data of Beas River back to AD 1834 using tree-ring data of *Cedrus deodara* growing within the Beas River Basin, Kullu Valley.
- Studied fruit and seed remains from Chalcolithic site Ghorakatora near Giriyak in District Nalanda (Bihar); revealing advanced agricultural practices in this region of Middle Ganga Plain in ancient times (1500 BC-800AD).
- Explored a ca. 4.7 Ka record of climatic variability through the study of phytoliths and stable isotopic signatures in Harappan archaeological site of Khirsara (Kachchh district, Gujarat); revealing three short-term humid phases over a prolonged dry phase.
- Three extant plant species (*Solanum diphyllum*, *Solanum pimpinefolia* and *Cosmos caustatus*) are found to be new to Western Ghat and one plant species (*Phylla longifolia*) to India.
- Radiocarbon dates on Indo-Gangatic Plains materials of archaeological significance reflect that the Indian cultural sites are in general older than earlier believed, as evidenced by 7000 yr. old rice.

Integrated collaborative research activities in several spheres with institutions in India and abroad (Brazil, China, Germany, Russia, UK, etc.) have helped to expand scientific knowledge. The collective research efforts are expressed in the form of 120 published papers, besides 56 research papers accepted for publication. Four Ph.D. degrees were awarded during the year. Two scientists were deputed abroad (China, Poland) under Inter-academy Exchange Programme of INSA, and one scientist was awarded INSA Visiting Fellowship. Two scientists participated in the Indian Expeditions to Arctic and Antarctica, and one scientist joined the IODP Expedition to North Atlantic and Newfoundland (Canada). Twenty five scientists and 2 Birbal Sahni Research Associates were deputed for attending various conferences abroad (in Argentina, Australia, Belgium, China, Germany, Ireland, Japan, Nepal and South Korea). Thirty scientists, one Research Associate, one Birbal Sahni Research Scholar, and 3 Technical personnel were deputed to attend various national and international conferences/ workshops held in the country. About 45 research papers were presented in these scientific meetings at different centers of India and abroad. In addition, 16 scientific posters were displayed during the interactive *Symposium for Young Scientists* organized at the Institute.

An orientation course was organized by the BSIP for the newly recruited Birbal Sahni Research Scholars and Research Fellows for awareness with the activities of the Institute. Keeping in view the significance of palynological and organic petrological researches in the field of fossil fuels exploration, a training programme on *Palynology in Fossil Fuel Exploration* was also successfully organized to educate young researchers from academic institutions and related industries.



Cumulative Impact Factor of Published Research Paper

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(w.e.f. 22.02.2011)

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Prof. Sunil Bajpai (w.e.f. 23.01.2013)

Dr. R.R. Yadav (w.e.f. 01.11.2012 to 22.01.2013)

Dr. N.C. Mehrotra (till 31.10.2012)

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 to 31.03.2014)

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Ex-Chairman, Geology Department, AMU
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Member-Convener (Ex-officio)*

Prof. Sunil Bajpai (w.e.f. 23.01.2013)

Director, Birbal Sahni Institute of Palaeobotany, Lucknow

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Member (Ex-officio)

Deputy Director General

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

***Dr. R.R. Yadav** (w.e.f. 01.11.2012 to 22.01.2013) & **Dr. N.C. Mehrotra** (till 31.10.2012)



A view of Research Advisory Council Meeting

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. P. Sanjeeva Rao
Scientist-G
Dr. A.K. Gupta (till 17.01.2013)
(Nominee of the Secretary DST)
DST, New Delhi

Ms Anuradha Mitra, IDAS
Joint Secretary & Finance Adviser
DST, New Delhi

Shri Parvez Mahmood
Sr. Superintending Engineer
Laboratory Service Engineering
CDRI, Lucknow

Prof. Sunil Bajpai (w.e.f. 23.01.2013)*
Director
Birbal Sahni Institute of Palaeobotany

Non-Member Secretary

Dr. S.C. Bajpai
Registrar
Birbal Sahni Institute of Palaeobotany

***Dr. R.R. Yadav** (w.e.f. 01.11.2012 to 22.01.2013) & **Dr. N.C. Mehrotra** (till 31.10.2012)

Foundation Day

The Institute celebrated its 66th Foundation Day on September 10, 2012. On this occasion Shri Kuldeep Chandra, Former Executive Director & Head, Keshava Dev Malviya Institute of Petroleum Exploration, ONGC Ltd., and presently Advisor (Research), University of Petroleum and Energy Studies (UPES), Dehradun delivered '16th Jubilee

Commemoration Lecture' on the topic *Palynology in Hydrocarbon Exploration*.

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



Founders' Day

The Institute celebrated its Founder- Prof. Birbal Sahni 121st birth anniversary on November 14, 2012. 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. K.G. Saxena of School of Environmental Sciences (SES), Jawaharlal Nehru University, New Delhi delivered the '42nd Birbal Sahni Memorial Lecture on the topic- *Plants, Environment and Sustainable Development*.

Prof. Rengaswamy Ramesh of Geosciences Division, Physical Research Laboratory (PRL), Navrangpura, Ahmedabad delivered the '58th Sir Albert Charles Seward Memorial Lecture' entitled- Scientific Problems pertaining to the Anthropocene.

Dr. C.S. Nautiyal, Director, National Botanical Research Institute (NBRI) & Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow presided over the function. Many guests and scientists from outside the Institute attended the occasion.



Training Programme ‘Palynology in Fossil Fuel Exploration’

Palynology, a branch of science dealing with the study of spores, pollen and other organic walled microfossils found in the sedimentary rocks, provides valuable geo-scientific database related to the high-resolution biostratigraphy, sequence biostratigraphy, palynofacies, palaeoenvironmental modelling, organic matter characterization, maturation, and source-rock evaluation. These parameters are utilized as vital inputs for analysis of various stages of fossil fuels (oil, gas, coal bed methane, shale gas, gas hydrates, etc.) and their exploration, development and operational requirements in a sedimentary basin. In view of the expansion of fossil fuel exploration activities in the country, palynology and palynofacies need to be strengthened to provide a veritable support to the upstream industrial sector for

BSIP during September 10-17, 2012. The program was started on 10th September on the occasion of Foundation Day of the Institute with the lecture by Sri Kuldeep Chandra, Former Executive Director R&D, Oil and Natural Gas Corporation, Dehradun on the topic *Principals of Evaluation of Petroleum Source Rocks: Revisited*. The lecture was followed by the inaugural address of Prof. S.N. Bhalla, Chairman of the Research Advisory Council, BSIP. The next 5 days were organized with basic to thematic lectures, followed by practical demonstrations of over one hour in each evening session. The programme ended with the trainee's visit to the laboratories of Keshava Dev Malviya Institute of Petroleum Exploration, ONGC, Dehradun on September 16-17, 2012 to get further knowledge on palynological methods for industrial uses, and discussions with the palynologists.

The application of palynology for fossil fuels exploration and development has become scientifically and economically important. The demand for higher resolution biostratigraphical data is increasing with the recognition of fossils and the relative position of their occurrences in space and time. The use of palynomorphs as palaeoenvironmental indicators has been developed in various sedimentary basins of India and is apparently useful in pre-Quaternary sediments. Thus, the training was focused on different types of biostratigraphical data (abundance of



improved identification of areas of focus for long-term exploration efforts. Thus, it is much needed to educate young researchers and to make them specialist for fulfilling the requirement for generation of data in academic institutions and fossil fuels exploration industries.

Keeping in view the significance and role of palynological and organic petrological researches in the field of fossil fuels/hydrocarbon exploration, a Training Programme on *Palynology in Fossil Fuel Exploration* was successfully organized at





Practical demonstration of chemical processing (maceration) technique

various palynomorphs, their deposition and preservation in sediments, maturation, etc.) with special emphasis on plant and animal derived microfossil analysis (e.g. spores-pollen, dinoflagellates, acritarchs, nanoplanktons, microforaminifera, etc.), and organic constituents estimation (dispersed organic matter, macerals).

The courses were taught by certain existing and ex-faculty members of the specialized organizations as well as by BSIP scientists. The speakers provided a thorough understanding of modern concepts of palynology and its related disciplines used in exploration of solid, gas and liquid hydrocarbons. The basic palynological techniques, i.e. chemical processing of rocks, preparation of palynological slides, numerical calibration of various types of palynofossils, their diversity indices, abundances in relation to age and depth, comparison of sedimentary horizons and depositional environments were introduced. These all disciplines were explained through power point and poster presentations, discussions, etc. with enhanced basic and advanced knowledge-bases required for developing and applying multidisciplinary approaches with palynological analyses. More emphasis was given on various types of palynomorphs occurring in various sedimentary horizons of India and methods of statistical analyses for high resolution palaeoclimatic and palaeoenvironmental reconstructions. These studies were also explained with interpreting the results in the framework of chronostratigraphy, integration of palynostratigraphy with

other stratigraphy, biostratigraphy, sequence stratigraphy and wire log data and its uses in solving different geological problems were theme of the course. In addition, coal macerals, study on vitrinite reflectance of coals, their burial methods and history of various types of palynomorphs and sedimentary organic matters occurring in large numbers of the sedimentary horizons of various basins of India were also part of the training. These all courses were followed by practical demonstrations on different types of microscopes and chemical analytical techniques (acid and acid-free palynological preparation and analysis) in comprehensive in-house laboratory facilities required for various types of sedimentary rocks.



Demonstration of microscopy for coal petrographic analysis

Thirty young researchers and students from Anna University (Chennai), Banaras Hindu University (Varanasi), Chitrakoot University (Chitrakoot), Dibrugarh University (Dibrugarh), Mizoram University (Aizawl), Periyar University (Salem), University of Petroleum and Energy Studies (Dehradun), Vikram University (Ujjain), CSIR-Central Institute of Mining and Fuel Research (Digwadih Campus, Dhanbad), Indian School of Mines University (Dhanbad), Oil and Natural Gas Corporation Ltd. (Sibsagar), and from BSIP (Lucknow) were participated in the programme. These participants were provided hands-on training that will be much helpful in developing a solid foundation in their future palynological and geological research works related to fossil fuels exploration.

Speaker	Affiliation	Title of the lectures
Kuldeep Chandra	ONGC/UPES Dehradun	<i>Synergy between Organic Geochemistry and Palynology towards enhancing effectiveness of Petroleum Exploration</i>
M. Shanmukhappa	ONGC, Dehradun	<i>Palynological Techniques and its applications in Hydrocarbon Exploration</i>
R.K. Saxena	ONGC, Dehradun	<i>Calcareous Nanofossil and its application in Hydrocarbon Exploration</i>
Jyotsana Rai	BSIP	<i>Nanofossils: The Size Matters and a Matter of Size</i>
N.C. Mehrotra	BSIP	<i>Introduction to Dinoflagellates: Cyst Morphology and Terminology</i> <i>High Impact Palynology in Hydrocarbon Exploration in commercially producing basins of India with recent achievements of BSIP</i>
Ratan Kar	BSIP	<i>Application of Palynology in Coal Exploration: Case study from an Indian Gondwana Coalfield</i>
Mukund Sharma	BSIP	<i>Stromatolites: An evidence of Early Life and their Stratigraphic Potential</i>
U.K. Bhui	PDP, Gandhinagar	<i>Geochemical Characterization of Hydrocarbon Crudes: Its application in Exploration</i>
Madhav Kumar	BSIP	<i>Use of Scanning Electron Microscope studies in Palynology</i> <i>Sedimentary Organic Matter: A Proxy Data for deciphering Sedimentary Environment</i>
Neerja Jha	BSIP	<i>An Introduction to Gondwana Palynology in India</i>
M.R. Rao	BSIP	<i>Palaeopalynology and its Applications with special reference to Tertiary Spore-pollen and Dinoflagellate Cysts</i>
D.S.N. Raju	ONGC, Rajahmundry	<i>History of Palaeontology, Advances in Microfossil studies, Biochronostratigraphy, Resolution Achieved application in Hydrocarbon Exploration</i>
Baleshwar Kumar	NGRI, Hyderabad	<i>Geochemistry and Palynology in unconventional Gas Resources and Exploration</i>
A.K. Singh	RGPT, Rae Bareilly	<i>Fundamentals of Organic Petrology</i>
A.K. Varma	ISM, Dhanbad	<i>Geological Facets of Coal Bed Methane</i>



Outreach Programmes

The Institute has been active in propagating the knowledge about Palaeobotany and allied disciplines to the common man employing multi-pronged approach. The Institute's scientists delivered many lectures in rural as well as urban areas on topics of common interest. Radio talks on science by scientists also helped in spreading science. The stall of the Institute at the Regional Science City, Lucknow was visited by a huge number of curious children and adults alike during the Science Expo during

January 30th to February 3rd. Some scientists held positions in the committees of the Regional Science City and programmes catalysed and supported by NCSTC (DST). On Science Day, the Institute organised an interesting and informative lecture by Dr. S.V. Sawant of National Botanical Research Institute, Lucknow who talked about Biotechnology. On this day, Open House was observed with open invitation to one and all to visit the museum and laboratories.





Orientation Programme

An Orientation Course was organized by the BSIP for the newly recruited Birbal Sahni Research Scholars (BSRSs) and Junior Research Fellows (JRFs) of different projects being implemented in the Institute. The program was inaugurated on May 21, 2012. The course work incorporated lectures and hands-on training by the scientists and other invited experts of different study areas of the institute. Prof. C.L. Verma,

Prof. P.K. Mishra of the University of Lucknow, and Associate Prof. P.P. Chakraborty of the Delhi University delivered lectures during the course. Seventeen days program was aimed to introduce various facets of Palaeobotany to the newly recruited scholars so that they can decide the areas of research for their Ph.D. program. Details of the lectures and hands-on training schedules were as follows:

Date	Speaker	Topical themes
21.05.2012	H.P. Singh	Prof. Birbal Sahni: A persona
	N.C. Mehrotra	About BSIP
	S.C. Srivastava	About The Palaeobotanical Society & BSIP's Events and Achievements
22.05.2012	Mukund Sharma	Introduction to Cyanobacteria
	A.K. Ghosh	Introduction to Calcareous Algae and Charophytes
23.05.2012	S.K.M. Tripathi	Cenozoic Spores and Pollen grains
	A. Bhattacharyya	Introduction to Dendrochronology
24.05.2012	A. Rajanikanth	Gymnosperms Plant Fossils
	R.C. Mehrotra	Leaf Architecture
25.05.2012	N.C. Mehrotra	Introduction to Dinoflagellate Cysts
	C.L. Verma	Pteridophytes Plants
28.05.2012	Madhav Kumar	Uses of Light Microscopy and Scanning Electron Microscopy
	Mukund Sharma	Preparation of Thin Sections
29.05.2012	R.C. Mehrotra	Methodology of CLAMP Analysis
	K.J. Singh	Study of Gondwana Plant Megafossils
30.05.2012	S.K.M. Tripathi	Introduction to Fossil Fungi
	Chanchala Srivastava	Introduction to Palaeoethnobotany
	Madhav Kumar	Introduction to Sedimentary Organic Matter
31.05.2012	Jyotsana Rai	Introduction to Nannofossils
	Anjum Farooqui	Recognition of Ancient Delta
01.06.2012	Abhijit Mazumder	Introduction to Foraminifers
	Binita Phartiyal	Palaeosol and Geochemistry
02.06.2012	P.K. Mishra	Introduction to Diatoms
	N.C. Mehrotra	Palynology in Fossil Fuel (oil) Exploration
	Ratan Kar	Palynology in Coal Exploration
04.06.2012	Biswajeet Thakur	GIS and Remote Sensing Applications
	C.M. Nautiyal	Radiometric Dating & Presentation Skills
05.06.2012	Neerja Jha	Palaeozoic Spores and Pollen & Methodology of Maceration Techniques
06.06.2012	Binita Phartiyal	Quaternary Palaeoclimate study in Polar Regions
	Rajni Tewari	Cuticles and Megaspores
07.06.2012	Ruby Ghosh	Introduction to Phytoliths
	Ram Awatar	Mesozoic Spores and Pollen
08.06.2012	O.S. Sarate	Coal Pellet Preparation Techniques and Macerals
	Alpana Singh	Fundamentals of Organic (Coal/Lignite) Petrology
	P.P. Chakraborty	Introduction to Sedimentology
09.06.2012	P.P. Chakraborty	Aspects of Sedimentology

After successful completion of the course all the BSRS are well aware with the activities of the institute

and proud of the legacy of they are now part. As a sequel they are attached to scientists for their Ph.D. work.

Research

Thrust Areas and Projects

Thrust Area 1: EARLY LIFE AND ENVIRONMENT: EVIDENCE FROM INDIAN PRECAMBRIAN BASINS

Precambrian Palaeobiology Group

Project- 1.1: Palaeobiological, biostratigraphical and evolutionary aspects of the Precambrian biota: Evidence from Neoproterozoic basins of India

Different geological sections of Marwar Supergroup exposed in the Jodhpur, Nagaur and Bikaner districts of Rajasthan have been studied for recording the evolutionary aspect in the biosphere and lithosphere of the Neoproterozoic. Several enigmatic forms akin to large algae are recorded from the Jodhpur Group exposed in the mines of the Sursagar area. Photo-documentation and line sketches have been prepared. True affinities of these forms with extant algal/lichen/fungal forms are being examined. Limestone beds with chert nodules and jasper have been noted in the Sonia Sandstone of Jodhpur Group exposed in the Artiyan Kalan locality. Lateral spread of the limestone beds noted in the Jodhpur and Nagaur districts above the Sonia Sandstone can be considered as the marker datum. Felsic volcanics have been noted in between the Sonia Sandstone at the Chhoti Khatu locality. Attempt is being made to obtain geochronological dates of this unit, which will help determine the exact age of the deposition of the Lower unit of the Jodhpur Group. At present Marwar Supergroup is considered Ediacaran-Cambrian succession. Chert and Jasper nodules are also recorded from the Dhanapa Dolomite. Occurrence of stromatolites and nodules mark the intertidal zones of the Bilara Group. Varied carbonate mud-mounds are recorded from the Gotan Limestone. A distinct pink Limestone marker bed has been recorded from the Pondlo Limestone of the Bilara Group. From the Nagaur Sandstone, *Bargaueria*, molluscan trace fossils and other trace fossils have been collected. Detailed lithologs have been prepared. Samples collected from the Dulmera area are prepared for the study. A paper based on biodiversity of Marwar Supergroup is compiled.

Owk Shale of the Kurnool Group has been studied in detail. Microfossils *Obruchevella*, *Leiosphaeridia* and *Jacutianema* are recorded. The study discounts the Mesoproterozoic age and supports the Neoproterozoic age for the Kurnool basin.



Terreneuvian, Cambrian trace fossil *Monomorphichnus multilineatus* on the bedding plane of the Nagaur Sandstone

MS and SKP undertook field work in the Bikaner, Jodhpur and Nagaur districts of Rajasthan for collection of samples from the Marwar Supergroup. BD has been assigned a problem to find out the genesis of chert in the Salkhan Limestone of the Semri Group for her Ph.D. thesis. A field visit has been undertaken to Sonbhadra district to collect samples of the Salkhan Limestone exposed in the Son Valley in eastern sector of the Vindhyan Supergroup.

Mukund Sharma, Yogmaya Shukla, S.K. Pandey & Bandana Dimri

Project- 1.2: Meso-Neoproterozoic palaeobiology of Chambal Valley of Vindhyan Basin, Rajasthan

Collection of Precambrian surface samples has been made from the Hindaun-Karauli road, Karauli district. The samples of heterogeneous lithofacies— shales, siltstones, sandstones and limestones in association of cherts belonging to upper part of Semri Group and Kaimur, Rewa and Bhander groups of Vindhyan Supergroup are collected from the out crops in 14 localities through seven traverses (Bajeda= Bajranga-Dughati; Mothiapur-Rampur-Kotari; Felikapura-Fatehpur; Pachna-Pahari-Diptipura; Kodar Hill; Pachna Police Chauki; Sewa-Kurgaon-Sapotra) for the studies of entombed, epilithic

biological remains and relics of algae- stromatolites. Lithocolumns are also prepared of the collected samples. In addition to this, microbiotic studies have been carried out in petrographic thin sections and from the isolated residue of macerated of heterogeneous lithofacies (carbonaceous shales and cherts) from Saradih Formation of Raipur Group, and Saraipali Formation of Singhora Group, Chhattisgarh Supergroup. Photo-documentation and finalization of collected data have been made.

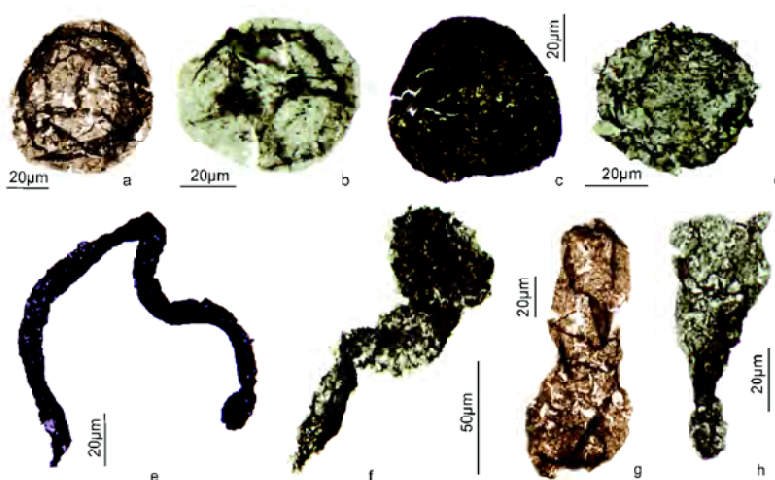
Rupendra Babu

Project- 1.3: Palaeobiological investigations of the Proterozoic Chhattisgarh Supergroup in Khariar Basin and Barapahar Protobasin

Enigmatic microbiotic assemblages from the samples belonging to Chandarpur and Raipur groups exposed in different vicinities of Barapahar Protobasin, Bargarh district (Odisha) have been studied to understand the significance and evolutionary status of varied palaeobiotic communities (micro-macrofossils and organo-sedimentary structures) preserved in variety of sedimentary rocks. Recovered rich and well diversified structurally, three/two dimensional, cellularly preserved assemblage (30 taxa) of *Tappania-Caudosphaera-Jacutianema* bearing organic walled microfossils (OWM) association from the lower and upper heterolithic succession of Chhaporadih Formation belonging to Chandarpur Group, exposed in and around Mundkati and Dechuan sections of Amabhona Tahsil. The assemblage represents well preserved population of both sphaeromorphic and few acanthomorphic acritarchs along with cyanobacterial remains. The recovered acritarchs are usually simples along with few ornamented sphaeromorphs and acanthomorphs (spinated) belonging to Spheromorphitae, Pteromorphitae and Acanthomorphitae subgroups. The cyanobacterial remains represent solitary and colonies of sphaeroidal cells and branched/unbranched trichomes both septate/aseptate with/without mucilaginous sheath resembles with the extant forms belonging to Nematomorphitae and Synapломorphitae subgroup of cyanobacteria. Globally, the *Tappania* bearing microfossils association widely distributed in well dated 1500-1000 Ma old sediments as well as

Caudosphaera, *Cheilofilum* and *Jacutinema* bearing microfossils widely distributed in well dated 1000-700 Ma old sediments. The chert samples of Sarangarh Limestone Formation of Raipur Group, exposed in Dungri Limestone Quarry, have yielded low amount and ill preserved assemblage of both sphaeromorphic and acanthomorphic acritarchs (10 taxa). The *Comasphaeridium*, *Goniosphaeridium*, *Lakhandina*, *Micrhystridium*, *Gorgonisphaeridium* and *Tanarium* are characteristic acritarchs of Cryogenian age in the assemblage belonging to Acanthomorphitae and Polygonomorphitae subgroups.

The preliminary studies of the recorded microbiotic communities from both the fossiliferous units of



OWM from the Chandarpur Group: a) *Leiosphaeridia jacutica*, b) *Leiosphaeridia tenuissima*, c) *Trachysphaeridium levis*, d) *Trachyhystrichosphaera aimica*, e) *Jacutianema solubila*, f) *Caudosphaera expansa*, g) *Tappania tubata*, h) *Flabelleforma* sp.

Chhattisgarh Supergroup in Barapahar Protobasin and their occurrences in well dated sediments across the world shows an evolutionary trend ranges from Calymmian to Cryogenian age in ascending order that were evolved and survived in different complexes of shallow sea. The occurrence of taxonomically resolved eukaryotes (*Tappania*, *Jacutinema* and *Cheilofilum*) from the Chhattisgarh Supergroup also gives a clue of Meso-Neoproterozoic boundary within the Chandarpur Group.

Field work has been carried out in Barapahar Protobasin in and around Amabhona Tahsil of Bargarh district and Khariar Basin in Nuapada district, Odisha, and collected sets of systematic samples from the Pairi, Singhora, Chandarpur and Raipur Groups for the microfossils studies to establish the biostratigraphy. Dolerite and Thoriferous conglomerate are also collected from the Chandarpur Group. Marked and completely measured new sections and prepared lithocolumns of visited areas for the corrections of stratigraphic setup.

V.K. Singh

Thrust Area 2: PHANEROZOIC TERRESTRIAL AND COASTAL ECOSYSTEMS: BIOSTRATIGRAPHICAL, PALAEOENVIRONMENTAL, PALAEO-ECOLOGICAL AND PALAEOBIOGEOGRAPHICAL ASPECTS

Palaeozoic-Mesozoic Megafloristics Group

Project- 2.1: Palaeofloristics and palaeoecology of Palaeozoic rocks of Singrauli and Kuresia coalfields (Son-Mahanadi Basin) and northwest Himalayas (Himachal & Uttarakhand)

Field work in Singrauli Coalfield (MP) has been undertaken and investigations are carried out in Bina, Jayant and Jhingurdah collieries. Collected around 220 megafossil specimens from the carbonaceous, grey and whitish shales exposed in these collieries. The occurrence



Vertebraria axis

of megafossils is very poor in first two collieries, whereas Jhingurdah colliery has comparatively better preserved flora. The genus *Glossopteris* dominates the flora followed by *Vertebraria*, *Noeggerathiopsis* and equisetalean stems. Fine mesh forms of *Glossopteris*, viz. *G. angustifolia*, *G. tenuifolia* and *G. stenoneura* are dominating over broad mesh forms, viz. *G. nimishea* and *G. conspicua*. Surprisingly no other genera belonging to pteridophytes and conifers could be seen in any of these localities. A large number of vertically preserved *Vertebraria* axes have also been collected from the grey to whitish shales in the Jhingurdah colliery. 35 megafossils have been processed for the study.

Around 40 specimens of leafless articulate stems preserved as impressions, compressions and casts recovered from the Rajnagar colliery, Chhattisgarh have been studied. In Indian Gondwana, they are generally documented as equisetaceous/ equisetalean stems / axes belonging to various leaf genera of the group sphenophytes. An attempt has been made to place all such Indian records earlier described as equisetaceous/ equisetalean stems/axes under the genus *Paracalamites*. The present specimens from the Rajnagar colliery have been identified as *Paracalamites australis*, *P. decoratus* and *P. striatus*. Besides, the remaining specimens from Spiti area have been cleaned, photographed and documented as conifer shoots and lycopod stems.

K.J. Singh & Anju Saxena

Project- 2.2: Palaeobotanical investigations from Johilla and Sohagpur coalfields, South Rewa Gondwana Basin: Implications for basinal correlation and evolutionary, biostratigraphical and palaeoecological aspects

The samples collected along the right bank of Johilla River near its confluence with Ganjra Nala, Umaria district (MP) have been photo-documented and tentatively identified. The assemblage comprises the taxa *Gangamopteris cyclopteroides*, *G. major*, *Glossopteris gigas*, *G. indica*, *G. mohudaensis*, *Noeggerathiopsis hislopai*, *Alatocarpus indicus*, *Samaropsis goraiensis* and equisetaceous stem.

Plant megafossils and rock samples have been collected from the different open cast project (OCP) and underground (u/g) mines of the Sohagpur and Johilla coalfields of Madhya Pradesh. From Sohagpur, a rich assemblage of Barakar plant fossils comprising different species of the genera *Glossopteris*, *Gangamopteris*, *Noeggerathiopsis*, *Buriadia*, *Ginkgo*, a variety of seeds, equisetalean and simple axes is collected from Burhar VI top seam of Dhanpuri OCP, Dhanpuri u/g Mine, Amlai OCP, IV and VI seams of Sharda OCP mine. Additionally, equisetalean axes are found in the fossiliferous shales of seam VII of Bangwar mine. Field work is also undertaken in West Nowrozabad u/g, Kanchan OCP of Nowrozabad subarea; Vindya and Pinora u/g mines of Pinora subarea, Birsinghpur and Pali u/g mines of Birsinghpur subarea; Umaria and Piparia u/g mines of Umaria subarea of the Johilla Coalfield. The

impressions and compressions of plant fossils are collected from the L1B seam of West Nowrozabad u/g mine, L1B seam of Pinora mine, Johilla top seam of Birsinghpur incline ¾ and IVB seam of Piparia u/g mine. Plant fossil assemblages of these mines belong to species of *Gangamopteris*, *Glossopteris*, *Noeggerathiopsis*, *Buriadia*, equisetalean axes and a variety of seeds. Carbonaceous shale samples are also collected from the mines of the coalfields and outcrop section of the Barakar coal seam exposed in Ganjra Nala, for the recovery of megaspores and seeds.

The plant fossils reported by Feistmantel (1879, 1880, 1881, 1882) and Zeiller (1902) from the different Lower Gondwana formations of Peninsular India has been studied at GSI Museum, Kolkata. In all, 120 specimens belonging to different species of *Glossopteris*, *Gangamopteris*, *Palaeovittaria*, *Euryphyllum*, *Noeggerathiopsis*, *Taeniopteris*, *Macrotaeniopteris*, *Psymophyllum*, *Rhipidopsis*, *Sagenopteris*, *Sphenophyllum*, *Trizygia*, *Sphenopteris*, *Pecopteris*, *Ottokaria*, *Dictypteridium*, *Voltzia*, *Buriadica*, *Cordaites*, *Botrychiopsis*, *Phyllothea*, *Schizoneura*, *Vertebraria* and *Albertia* are critically examined and photographed.

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

Project- 2.3: Mega- and microfloristics of the Permo-Carboniferous sediments of Kashmir Region: Evolutionary, biostratigraphical, palaeoecological and palaeophytogeographical implications

Well preserved lycopsid axes collected from the Gund and Tethar villages (Carboniferous), Kashmir have been tentatively identified and photodocumented. The axes belong to the lycopsid genera *Achaeosigillaria*, *Lepidodendron*, *Lepidosigillaria*, *Sigillaria* and *Spondylodendron*. Systematic description and comparison of these lycopsids are in progress. Plant megafossils collected from the dark grey sandy shale of the Nishatbagh Formation (Early Permian) have also been tentatively identified and photodocumented. The assemblage comprises the genera *Gangamopteris*, *Glossopteris*, *Psymophyllum*, *Cordaites*, equisetalean axes and seeds. Systematic description and comparison is in progress. Several distorted, cracked, twisted, perforated wood pieces and broken/cracked pollen grains/

spores have been recovered from the shale samples of Nishatbagh Formation indicating palaeofire evidences.

Palynological analysis of 9 samples collected from the C and D members of the Zewan Formation (Late Permian) and E₁, E₂ and E₃ units (Member E) of Khunamuh Formation has been carried out. Palynoflora of the Zewan Formation is represented by *Alisporites* sp., *Crescentipollenites fuscus*, *Faunipollenites* sp., *Lunatisporites diffuses* and *Verrucosisporites* sp. Two palynoassemblage zones, namely *Densipollenites magnicarpus* and *Klausipollenites decipiens* indicating Late Permian and Early Triassic affinities, respectively, are identified from the Unit E₁ (Member E) of the Khunamuh Formation. Palynoflora recorded from the E₂ Unit of Khunamuh Formation includes the palynotaxa

Cingulitriteles sp., *Densipollenites magnicarpus*, *Scheuringipollenites barakarensis* and *Taeniaesporites* sp.

Rajni Tewari, Ram Awatar, S.S.K. Pillai & Deepa Agnihotri

Field work has been undertaken in different sections of the Carboniferous and Permian localities exposed in Srinagar and adjoining areas for the collection of plant fossils and palynological samples. Rock samples are collected from the Carboniferous *Fenestella* shale sections exposed near Takia Village and Shaitan Nala for the recovery of spores-pollen and megaspores. Other Late Carboniferous sections showing the alternation of carbonaceous shale and sandstone with diamictite base exposed near the Gund and Tethar villages on Jammu-Srinagar highway are also visited and well preserved plant mega remains like lycopsid axes, *Cordaites* and equisetalean axes and samples for palynological, geochemical studies and radiometric dating are collected from the area. *Cordaites* like leaves are also recorded from the section exposed at Duligam, in Banihal.

Well preserved leaves of *Glossopteris*, *Psymophyllum*, *Cordaites*, equisetalean axes and seeds are collected from the carbonaceous shales of Nishatbagh Formation exposed 1 km east of Nishatbagh Garden, Srinagar. Samples for palynological studies, geochemical analysis and radiometric dating are additionally collected from this section. Rock samples from different Permo-Triassic boundary intervals namely, Zewan (Late Permian) and Khunamuh (Early Triassic) formations of

Guryul Ravine Section near the Khunamuh village are collected for palynological and geochemical studies (with S.K. Pandita, G.D. Bhat & Kamlesh Kumar).

Geochemical analysis (including major, trace and rare earth elements) of the samples collected from Gund, Nishatbagh, Mamal, Zewan and Khunamuh formations including mixed zone (P/T boundary) has been carried out (at WIHG, Dehradun) for the interpretation of palaeoenvironment and palaeoclimatic changes during the catastrophic event. Study is in progress.

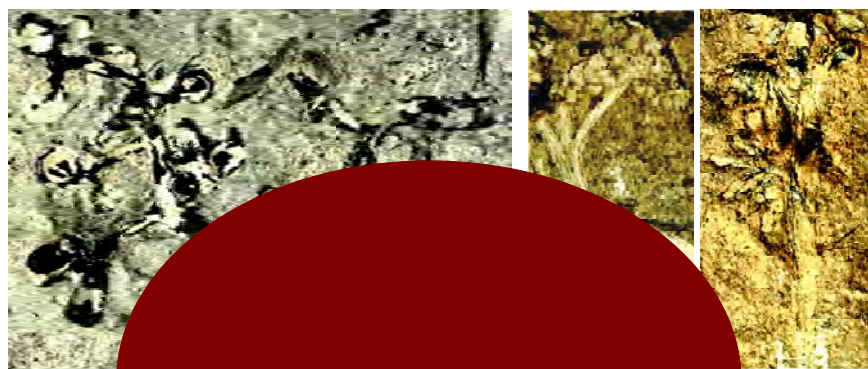
The morphological features of the plant fossils reported by Seward (1905, 1907) i.e. *Gangamopteris kashmirensis* (11 specimens), *Psymophyllum* sp., *Psymophyllum hollandii* (3 specimens), *Cordaites* sp. (2 specimens) and the specimens described by Pal (1978) from the Carboniferous sediments of Kashmir region of Himalaya i.e. *Archaeosigillaria* sp., *Lepidosigillaria quadrata*, *Lepidodendropsis fenestrata* (2 specimens), *Lepidodendropsis sigillarioides*, *Lepidodendropsis pranabii*, *Lepidodendron gundensis*, *Cyclostigma ungeri* (2 specimens), *Cyclostigma indica* (2 specimens), *Rhacopteris* cf. *R. circularis*, *Rhodea tenuis* (2 specimens) and *Archaeocalamites radiates* are studied and photographed in detail at GSI Museum, Kolkata. The study and photographs of the specimens will be helpful in comparison and revision of the fossil flora of Permo-Carboniferous sediments of Kashmir region, Himalaya.

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

Project- 2.4: Gondwana floristics of India (Wardha-Godavari Basin) and Antarctica: Evolutionary, biostratigraphical, palaeoecological and palaeophytogeographical significance

A heterogeneous and well-preserved assemblage of Triassic plants, including pteridophytes and gymnosperms, is described from the Lashly Formation of the Allan Hills. The pteridophytes include the sphenopsids *Calamites aliwalensis*, unidentified calamitalean axes, *Neocalamites carreri* and *Neocalamites* sp. The gymnosperms include Corystospermales, Peltaspermales and Pinales. Corystosperms dominate the megafossil assemblage and include *Dicroidium odontopteroides*, *D. crassinervis*, *D. fremouwensis*, *D. coriaceum* subsp. *dutoitii*, together with a microsporangiate structure *Pteruchus* sp. Peltaspermales include microsporangiate and ovuliferous reproductive structures namely *Townrovia polaris* and *Matatiella dejerseyi*, respectively. Conifers are represented by *Heidiphyllum elongatum* foliage and an unidentified cone. The megafossil assemblage is similar

to those recorded from the late Early Triassic of New South Wales and Antarctica, Middle Triassic of Argentina, New Zealand, southeast Queensland and Middle to Late Triassic of South Africa, India, northern Argentina and Australia, early to middle Late Triassic of the central Transantarctic Mountains, Antarctica and Late Triassic of Chile and North Victoria Land, East Antarctica. The records of *Calamites aliwalensis*, *Neocalamites carreri*, *Dicroidium fremouwensis*, *Pteruchus* sp., *Townrovia polaris*, *Matatiella dejerseyi* and a conifer cone are the first of these taxa from the Allan Hills. Recent finds from the Permian beds of India and Jordan indicate a much earlier origin of *Dicroidium* than previously suspected. Persistence of greenhouse conditions from the end of the Permian through the Triassic allowed the rich and diverse *Dicroidium* forests to develop in the polar regions of



Matat

Antarctica (Joshi & Agnihotri).

Petrographic evidence of a recent fire from the Lashly Formation of the Allan Hills has been recorded. Petrological studies of lenticular tuff within carbonaceous shale indicate their volcanoclastic origin, with obsidian (natural glass) and woody phytoclasts along with black matrix. The abundance of glassy matrix indicates sudden cooling of lava, which was a proximate source of volcanism (jointly with Kamlesh Kumar, Sankar Chatterjee, N.C. Mehrotra & G.K. Singh).

Palynological studies have been carried out from the Weller and Lashly formations of Allan Hills, Antarctica. Two palynoassemblages have been recovered. Palynoassemblage 1 from the Weller Formation includes the palynotaxa *Crescentipollenites* sp., *Striatopodocarpites* sp., *Plicatipollenites indicus*, *Paravitatina lucifer*, *Faunipollenites limpidus*, *F. diagonalis*, *F. microcorpus*, *Cydripites prisus*, *Faunipollenites varius*, *Gnetaeapollenites sinuosus*, *Inaperturopollenites nebulosus*, *Marsupipollenites tridaitus*, *Pretricolpipollenites bharadwaji*, *Pyramidosporites racemosus* indicating Late Permian

age equivalent to the Raniganj Formation of Damodar Basin, India. Besides, appearance of younger elements namely *Arcuatipollenites* sp., *Lundbladispore* sp., *Densoisporites* sp., etc. is also noticed. Palynoassemblage- II from the Lashly Formation includes the palynotaxa *Crescentipollenites* sp., *Striatopodocarpites* sp., *Plicatipollenites indicus*, *Lahirites triassicus*, *Rhizomospore radiata*, *R. biharia*, *Decisporis panchetensis*, *D. variabilis*, *Verrucosipollenites*, *Divaripunctites bifurcatus*, *Klausipollenites* sp., *Faunipollenites gopadensis*, *Gondwanipollenites bengalensis*, *G. multistriatus*, *Guttatisporites guttatus*, *Praecolpites nidpuriensis*, *Weylandites bilateralis*, *W. indicus*, *W. minatus*, *Arcuatipollenites pellucidus*, *A. ovatus*, *Krempipollenites indicus*, *Lundbladispore densispinosa*, *L. baculata*, *L. willmotii*, *Densoisporites* sp., *Osmundaidites panchetensis*, *Novitasporites triassicus*, *Strotosporites* sp., *Kamthisaccites* sp., *Govinispora* sp., *Hamiapollenites* sp. and *Cydripites* sp. indicating an Early Triassic age comparable to the Panchet Formation of Damodar Basin. Work is in progress (jointly with K.L. Meena and S.S.K. Pillai).

Rajni Tewari

Photo-documentations and systematic description of plant fossils collected from Prakashamkahn-4 open cast mine of Manuguru area, Godavari Graben, Andhra Pradesh have been carried out. Plant fossil assemblage is represented by *Glossopteris arberii*, *Glossopteris communis*, *Glossopteris damudica*, *Glossopteris indica*, *Glossopteris longicaulis*, *Glossopteris taenioides*, *Glossopteris tenuinervis*, *Phyllothea* sp. and *Cordaite* sp.

Rajni Tewari & Arun Joshi

Project- 2.5: Palaeobiology of Mesozoic Gondwana of Pranhita-Krishna-Godavari basins

Palaeophytobiology of Vemavaram Formation, K-G Basin has been studied. Phytocoenosis of Early Cretaceous sequence is distinguished by Pteridosperms- *Thinnfeldia ommevaramense*; Bennettitales- *Dictyozamites falcatus*, *Dictyozamites feistmantelii*, *Dictyozamites vemavaramensis*, *Ptilophyllum acutifolium*, *Ptilophyllum cutchense* and *Pterophyllum footeanum*; Coniferales- *Brachyphyllum rhomboicum*, *Pagiophyllum feistmantelii* and *Elatocladus vemavaramensis*. Synthesis of state of the art on the Vemavaram Flora is prepared. New species of

Thinnfeldia ommevaramense n.sp., *Dictyozamites vemavaramense* n. sp. have been systematically described and compared. Overall evidences of Vemavaram Formation indicate prevalence of marginal marine conditions.

Comparative study of Raghavapuram Flora helped to bring out floral differences and distribution of various taxa in the east coast during the Early Cretaceous times. Comparative Early Cretaceous floristics of India indicates a cosmopolitan geographic connotation and regional variations. Besides, undertaken field work in Pranhita-

Godavari Basin and surveyed different Mesozoic exposures distributed in the states of Maharashtra and Andhra Pradesh. Collected a number of ancient plant relics preserved in the form of impressions, compressions and petrifications. Sediment samples are also collected

for chemical analysis for subsequent recovery of microfossils. Similarly various outcrop sections in the K-G Basin distributed in the state of Andhra Pradesh have also been surveyed and a number of fossil remains and sediment samples are collected.

A. Rajanikanth & Chinnappa Chopparapu

Project- 2.6: Mesozoic palaeofloral diversity, biostratigraphy and palaeoclimatic studies in Saurashtra and Kachchh basins

The morphotaxonomic study of plant fossils collected from Dhareasi area of Kachchh Basin, Gujarat has been undertaken to document palaeofloral assemblages. The pinkish-grey shale embodies plant fossils comprising number of species of *Cladophlebis*, *Hausmannia*, *Matonidium*, *Ptilophyllum*, *Ctenozamites*, *Pterophyllum*, *Elatocladus*, *Brachyphyllum*, *Pagiophyllum*, *Araucarites* and *Podozamites*. The fossil flora possesses mixed type of assemblage which is dominated by Cycadales and Conifers. The assemblage shows close affiliation with the flora reported from Jabalpur Formation, but some of the forms like *Matonidium*, *Isoetes*, *Ctenozamites*, etc. are not been reported from Jabalpur Formation. Flora also resembles with floral assemblage of Rajmahal Formation where Bennettitales are commonly met and

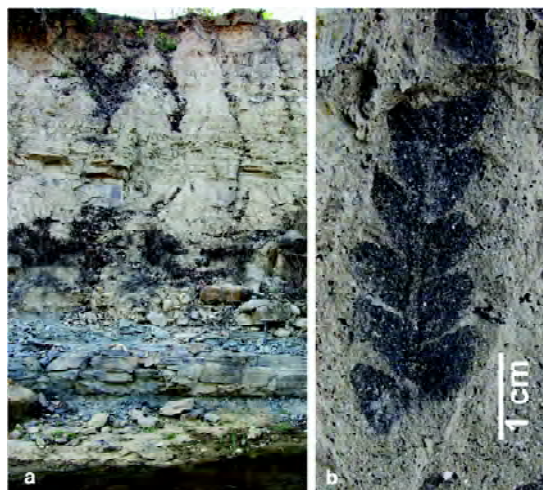
dominant, but does not resemble with the Nipania flora of Rajmahal Hills, which is dominated by conifers with rare occurrence of Bennettitales.

Field work is undertaken to collect plant fossils preserved in shale, clay and sandy coarse sandstones in the sections exposed at Trambau, Mithi River, Rudramata Dam Site situated along Bhuj-Nagor Road, Khari River section at north-west of Bhuj, Bhajodi and Dauda Mota on the way to Bhuj-Lakhpat road in Kachchh district. Plant fossils have also been collected from various lithotypes, e.g. mudstones, grayish-black shales and siliceous shale exposed in pit sections in mining area around Than, Raourani, Kara and Tarnetar in Surendranagar district, Gujarat.

Neeru Prakash

Project- 2.7: Floral diversity, biostratigraphy and palaeoecology of the Triassic sequence from South Rewa (Ramkola-Tatapani Coalfield) and Satpura Gondwana basins

Morpho-taxonomic study of species of *Dicroidium* from the early Triassic of Nidpur locality (South Rewa Basin) has been done based on the specimens available in the repository of Institute's Museum. The megafossil specimens preserved as compressions have been photographed and rest of the samples have been macerated for the study of megaspores and cuticles. Further study is in progress. Restudy and reassessment of megafossil assemblage from the Parsora Formation is being done. Revision of the miospore assemblage zones of the Triassic sequence is being carried out with special reference to the late Triassic of Tiki Formation. Well preserved megaspore taxa of Permo-Triassic sequence have been recovered from the outcrop near Prem Nagar of Ramkola-Tatapani Coalfield, Balrampur district of Chhattisgarh. The megaspores have been isolated, studied in dry state and photomicrography has been done. Further studies in wet condition and SEM observations are in progress. Study on the phenomenon of dwarfism observed in the species of *Glossopteris* known from the different late Permian and early Triassic formations of Peninsular India has been carried out to unravel the changes in



a) Permian -Triassic sequence exposed near Premnagar, Ramkola-Tatapani Coalfield; b) *Dicroidium* sp.

morphological traits of seven species of *Glossopteris* whose existence continued surpassing the Permian-Triassic mass extinction event.

A.K. Ghosh, Ratan Kar & Reshmi Chatterjee

Palaeozoic-Mesozoic Miofloristics Group

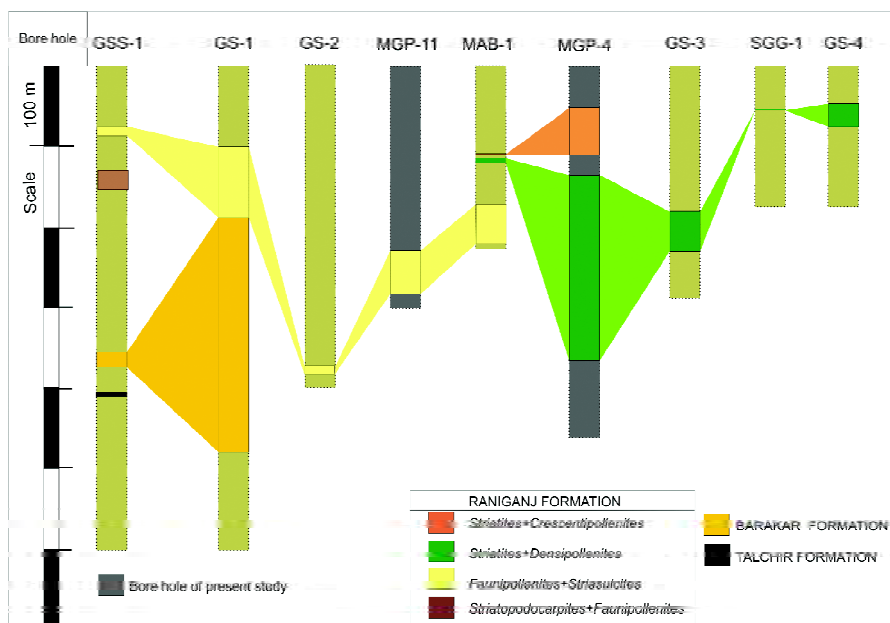
Project- 3.1: Palynology of Gondwana sediments of Satpura–Wardha-Godavari basins: Biostratigraphical, palaeoenvironmental and palaeophytogeographical implications

Palynological studies have been carried out in succession comprising 55 sub-surface samples from bore-hole 1007 of Manuguru area (Godavari Graben), represented by clay, shale, sandstones and coal. The palynofloras in this sequence have a homogenous composition which demonstrates that not much significant changes took place through the considered stratigraphic range. The entire sequence is dominated by non-striate disaccate genus *Scheuringipollenites* and sub-dominated by *Faunipollenites* (= *Protohaploxypinus*). The other frequent pollen genera among the non-striate disaccates are *Rhizomspora*, *Primuspollenites*, *Ibisporites* and *Platysaccus*. Among the striate disaccates, the most frequent are *Striatites*, *Striatopodocarpites* and *Stroterosporites*. The common monosaccate genera include *Caheniasaccites*, *Potoniesporites*, and *Barakarites*. Spores are less common and include *Latosporites*, *Brevitriletes*, *Horriditriletes*, *Microbaculispora*, *Callumispota*, etc. They characterize the palynofloral composition of the Lower Barakar Formation. The correlation of this assemblage with palynofloras of other Gondwana continents point out their Early Permian (Sakmarian to Artinskian) age. Palynomorphs assigned to Chlorophyta, Prasinophyta and acritarchs are also recorded indicating brackish to fresh water environments. The results from palynological analyses suggest that these sediments were deposited during post glacial near shore cool and humid environment.

Neerja Jha & K. Pauline Sabina

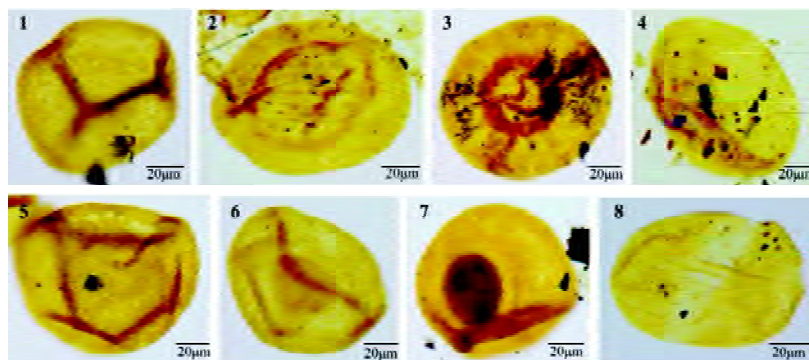
Palynological studies for dating, correlation and DOM studies for depositional setting of the sediments from Gauridevipet area of Chintalapudi sub-basin (Godavari Basin) have been carried out on two bore-holes— MGP-11 and MGP-4. One palynoassemblage, i.e. *Faunipollenites* (= *Protohaploxypinus*) and *Striasulcites* assemblage has been identified in bore-hole

MGP-11, and two palynoassemblages in MGP-4, one is characterized by the dominance of Striate disaccates and *Densipollenites*, and the other, *Striatopodocarpites* and *Crescentipollenites* palynoassemblages. The other stratigraphically significant taxa present in the assemblages include *Guttulapollenites hannonicus*, *Lunatisporites noviaulensis*, *L. pellucidus*, *Densoisporites contactus*, *Chordasporites australiensis*, *Goubinispota* spp., *Lundbladispota microconata*, *L. raniganjensis* and *Klausipollenites schaubergeri* suggest a Late Permian (Lopingian) age to these sediments. The palynoassemblages have been compared with that of other Gondwana continents. On



Correlation of various bore-holes from Chintalapudi sub-basin vis-a-vis present study

the basis of palaeobotanical affinity of the identified microflora, it has been inferred that the peat forming plant community composed mainly of conifers, glossopterids, and cordaites. Spores are subordinate and are derived from lycopsids (*Lundbladispota*, *Densoisporites*), sphenopsids (*Latosporites*) and filicopsids (*Horriditriletes*, *Lophotriletes*, *Verrucosisporites*, *Osmundacidites*, *Leiotriletes*, *Callumispota*, *Brevitriletes* and *Microbaculispora*) occurring in variable proportions. On the basis of palynofacies analysis, anaerobic, reducing, water logged peat-forming conditions have been inferred. The charcoal fragments recovered



1) *Densoisporites contactus*, 2) *Striomonosaccites circularis*,
3) *S. ovatus*, 4) *Densipollenites invisus*, 5) *D. invisus*, 6) *D. indicus*,
7) *D. densus*, 8) *Chordasporites australiensis*

reflects a possible wildfire in the accumulated swamps or a wildfire in the hinterland after which the sediments were flushed by fluvial systems into the swamps.

Neerja Jha, K. Pauline Sabina & Neha Aggarwal

Fifty rock samples from bore-hole MJR-11 have been macerated for palynological and palaeoenvironmental studies. Scanned and photographed spore and pollen recovered in 30 samples. Morphographic studies as well as identification of palynomorphs is in progress. Few palynomorphs identified are *Callialasporites trilobatus*, *C. dampeiri*, *C. sementatus*, *C. monoalasporeus*, *C. microvelatus*, *C. limbatus*, *C. turbatus*, *Osmundacidites wellmanii*,

Laevigatosporites major, *Gleicheniidites* sp., *Podocarpidites rousei*, *Staplinisporites* sp., *Polycingulatisporites triangularis*, *Lycopodiumsporites* sp., *Trilobosporites* sp., *Lametatriletes indicus*, *Foveosporites* sp., *Striatopodocarpites* sp., *Chordasporites* sp., *Matonisporites* sp., *Contignisporites* sp., *Cicatricosisporites* sp., *Camarozonosporites ohaiensis*, *Chomotriletes minor*, *Dictyophyllidites harrisii*, *Exesipollenites* sp., etc.

Neerja Jha & Harinam Joshi

Chemical processing and preparation of slides of 20 samples from bore-hole MCP-8, 5 samples of bore-hole MCP-9, and 50 samples of bore-hole MSP-21 have been carried out for the study of palynomorphs and dead organic matter.

Neerja Jha & Shreya Mishra

Collection of samples for palynological studies has been made from the Godavari Valley coalfields. Visited Exploration Division of Singareni Collieries Company Ltd., Kothagudem, Ramagundam, Bellampalli, and MECL Bellampalli office for scientific discussion and planning for visit in nearby areas. Surface and sub-surface samples are collected from Rampur shaft block of Khammam district, Koyagudem, Nimugudem, and Renganghat areas.

Neerja Jha, Harinam Joshi & Shreya Mishra

Project- 3.2: Palynostratigraphy, palaeoclimate and evolutionary trends of palynofloras in Gondwana sequences of Son-Mahanadi–Damodar basins

Palynological analyses of 36.30-643.84 m thick strata of bore core MBKW-3, Mand-Raigarh Coalfield have been carried out. On the basis of dominance and sub-dominance of spore/pollen taxa, two palynoassemblages have been identified—*Scheuringipollenites barakarensis* assemblage zone (45.90-643.84 m) and *Faunipollenites varius* assemblage zone (36.35-41.95m). These assemblages are correlated with the Lower and Upper Barakar (Early Permian) palynofloral assemblages of Indian Gondwana. The occurrence of radial monosaccate pollen genera in the Barakar Formation indicates cold climate during the deposition of these sediments. Additionally, collection of outcrop samples from Sohagpur and Johilla coalfields (MP) has been made. Mega plant fossils have also been collected from Sohagpur Coalfield.

RamAwatar

Two palynoassemblages have been identified in sub-surface sediments of bore-hole IBSK-1 drilled in Kuraloi Block–A of Belpahar area in Ib-River Coalfield. Palynoassemblage-I shows the dominance of striate disaccates, viz. *Faunipollenites* (25-30%), *Striatopodocarpites* (20-22%) and sub-dominance of non-striate disaccate, chiefly *Scheuringipollenites* (16-18%). It shows affinity with late Early Permian (Upper Barakar Formation). Palynoassemblage-II also shows dominance of striate disaccates, viz. *Striatopodocarpites* (22-25%), *Faunipollenites* (10-18%) and sub-dominance of *Scheuringipollenites* (5-8%), but the presence of *Lundbladispora* (1-2%), *Densoisporites* (1-2%) and *Arcuatipollenites* (2-4%) indicates affinity with Late Permian (Raniganj Formation) age. Raniganj palynoflora has been identified in lithologically designated Barren Measures Formation.

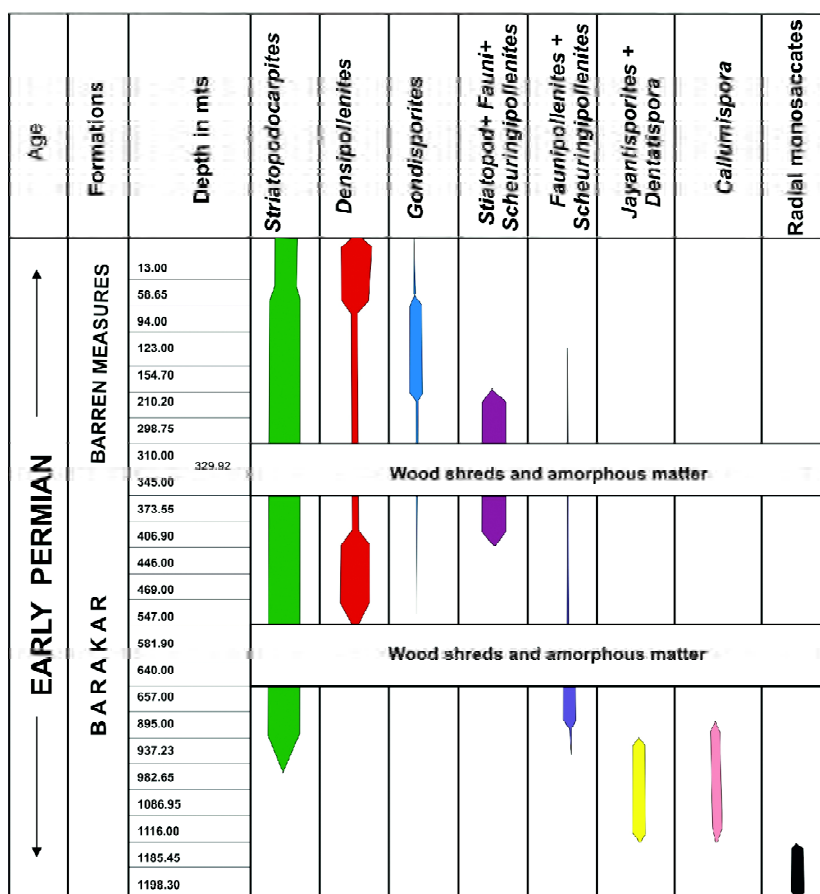
Studied palynofloral and stratigraphical aspects of Barakar Formation exposed along the Chaturdhara Nala near Gopalpur village, Baki Bihar area, Sundargarh district, Odisha. Two palynoassemblages are recovered, among which the first one is recorded with dominance of *Striatopodocarpites* and *Faunipollenites* along with *Arcuatipollenites*, *Verticopollenites*, *Rhizomaspota*, *Crescentipollenites*, *Diastriatites*, *Striamonosaccites*, *Distriamonosaccites*, *Densipollenites*, *Scheuringipollenites*, *Ibisporites*, *Striapollenites*, *Cyclogranisporites*, *Ephedripites*, etc. and revealed Raniganj palynoassemblage (Late Permian flora). The dominance of striated disaccate and sub-dominance of non striated palynofloral assemblage along with scanty distribution of trilete spores, also emphasize Late Permian evidence. The second palynoassemblage is proved to be Upper Barakar palynoflora. It has the dominance of *Faunipollenites-Striatopodocarpites*, followed by *Rhizomaspota*, *Scheuringipollenites*, *Cyclogranisporites*, *Cyclobacullisporites*, *Densipollenites*, *Striatites* and *Alisporites* along with the dominance of striated disaccate taxa followed by non-striated disaccate spores, and showed palynoassemblages which has been assigned Upper Barakar and Raniganj age which is recorded for the first time from this locality (jointly with SSK Pillai). Besides, collection of surface and subsurface samples has been made from the Ib-River Coalfield for further palynological studies.

K.L.Meena

Palynological study has been undertaken on the Gondwana coal and associated lithologies encountered in borehole EBM-2 of East Bokaro Coalfield, Damodar Basin. The investigation resulted in the recognition of Assemblage-III (*Densipollenites*, between depth 27.90-214.30 m), Assemblage-II (*Striatopodocarpites* + *Faunipollenites*, depth 225.00-297.60 m), and Assemblage-I (*Faunipollenites* + *Scheuringipollenites*, 307.00-433.00 m), which are utilized to demarcate the formations. Lithofacies study is also done for better understanding of the preservation and abundancy/ paucity of the spores-pollen in different lithologies, as the present bore-hole has significant thickness of mudstones, shales and siltstone. The palynological data has

revealed the presence of younger Raniganj sediments in the lithologically defined Barren Measure Formation, thus the rock units have been re-assigned their respective formations based on palyno-assemblages. Palynofacies and petrographical studies (jointly with S. Mahesh) of coal samples encountered in the bore-hole are also employed to determine the depositional environment of the coal precursor peat swamp. Coal maceral analysis as well as the Thermal Alteration index (TAI) has revealed that the coaly shale at 336.5 m depth has hydrocarbon generation potential. Based on the data, a manuscript on palynopetrographical facet and depositional account of Gondwana sediments from the coalfield is finalized. Additionally, visited the coalfield and collected rock samples for further palynological study.

Permian spores from the Gondwana Succession in India have been finalized (jointly with Vijaya). Palynological studies through the glacial sediments of earliest Permian (Talchir Formation) into the coal horizon of Upper Permian (Raniganj Formation) represent a high degree of morphographical variations among spores and pollen grains. These adequately identified taxa exhibit many kinds of exinal features that include simple, cingulate



Relative abundance of spore-pollen taxa in the strata of East Bokaro Coalfield

and zonate forms among spores. The microstructures of exine among these spores have great potential that determine the primitive and advanced states in morphological lineages through time and this variability of exine structures are effectively used in biostratigraphy. These spores are placed in accordance with classification proposed by Potonié, 1956. The geological age is dealt in the standard time scale. First Appearance Datum (FADs) of some distinct species is commented, which are significant in the Assemblage Zones of key pollen taxa described by Tiwari and Tripathi (1992).

Shale samples (19) from bore-hole RT-4 of Tamra block from Raniganj Coalfield have been undertaken to palynological and coal petrographical analyses (jointly with S. Mahesh & K. Pauline Sabina). On the basis of botanical affinity between the miospores and the parent plants as well as the different plant groups, each coal plant assemblage is determined. The dominance of bisaccates

such as *Scheuringipollenites*, *Faunipollenites* (= *Protohaploxypinus*), *Striatopodocarpites* and presence of monosaccates such as *Densipollenites*, *Parasaccites* reflect a peat forming community composed mainly of glossopterids, cordaites and conifers. Subordinate trilete spores derived from filicopsids (*Cyclogranisporites*, *Horriditriletes*, *Brevitriletes*, *Callumispora*, *Microbaculispora*, *Microfoveolatispora*, *Cyclobaculisporites*), lycopsids (*Indotriradites*, *Gondisporites* and *Didecitriletes*) and sphenopsids (*Laevigatosporites*) are less abundant occurring in variable proportions reflecting a hypautochthonous taphocenose. Presence of *Botryococcus* algae has been recorded. Palynofacies and petrographic analyses also suggest deposition in open mires in a Limnic to limno-telmatic conditions with intermittent flooding of the site.

Srikanta Murthy

Project- 3.3: Sedimentary organic matter, palynofloral characteristics and depositional environments of the Early Cretaceous sediments of Kachchh and Saurashtra basins

Organic matter (OM) obtained from the sedimentary sequences intruded by sills and dykes at Jadura in Kachchh district, Gujarat has been attempted to study relationship between igneous activity and OM maturation. The OM recovered through normal chemical processing techniques has been analyzed to estimate frequencies of altered and non altered phytoclasts in various samples collected from shale bearing strata intruded by intrusives. It is observed that the sample adjacent to the sill and dykes shows thermal alteration in OM than those situated away from the intruding rocks. In contrast to darkening of OM, colour changes in shale from black or dark colour to gray to light brown is the most visible effect noticed, because of baking of such lithotypes due to effect of igneous activities over it. The phenomena also caused folding and faulting of adjacent Mesozoic strata in the area.

Coal and shale samples collected from a pit section of Than Formation (Early Cretaceous) exposed along the

Surendranagar-Thangad road in District Surendranagar (Gujarat) showing large number of charcoalfied woody vascular tissues, e.g. uniseriate, biseriate and multiseriate tracheids with bordered pits of the gymnospermous origin. The darkening of colour from dark brown to black and angularity in shape of these vascular tissues indicate effect of fire over the existing vegetation which generated large amount of charcoal. These charcoalfied plant pieces also exhibit high to low morphological distortion in their tissue or cells under light microscopes. The morphological distortion may caused by loss in their weight due to volatilization of protoplasmic fluids resulting shrinkage, perforations, cracking, fracturing, curling, deformities and amalgamation in the cellular structures are clearly visible in recovered phytoclasts. Alterations in morphology of various plant tissues and change in their colour is solely led by the effect of moderate to high thermal radiation during forest fire prior to their deposition in the sediments.

Madhav Kumar

Terminal Cretaceous-Neogene Megafloristics Group

Project- 4.1: Tertiary plant mega remains of northeast India: Floristic and climatic changes

A number of plant remains collected from the Dafla, Subansiri and Kimin Formations of Arunachal Pradesh have been cleared and photographed. Herbaria of the

FRI (Dehradun) and BSI (Kolkata) are consulted for the identification of fossil plants collected from the Late Oligocene sediments of Makum Coalfield, Assam. Four



Upright trees in the mudstone unit overlying coal in Makum Coalfield

new fossil leaves resembling *Firmiana* and *Pterygota* of the Malvaceae *s.l.* and *Paranephelium* and *Sapindus* of the Sapindaceae are identified and documented. Another manuscript dealing with a fossil leaf resembling *Poeciloneuron indicum* Bedd. is described from the Late Oligocene (Chattian 28.4-23 Myr) sediments of Assam. The modern analogue is endemic to the Western Ghats which is situated in the same palaeolatitude. Its presence, along with known fossil records indicates that the seasonality in temperature was less pronounced and CMMT (cold month mean temperature) was not less than 18°C with plenty of rainfall, in the region during the period of deposition.

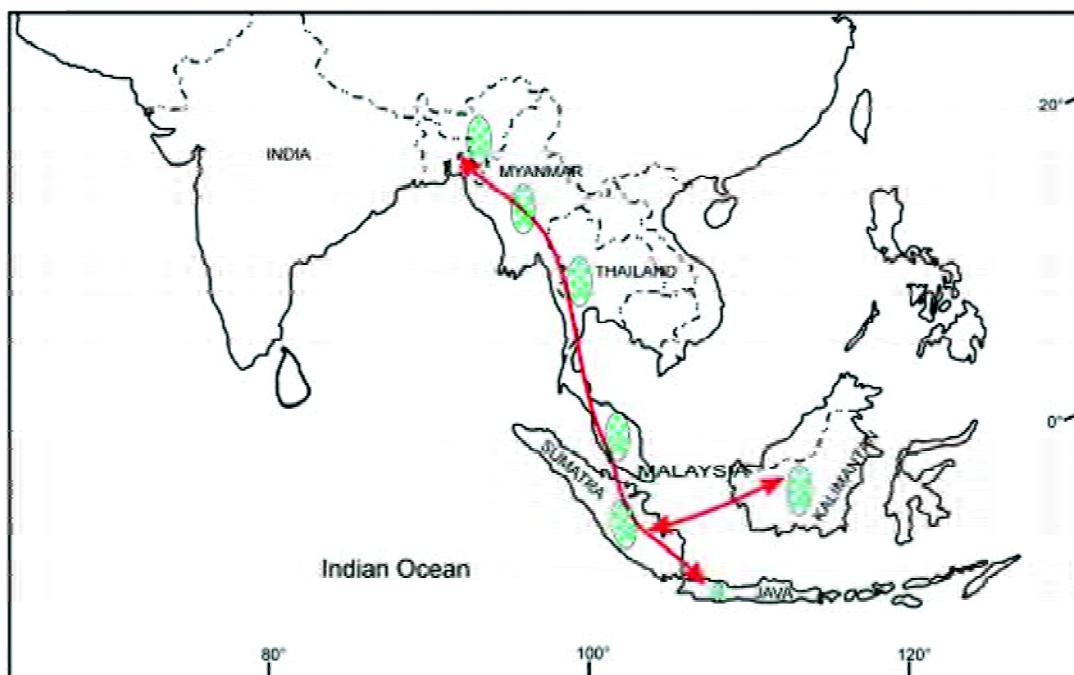
A new fossil leaf impression of *Alphonsea* Hk. f. & T. of the family Annonaceae is also described from the Late Oligocene sediments of Makum Coalfield. This is the first authentic record of the fossil of *Alphonsea* from the Tertiary rocks of South Asia. The study

suggests that the Indian plate was not only a biotic ferry during its northward voyage from Gondwana to Asia but also a place for the origin of several plant taxa.

The modern counterparts of the identified 11 fossil woods taxa collected from the Tipam Group of Mizoram are: *Gluta* L., *Mangifera* L. (Anacardiaceae), *Bursera* Jacq. ex L. (Burseraceae), *Terminalia* L. (Combretaceae), *Shorea* Roxb. (Dipterocarpaceae), *Cynometra* Linn., *Dalbergia* L. f., *Millettia* Wight et Arn.–*Pongamia* Vent, *Ormosia* Jacks. (Fabaceae), *Artocarpus* Forst. (Moraceae), and *Madhuca* Gmelin. (Sapotaceae). The genus *Dalbergia* is described for the first time from India. The distribution pattern of the above

taxa indicates the existence of a tropical warm and humid climate in Mizoram during the depositional period. The reconstructed climate data using CoA (coexistence approach) indicates an MAT (mean annual temperature) of 26.1-27.7 °C, a WMT (mean temperature of the warmest month) of 25.4-28.1 °C, a CMT (mean temperature of the coldest month) of 25.6-26 °C, and an MAP (mean annual precipitation) of 3180.5-3263.6 mm.

R.C. Mehrotra & Gaurav Srivastava



Route of plant migration between India and southeast Asia based on fossil records

Project- 4.2: Plant mega remains from the Tertiary successions of western India and their bearing on palaeofloristic and palaeoclimatic interpretations

A large number of leaf and fruit impressions from the Early Eocene sediments of Bikaner district, Rajasthan have been collected. These specimens are first cleared and then photographed. Many of them have been identified with the help of herbarium sheets at the FRI, Dehradun. They belong to families– Annonaceae, Euphorbiaceae,

Fabaceae, Malvaceae, Myrtaceae, Zinziberaceae, etc. A manuscript based on a malvaceous leaf is documented. Besides, a manuscript dealing with the fossil woods of the family Dipterocarpaceae has also been finalized.

R.C. Mehrotra & Anumeha Shukla

Project- 4.3: Siwalik floral diversity and palaeoclimatic changes in the Himalayan Foreland Basin

Investigation on the plant megafossils collected from Churia group of western Nepal revealed the presence of fossil wood, leaves and a fruit of a phytogeographically important genus, *Dipterocarpus* Gaertn. of the family Dipterocarpaceae. They have been described under form species, *Dipterocarpoxydon siwalicus* Prakash, *Dipterocarpus nepalensis* sp. nov., *D. suraikholaensis* Prasad & Pandey, *D. miocenicus* sp. nov. and *D. churiensis* sp. nov.. The analysis of present day distribution of the comparable forms of fossil remains indicates that all the extant species of the genus do not grow in the sub-Himalayan zone of India and Nepal. They are presently distributed in the evergreen forests of South-east Asian region (Myanmar, Malaya, Java and Borneo). This suggests that after rise of Himalaya, drier condition was prevailed due to which such moist loving species could not survive there. Based on the present and past distribution of the comparable extant species, the phytogeography as well as route of migration of *Dipterocarpus* has been discussed.

Three more leaf impressions have been reported from the Siwalik sediments of Arjun Khola area under



Carbonised fossil wood log embedded in sandstone bed of Siwalik of H.P.

the form species *Pongamia arjunkholaensis* sp. nov., *Lagerstroemia corvinusii* sp. nov., *Actinodaphne palaeoangustifolia* Antal & Awasthi belonging to the families Fabaceae, Lythraceae and Lauraceae respectively. This study provides palaeobotanical information about assigned genera of the fossils. The nearest living relatives (NLR) of these fossils indicate the prevalence of unfavorable climatic conditions which resulted in disappearance of these taxa from sub-Himalayan zone after Mio-Pliocene times. The assemblage suggests a warm and humid climate in the region during the deposition of the fossil bearing sediments. Further, identification of 25 plant fossils collected from different Siwalik fossil localities of India and Nepal has been carried out with the extant taxa belonging to different angiospermous families. Two new fossil fruits from Lower Siwalik sediments of Himachal Pradesh have been identified with *Accacia caesia* and *Gauania tilaefolia* of the family Fabaceae and Rhamnaceae respectively. Besides, a variety of plant fossils (petrified woods, leaf and fruit impressions) and palynological samples from the Siwalik sediments of Nahan, Sarkaghat and Kangra areas of Himachal Pradesh have been collected.



Fossil fruits: a) *Accacia caesia*, & b) *Gauania tilaefolia*

Mahesh Prasad

Project- 4.4: Megaflora from sedimentary sequences associated with Deccan Traps: Diversification of angiosperms in India

A fruit resembling *Cocos* is reported from the Binori Reserve Forest, Ghansor, Seoni district (MP). The coconut palm is native to coastal areas of Southeast Asia and Melanesia, and has wide pantropical distribution. The occurrence of *Cocos* along with the known coastal and mangrove fossil records further confirm marine incursions in the central India. The origin and dispersal of the genus *Cocos* is also discussed.

A number of woods (about 20) from newly discovered locality (about 10 ft. below from the ground of fresh of dug well) in Kathhotia Tola village of Dindori

district (MP) have been sectioned and studied. Surprisingly all the woods belong to the single Genus *Hydnocarpus* (Family Achariaceae). Further work is under progress. Work on *Corchorus* L. (Malvaceae) from Yavatmal district (Maharashtra) is also under progress. Few woods from newly discovered locality Dhangaon, Mandla district (MP) have been studied and identified with the woods of *Grewia* of the family Malvaceae (subfamily Grewioideae). In addition to this, visited Forest Research Institute, Dehradun to consult xylarium for comparison of fossil woods with modern genera.

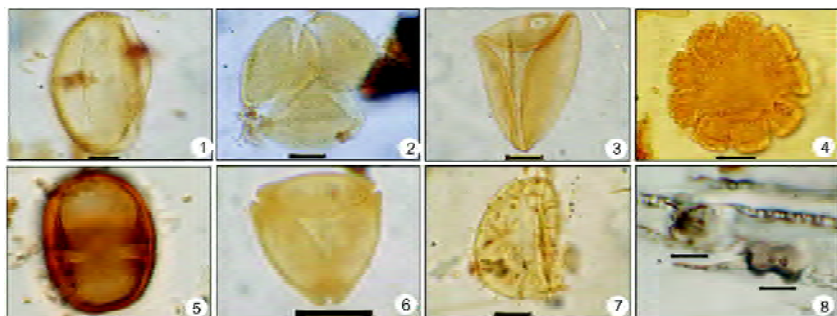
Rashmi Srivastava

Terminal Cretaceous-Neogene Miofloristics Group**Project- 5.1: Biota from Palaeogene lignite-bearing sequences of western India: Climatic, tectonic, stratigraphic, ecologic and biogeographic signatures**

Palynological study on the samples collected from Matanomadh lignite mine (Kachhh Basin) has been completed. The assemblage contains 31 genera and 41 species of algal remains (6 genera & 8 species, including dinoflagellate cysts), fungal remains (1 genera & 1 species), pteridophytic spores (10 genera & 12 species), and angiospermous pollen grains (15 genera & 20 species). Analysis reveals that the assemblage is dominated by angiospermous pollen followed by pteridophytic spores/dinoflagellate cysts. The important genera are: *Operculodinium*, *Cordosphaeridium*, *Polysphaeridium*, *Glaphyrocysta*, *Lejeunecysta*, *Lygodiumsporites*, *Dandotiaspora*, *Todisporites*, *Biretisporites*, *Polypodiaceasporites*, *Retimonosulcites*, *Proxapertites*, *Neocouperipollis*, *Spinizonocolpites*, *Acanthotricolpites*, *Lakiapollis*, *Tricolporopollis*, *Albertipollenites*, *Dipterocaruspollenites*, *Triangulorites* and *Polybrevicolporites*. The assemblage has been compared to modern taxa and found 14 extant families. Out of these, 5 families are restricted to tropical to subtropical; 5 are tropical, 1 cosmopolitan; 1 marine; 1 fresh-water and 1 tropical-temperate. Pteridophytic spores are represented by the families of Osmundaceae (*Osmundacidites*, *Todisporites*), Schizaeaceae (*Lygodiumsporites*, *Schizaeoisporites*) and Polypodiaceae (*Polypodiaceasporites*, *Polypodiisporites*) collectively indicate the prevalence of perennial water in their close

vicinity, and warm and humid climate. The dominant population of the palynoflora is represented by 5 families of angiosperms. Of these, Arecaceae (Monocot) is the most abundant. Palms referable to the family Arecaceae are predominantly pantropical, and restricted to evergreen and semi-evergreen forests. The diversity of *Spinizonocolpites* (*Nypa*) complex in the present study appears to have been governed by the exploitation of various brackish water habitats. The dominance and variety of palm pollen is sufficient for interpreting the climate as definite tropical. Pollen grains belonging to Bombacaceae (*Lakiapollis ovatus* and *Tricolporopollis matanomadhensis*) are also abundant in this assemblage. Tropical rain forest elements belonging to the families Dipterocarpaceae (*Dipterocaruspollenites*), and Oleaceae (*Retitrescolpites*) also occur in the section.

The overall assemblage indicates a warm and humid climate of a coastal zone, with a dense tropical rain forest in the vicinity of the site of deposition. An analysis of ecological groups represented by Matanomadh lignite deposits reveals that the coastal elements are dominant over freshwater swamps and marine elements. The presence of dinoflagellate cysts (*Polysphaeridium*, *Operculodinium*, *Glaphyrocysta*, *Cordosphaeridium* and *Lejeunecysta*) and mangrove (*Spinizonocolpites* and *Spinomonocolpites*) elements in the palynoflora indicates an influx of brackish water during the deposition.



1&2) *Dipterocarpaceae* pollenites, 3) *Graminidites*, 4) *Retistephanocolpites*,
5) *Meliapolleis*, 6) *Trisyncolpites*, 7) *Spinomonosulcites*, 8) Phytoliths

The members of *Arecaceae* and *Liliaceae* are indicative of coastal and shore-line elements and tend to remain apart storm tide. The occurrence of freshwater elements (*Lygodiumsporites* = *Lygodium*; *Polypodiaceasporites* = *Polypodium*) and *Polyporina* indicates prevalence of ponds and other freshwater forms dotting the landscape. It is concluded that the deposition of the Lifri Mine of Matanomadh lignite mine succession took place in fluctuating conditions ranging through lacustrine, swamp, marshy and deltaic environments. In addition, Intertrappeans sediments collected from Khora village and also samples from Madhwali Nadi have been processed.

M.R. Rao & Poonam Verma

Palynomorphs recovered from the amber of Vastan lignite mine (Cambay Basin) have been done. Some of the important genera are *Cyathidites*, *Polypodiaceasporites*, *Liliacidites*, *Matanomadhiasulcites*, *Retimonosulcites*, *Proxapertites*, *Neocouperipollis*, *Acanthotricolpites*, *Spinomonosulcites*, *Dipterocarpaceae* pollenites, *Retitrescolpites*, *Lakiapollis*, *Tricolporopollis*, *Bombacacidites*, *Rhoipites*, *Tribrevicolporites*, *Sastriipollenites*, *Tricolporopollis*, *Striacolporites*, *Alangiopollis*, *Paleosantalaceae* pollenites, *Araliaceoipollenites*, *Polybrevicolporites*, *Yeguapollis*, *Pseudonothofagidites*, *Triporepollenites*, *Retistephanocolpites* and *Polyporina*. Data interpretation of recovered pollen-spores has been taken up.

Poonam Verma

Scanning and photomicrography of spore-pollen and dinoflagellate cysts of Akri lignite mine of Kachchh have been done. A rich and diverse palynological assemblage consisting of dinoflagellate cysts, pteridophytic spores and gymnospermous pollen has been recorded. Some of the important genera are: *Polysphaeridium*, *Cleistosphaeridium*, *Operculodinium*, *Thalasiphora*,

Glaphyrocysta, *Homotryblum*,
Achomosphaera, *Botryococcus*,
Lygodiumsporites, *Lycopodiumsporites*,
Todisporites, *Biretisporites*,
Retipollenites, *Liliacidites*,
Palmaepollenites, *Palmidites*,
Neocouperipollis, *Spinizonocolpites*,
Acanthotricolpites, *Rousea*,
Albertipollenites, *Sastriipollenites*,
Striacolporites, *Lanagiopollis*,
Lakiapollis, *Tricolporopollis*,

Pelliceroipollis, *Tribrevicolporites*,
Paleosantalaceae pollenites, *Meliapolleis*,
Retistephanocolpites, *Ctenolophonidites*,
Proteacidites and *Polyporina*. A critical study reveals that the assemblage (Early Eocene) recovered is closely comparable to Vastan lignite mine of Cambay Basin. Additionally, processing of 33 samples collected from Panandhro lignite mine has also been completed and photo-documentation has been taken up and continued.

M.R. Rao & D.S. Seetharam

Palynofloral assemblage from bore-hole MK-327 drilled near Kapurdi, Barmer district of Rajasthan has been studied. The sequence, represented by Akli and Mataji Ka Dungar Formations, is made up of clay, sandstone and lignite. The assemblage is constituted by algal cysts, pteridophytic spores, angiospermic pollen and fungal remains. Angiosperm pollen dominates over the pteridophytic spores and fungal remains. Palynotaxa in the assemblage show affinity with families— *Arecaceae*, *Liliaceae*, *Oleaceae*, *Bombacaceae*, *Caesalpiniaceae*, *Proteaceae*, *Rubiaceae*, *Onagraceae*, *Caprifoliaceae*, *Clusiaceae* and *Lamiaceae*. Pteridophytic spores are represented by *Osmundaceae*, *Matoniaceae*, *Polypodiaceae*, *Lycopodiaceae* and *Schizaeaceae*. The assemblage is marked with good representation of *Dandotiaspora* spp., *Lycopodiumsporites* spp., *Proxapertites* spp., *Matanomadhiasulcites* spp., *Spinizonocolpites* spp., *Tricolpites retibaculatus*, *Liliacidites microreticulatus*, *Grevilloideaepites eocenicus*, and *Kielmeyerapollenites eocenicus*.

Distribution and frequency of palynotaxa enable identification of two zones in the bore-hole sequence. The Lower Zone is characterized by dominance of *Dandotiaspora dilata*, *Lycopodiumsporites* spp., *Proxapertites* spp., *Grevilloideaepites eocenicus*, *Liliacidites microreticulatus*, *Granustephanocolpites*

and *Palmidites* spp. This zone is also marked with restricted occurrence of *Matanomadhiasulcites maximus* and *Grevilloideaepites pachyexinus*. In Upper Zone, increased frequency of *Tricolporopollis rubra*, *Spinizonocolpites echinatus*, *Kielmeyerapollenites eocenicus* and *Matanomadhiasulcites kutchensis* is noticed. This zone possesses restricted occurrence of *Bombacacidites triangulates*, *Meliapollis pachydermis*, *M. simplex*, *Foveotricolporites reticuloidus* and *Lygodiumsporites lakiensis*. Based on the stratigraphical record of palynofossils in Indian Palaeogene strata, the bore-hole sequence is dated as late Palaeocene-early Eocene.

Rich and well-diversified palynofloral assemblages from Matasukh lignite mine, Nagaur district, representing Marh Formation, have also been studied. The sequence is constituted by lignite, carbonaceous clay, grey shale and siltstone. Quantitatively as well as qualitatively, angiosperm pollen dominates over the pteridophytic spores and fungal remains. Recorded significant palynotaxa in the assemblage are assigned to different species of *Lygodiumsporites*, *Todisporites*, *Lycopodiumsporites*, *Dandotiaspora*, *Arecipites*, *Palmidites*, *Longapertites*, *Proxapertites*, *Matanomadhiasulcites*, *Pseudonyssapollenites*, *Dermatobrevicolporites*, *Sastripollenites*, *Ratariacolporites*, and *Meliapollis*. Based on the litho-stratigraphical record of palynofossils in Indian Palaeogene strata, the investigated sequence is dated as early Eocene.

Palynofloras from 24 samples representing Mangrol lignite mine (Surat district), Gujarat have been studied. Assemblages are dominated by angiospermic pollen particularly those having affinity with the family Bombacaceae. Pteridophytic spores and fungal remains are poorly represented. Pteridophytic spores have been ascribed to Cyatheaceae (*Cyathidites australis*), Matoniaceae (*Biretisporites bellus*), Schizaeaceae (*Lygodiumsporites eocenicus*, *L. lakiensis*), and Osmundaceae (*Todisporites flavatus*). Pollen grains of the family Bombacaceae are ascribed to *Lakiapollis ovatus*, *L. matanomadhensis* and *Dermatobrevicolporites dermatus*. Other pollen in the assemblage show affinity with the families Arecaceae, Ctenolophonaceae, Symplocaceae, Annonaceae and Alangiaceae. Pollen grains of the family Arecaceae have been assigned to *Longapertites discordis*, *L. punctatus* and *Spinomonosulcites achinatus*. The family Annonaceae is represented by *Matanomadhiasulcites*

kutchensis and *M. maximus*. Pollen grains of the families Liliaceae and Alangiaceae are represented by *Retimonosulcites ovatus* and *Pellicieropollis langenheimii* respectively. The family Ctenolophonaceae is represented by *Polybrevicolpites neyvelii* and *Retistephanocolpites williamsii*.

Palynotaxa occurring in Mangrol assemblage indicate tropical to subtropical climate. Plants growing within this broad frame of climate occupied varied ecological niches. Members of the pteridophytic family Osmundaceae belong to swamp and water edge ecological group, whereas those of Schizaeaceae represent the presence of thick forest in nearby area. Pollen showing affinity with Annonaceae and Bombacaceae indicate existence of evergreen forests in vicinity of the depocentre. It is inferred that woody elements of dense forests and swamps accumulated at the deposition site and created anoxic bog conditions which were responsible for the deposition of organic rich sediments. Warm and humid conditions and high precipitation during the deposition regime is indicated by the presence of epiphyllous fungal fruiting bodies.

S.K.M. Tripathi & Hukam Singh

Palynological investigation of the Early Eocene sediments (lignite, shale, clay, carbonaceous clay, etc.) exposed at Tadkeshwar lignite mine (Surat district) has 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*, *Matanomadhiasulcites*, *Ctenolophonidites*, etc.



Hukam Singh

Thirty samples of lignite, carbonaceous shale, clay, etc. collected from spot measured section at the Surkha lignite mine of Bhavnagar district (Gujarat) have been macerated. The 25 productive samples have yielded

various types of sedimentary organic matter, pteridophytic spore, angiosperm pollen grains, fungal fruiting bodies and dinoflagellate cysts. The recovered palynoflora consist of pteridophytic spores viz., *Polypodiisporites repandus*, *Lygodiumsporites lakiensis*, *Cyathidites minor*, *Pteridacidites* sp.; angiosperm pollen grains of *Palmidites plicatus*, *Palmaepollenites* spp., *Neocouperpollis* spp., *Arengapollenites ovatus*, *Matanomadhiasulcites maximus*, *Tricolpites levis*, *T. reticulatus*, *T. retipilatus*, *Clavaperiporites clavatus*, *C. jacobii*, *Lakiapollis*

ovatus, *Lanagiopollis rugularis*, *L. ruguloverrucatus*, *Tricolporopollis rubra*, *Retitrescolpites africanus*; dinoflagellate cyst of *Homotryblium* sp. and *Spiniferites* sp.; and microthyraceous fruiting bodies. The qualitative analysis of palynoassemblage indicate prevalence of swampy, marshy and deltaic condition near the coast under tropical regime, where large amount of plant derived organic matter from nearby forest were transported by meandering streams towards the depositional site.

Priyanka Monga & Madhav Kumar

Project- 5.2: Palynology of the Deccan Volcano-sedimentary Province (Central India) and the Khasi Hills (Meghalaya)

Sediments from the Deccan Intertrappean beds exposed near the villages of Ranipur and Padwar in Jabalpur district (MP) have been chemically processed and relooked. The assemblage recovered from a new dug well near Padwar indicates a Maastrichtian age for this bed. New records of fungal remains are studied in detail. Sediments from the railway line cuttings near Anjar, Gujarat are also macerated. The assemblage recovered indicates two types of assemblage, the lower includes *Aquilapollenites*, *Minerisporites*, *Mulleripollis*, *Gabonisporites vigourouxii*, *Ephedripites*, *Costotheca*, *Spermatites*, *Azolla cretacea*, *Ariadnaesporites ariadnae*, *Spinizonocolpites*, *Tricolpites*, *Longapertites* and the upper one includes *Matanomadhiasulcites*, *Lakiapollis*, *Retitribrevicolporites*, *Proxapertites*, *Pseudonothofagidites*, *Tricolporopollenites*, *Retitribrevicolporites eocenicus* and *Lithoparaphysis paproensis*. Therefore, evidence of floral change across the K/T in this section is indicated. Besides, Deccan Intertrappean sediments from localities near Anjar, Kora, Dayapar and Laxmipur in Bhuj district (Gujarat) are systematically collected; lithologs and geological

observations are documented (jointly with Ratan Kar).

Late Cretaceous and Palaeocene samples from the South Shillong Plateau collected earlier have been processed and the palynomorphs are studied. Diversified floral assemblages representing all the plant groups are recognized. Morphotaxonomical observations are made. Critical observations on the *Aquilapollenites* and *Normapolles* groups of pollen (characteristic taxa of the Northern Hemisphere) are made for palaeogeographic interpretation. During the Late Cretaceous, India was placed under Palmae province, as it was nearer to the equator. On the basis of these exotic taxa in the Indian subcontinent, it is interpreted that before the actual locking of the two landmasses occurred, some sort of land connectivity via the island arc system was already in place which allowed the northern elements to intrude India and establish themselves in the Indian peninsula and eastern coast. Palaeocene taxa are recorded from the carbonaceous sediments of Therria Formation exposed along the Pynursla-Dawaki Road.

R.S. Singh

Project- 5.3: Palynological investigation of the Miocene sediments of Mizoram and Tripura

Terrestrial pollen assemblages have been recovered from the Bhuban Formation, Dhanonjoypara, northeastern Tripura. Organic debris especially spores, pollen grains, fresh water algae, plant tissues and terrestrial fungi are preserved in shales associated with plant fossil remains (trace fossils, wood borers and wood logs). The Bhuban Formation is here assigned to the Early Miocene based on the presence of key species of *Malvacearumpollis*, *Trisyncolpites*, *Polyadopollenites*, *Spinizonocolpites echinatus*, *Striatriletes susannae*, *Pteridacidites tripuraensis*, *Osmundacidites wellmanii*,

Acanthotricolpites brevicolpus, *Retitrescolpites typicus*, *Hibisceapollenites robustispinosus*, etc. A temporal gap between the Bilkhawthlier-Rengtekawn Late Oligocene and overlying Bhuban Formation (Early Miocene) exposed in the studied region is suggested here based on the differences observed in palynological assemblages.

The early Bhuban Formation was deposited in a continental environment, with local peat, swamp and coastal plains environments. The appearance of some neotropical families in the upper part of the section might

indicate the beginning of late Miocene warming events. Records of Asteraceae, Malvaceae, Combretaceae, and Scrophulaceae are the oldest reports in Dhanonjoypara to date and provide significant information on the early divergence and radiation times of these major angiosperm families. Frequency of marshy and aquatic taxa has also

been reduced, resulting in fast drying of swampy areas as found today. Occurrence of degraded grass land pollen and monolete fern spores is indicative of biological degradation in sediments. The presence of some species confined to the Gondwanan continents is also being important in the analysis of palaeobiogeographical issues.

B.D. Mandaokar

Project 5.4: Palynological investigation of Palaeogene sedimentary rocks of Garo Hills, Meghalaya: Palaeoecological and palaeogeographical interpretations

Completed survey of literature associated with the project and prepared reference cards of the literature concerning the project. Manuscripts of the following papers have been finalized: i) Late Eocene palynoflora from the Kopili Formation exposed along Jowai-Badarpur Road, Jaintia Hills District, Meghalaya; India: Palaeoecological and palaeogeographical interpretations

(jointly with P.S. Ranhotra), ii) *Densiverrupollenites* Tripathi and Singh 1984, marker for Late Eocene sediments of India, and iii) Oldest record of genus *Hammenisporis* (van der Hammen) Saxena and Trivedi 2009 from north east India.

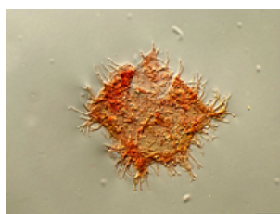
G.K. Trivedi

Thrust Area 3: INTEGRATIVE MARINE MICROPALAEONTOLOGY: FOCUS ON HIGH RESOLUTION BIOSTRATIGRAPHY, SEA LEVEL CHANGES, PALAEO-OCEANOGRAPHIC AND PALAEOCLIMATIC EVENTS

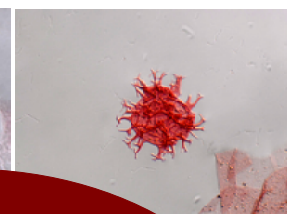
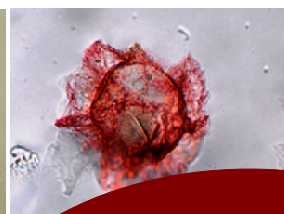
Marine Micropalaeontology Group

Project- 6.1: Study of Late Cretaceous-Early Palaeogene successions of South Shillong Plateau: Implications for climate and relative sea level changes

A palynological study is carried out on shallow marine deposits of 160 m thick Lakadong Sandstone Member from Ranikor-Barsora, Mawsynram area, Meghalaya. The study revealed a rich dinocyst assemblage, represented by *Apectodinium homomorphum*, *A. quinquatum*, *A. summisum*, *A. augustum*, *Glaphyrocysta ordinata*, *G. exuberance*, *Amphorospheridium* sp., *Thalassiphora pelagica*, *Muratodinium fimbriatum*, *Wetzeliella astra*, *Adnatospheridium multispinosum*, several species of *Homotryblum*, *Spiniferites* and *Cordospheridium*. However, carbonaceous shales and impersistent coal lithounits lacks dinoflagellate cyst but are rich in pollen and spores. Low species diversity, and numerical abundance of dinoflagellate cysts suggests a near shore environment of deposition. The dinocyst assemblage indicates that Lakadong Sandstone Member is late Thanetian-Lutetian in age. Further palynofacies assemblages of the two Lakadong Sandstone successions from Jathang and Ranikor-Barsora (N-S transect) area have been compared to decipher sea level fluctuation and



Apectodinium quinquatum



to e... nate
in... es
a...
ad
ges
across... Um
Shorynke... has been
carried out with.../ survivor/
incoming species; species diversity, abundance and
distribution, for preparation of relevant figures and graphs.
A global comparison of significant nannofossil bioevents
has been made and a comparative zonation chart has been
prepared (jointly with Rahul Garg & Jyotsana Rai).

Abha

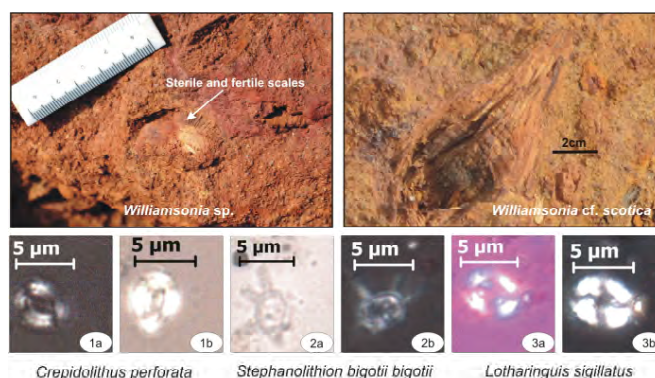
Project- 6.2: Calcareous nanofossils from western Indian Jurassic continental shelves: Biostratigraphic, palaeoenvironmental and palaeogeographic implications

The oldest marine sedimentary rock unit, the Kaladongar Formation (GPS location 23°59'40"N: 69°42'28"E) in the Patcham Island, is exposed in Kuar Bet Islet in Kachchh Basin, and has yielded calcareous nanofossils of early Jurassic age (NJ5 to NJ7 nanofossil Zones) straddling the Pleinsbachian-Torcion boundary. This finding suggests that after faulting, the first transgressive event in the basin might have occurred some 15 million years earlier than the much accepted Late Bajocian age. 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. Record of upper Pleinsbachian age nannofossils from Masirah Island from Sultanat of Oman, Arabia strengthens this finding. Reworked Pleinsbachian-Aalenian age nanofossils were earlier recovered from Callovian age nannofossil assemblage of Jara Dome situated in the easternmost extremity of mainland. Recent ongoing studies from Jumara Dome have also indicated presence of Early Jurassic reworked nannofossils in Middle Jurassic assemblages. This has wide palaeogeographical implication as it suggests that after faulting the transgressive event in Kachchh Basin might have taken place during Pleinsbachian-Toarcian time, i.e. about ?15 my. earlier than Late Bajocian (ammonite: *Leptosphinctes* sp. and coral: *Isastrea bernardiana* records). Additionally, field work in Kachchh area is conducted and samples from Kuar Bet, Chaper Bet, Dingi Hill, Sadhara Dome of Patcham Island and Habo Dome, Gangeshwar Dome of Mainland are collected to find preservation and abundance of calcareous nannofossils.

Jyotsana Rai

First record of bennetitalean fossil flower represented by *Williamsonia* sp. along with Carpolithes (seed), from the upper part of the Callovo-Oxfordian Washtawa Formation (Nara Shale Member) is recorded. The specimen is comparable with *W. kakadbhitensis* of Albian age from the Bhuj Formation of Kachchh Mainland area. All the known record of *Williamsonia* is from early to late Cretaceous sediments in India and this is about 40 million years earlier record. The horizon with plant fossils is rich in datable ammonites and also contains nannofossils. The mainland sections display exceptional preservation of Callovian age calcareous nannofossils but in Oxfordian strata nannofossils are not well preserved.

In the bed of the Trambau River between Kantkote



Williamsonia fossil flower and datable nanofossils from same horizon, Wagad highland, Kachchh

and Jharsa villages a succession of brick-red to yellowish (iron-rich) calcareous, mudstone is exposed. One bedding surface at the nala is, for several hundred meters, studded with a variety and size range of ammonoids, belemnites, large bennetitalean fossil wood logs and pieces with attached fructifications and seeds at places, along with large *Thalassinoides* burrows. At places symmetrical ripple marks are also seen suggesting wave influence and hence comparatively shallow-water conditions. The ammonite assemblage has been dated as late Middle Oxfordian for this part of the succession. More precisely, the ammonite assemblage belongs to Oxfordian *Transversarium* Zone, *Schilli* Subzone (Krishna et al., 1994, 1995). Associated with the ammonites is a moderately diverse nannofossil flora, represented by *Axopodorhabdus cylindratus*, *Biscutum dubium*, *Carinolithus magharensis*, *Crepidolithus perforata*, *Cyclagelosphaera margerellii*, *C. tubulata*, *Ethmorhabdus gallicus*, *Lotharingius contractus*, *L. sigillatus*, *Stephanolithion bigotii bigotii*, *Stradnerlithus geometricus*, *S. fragilis*, *Triscutum expansus*, *Triscutum spp.*, *Watznaeuria barnesae*, *W. britannica*, *W. ovata* etc. The calcareous matrix of the sandy Nara Shales has been provided by calcareous nannofossils. The low-diversity, moderately preserved nannofossils from the upper part of Nara Shales Member of the Washtawa Formation can also be placed, with confidence, in the NJ 15 *Cyclagelosphaera margerellii* Zone of Bown et al (1988) of Lower Oxfordian (cordatum AZ) to Lower Kimmeridgian (autissiodorensis AZ).

The Wagad Island section contains excellent datable ammonite in hard calcareous bands and moderately-preserved nannofossils in calcareous sandy shales in

between these hard bands. Early and early Middle Oxfordian ammonites are recorded from Mainland Kachchh, whereas Middle and Late Oxfordian ammonites have been recorded from Kantkote of the Wagad region. Possibly, the mainland area underwent sediment starvation, while sedimentation was going on in Wagad Island. The part of the section in question may correspond to a maximum flooding zone.

Pariwar Formation in the Jaisalmer Basin, Rajasthan has been precisely dated for the first time as early Middle Albian 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). Presence of nannoconids in the assemblage indicates Tethyan affinity and *Seribiscutum primitivum* showed presence of bipolar high cold water taxon from Austal province to mid latitudinal position. The Tethyan nannofossil laden water current appears to have been mixed with cold water current during Aptian-Albian time (Kale & Phansalkar, 1992) and continued up to Campanian time. Record of *B. constans*, *Z. erectus* indicates surface water nutrient rich upwelling conditions.

Jyotsana Rai, Abha & Mridul Gupta

Project- 6.3: Micropalaeontology of the Subathu sediments of Lesser Himalaya, Himachal Pradesh

The marine Subathu (Eocene) palynofloral assemblage recorded from Sarahan area has been described morphologically. The palynoflora consists of a variety of dinoflagellate cysts, spore, pollen grains, fungal spores and ascostromata. The palynofloral assemblage clearly demonstrates that the climate during the Eocene times in the area was subtropical and the environment of deposition was shallow marine. Palynofloral assemblages are also studied from the measured stratigraphic section of the Dagshai and Kasauli Formation exposed on the Nahan-Sarahan road. A rich palynofloral assemblage has been recorded from the Dagshai Formation which is dominated by mainly fungal spores and ascostromata followed by angiosperm pollen and pteridophytic spores. Gymnosperm pollen is poorly present in the assemblage. The palynoflora recorded from the overlying Kasauli Formation is qualitatively very poor. Angiosperm pollen grains, fungal spores and degraded type of organic matter

(OM) suggest that the sediments were deposited under fluvio-deltaic environment of deposition in a fast sinking basin. The occurrence and relative abundance of dispersed OM types, the thermal maturation levels are evaluated by TAI values and the dominance of organic facies have been worked out to interpret the hydrocarbon source potential of the Subathu rock of the Nahan area of Himachal Pradesh.

Thirteen genera and 25 species of dinoflagellate cysts have been recorded from the rocks of Gainthia Formation (Eocene) near Nainital, Uttarakhand. Dinocysts belonging to the following families: Spiniferitaceae, Homotrybliaceae, Cordosphaeridiaceae, Areoligeraceae, and Thalassiphoraceae have been recorded. The dinocyst assemblage shows close similarities with the palynoflora recorded from the Subathu Formation of Himachal Pradesh.

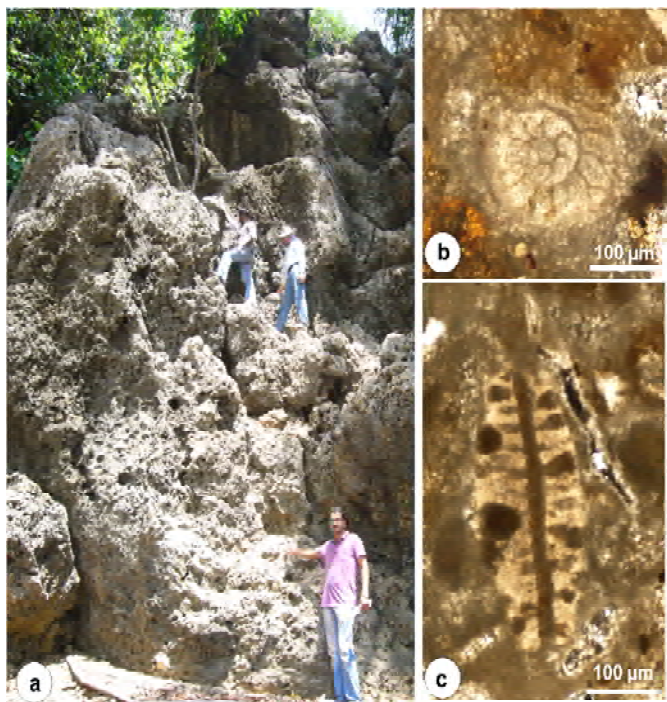
Samir Sarkar

Project- 6.4: Biofacies analysis of the Cenozoic sediments of Andaman-Nicobar Basin and its implications for palaeogeography, palaeoecology and palaeobathymetry

Work on facies characterization of reef forming coralline algal sediments from the Middle Pliocene of Car Nicobar Island has been finalized. Based on the study of facies characterization, palaeoenvironmental significance of reef-forming Coralline Algae dominated sediments along with benthic foraminifera from the Guitar Formation (Middle Pliocene) of Car Nicobar Island, India has been done.

Studies on 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) have been done. A new outcrop of late Middle Miocene sediments belonging to Long Formation in the Kalapathar area of Little Andaman Island has been discovered. Thin section analysis reveals the occurrence of species of non-geniculate corallines *Lithothamnion* and geniculate corallines (viz., *Corallina*, *Jania* and *Amphiroa*) along with species of benthic foraminifera represented by the genera *Operculinoides*, *Amphistegina*, *Eulepidina*, *Operculina*, *Heterostegina* and coral fragments. An assemblage of diatoms represented by species of *Thalassiosira*, *Coscinodiscus*, *Actinocyclus*, *Arachnoidiscus*, *Navicula*, *Rossiella*,



a) Late Middle Miocene outcrop in the Kala Pathar area of Little Andaman Island, b) Benthic Foraminifera (*Orbitoides*), and c) Coral fragments

Glyphodesmis has been recovered from the Inglis Formation outcropping near the Kalapthar beach section of Havelock Island. Based on planktic foraminifera (*Globigerinattela insueta* Zone to *Globorotalia perpheroronda* Zone) an Early Middle Miocene has been suggested earlier for the Inglis Formation. Quantitative analysis of the centric and pinnate diatoms is in progress. Based on the diatom assemblage palaeoenvironmental interpretations will be made.

A.K. Ghosh, Abhijit Mazumder & Pawan Govil

Field work has been undertaken in different islands of Andaman to examine different outcrops of Chidiya Tapu (Munda Pahar), Sippighat Section (Port Blair), Carbin's Cove (Port Blair), Wandoor Beach Rock (Port Blair), Melville Point (Havelock Island), Vijay Nagar (Havelock Island), Light House (Havelock Island), Laxmanpur-Neil West Coast Section (Neil Island), Bhangadungi-Bharatpur Section (Neil Island), Sitapur-Neil East Coast Section (Neil Island). In all the outcrops the sections are properly measured, GPS data have been taken and samples are collected from the measured sections.

A.K. Ghosh & Abhijit Mazumder

Project- 6.5: Phytoplankton response to palaeoclimatic fluctuations along the Kerala-Konkan Coast

Diatom and palynofacies analyses have been carried out on surface sediments from the Vembanad Estuary to decipher the variations in the primary

in differential salinity in various parts of the estuary. The variation in the TOC data is also studied in surface sediments.

Biswajeet Thakur



Diatoms: *Hemidiscus*

Encyonema

Triceratium

productivity and run off related environmental changes. In palynofacies study, various organic matter (OM) constituents are characterized and quantitative analysis is performed on sediment samples. In all the samples, terrestrial OM content is high as compared to marine components. Amongst the fresh water diatoms centric diatom dominates over pennate forms. Various stations in the estuarine complex show varying frequencies in the distribution of diatoms and palynofacies components. These studies suggest uneven freshwater supply resulting

A 92 cm core from the Bougatty (bar mouth) region of Cochin region of Vembanad estuary is studied for diatom and palynofacies. The samples are taken at 1 cm interval. The study revealed high primary productivity and OM content. Predominance of freshwater and brackish diatoms over the marine forms is noticed in most of the samples. The commonest brackish water diatom *Nitzschia panduriformis* var. *Lucida* is found in abundance in all the samples of the core. The presence of copepod egg envelopes, foraminiferal test linings, dinocyst (*Bitectatodinium spongium*, *Spiniferites* sp., *Achomosphaera* sp., *Lingulodinium* sp., etc) at various levels of the sediment core are indicative of marine incursion in the Vembanad estuary.

Biswajeet Thakur & Vandana Prasad

Thrust Area 4: ORGANIC PETROLOGY: CHARACTERIZATION OF SOLID FOSSIL FUEL FOR DEPOSITIONAL AND UTILIZATIONAL ASPECTS

Organic Petrology Group

Project- 7.1: Petrology of coals from Wardha-Godavari Valley Coalfield and its impact on coal bed methane potential and depositional environments

Petrographic work has been carried out on sub-surface coal seams intersected in bore-holes SR-94 and SR-94A from Rampur Shaft Block of Kothagudem sub-basin, Godavari Valley Coalfield. Four coal seams have been encountered in the study area which are known as, I Seam, Index below I Seam, Queen Seam (Section I, Section II and Section III) and the lowermost King Seam. The maceral and reflectance study has revealed that these

coals can be classified under vitric, fusic and mixed types and in general they have attained high-volatile bituminous C stage of rank, barring the lowermost King seam which has attained high volatile bituminous B stage of rank. In addition, field work in various localities of the Wardha Valley Coalfield has been undertaken, and collected samples from Nagpur, Yeotmal and Chandrapur districts of Maharashtra for coal petrographic study.

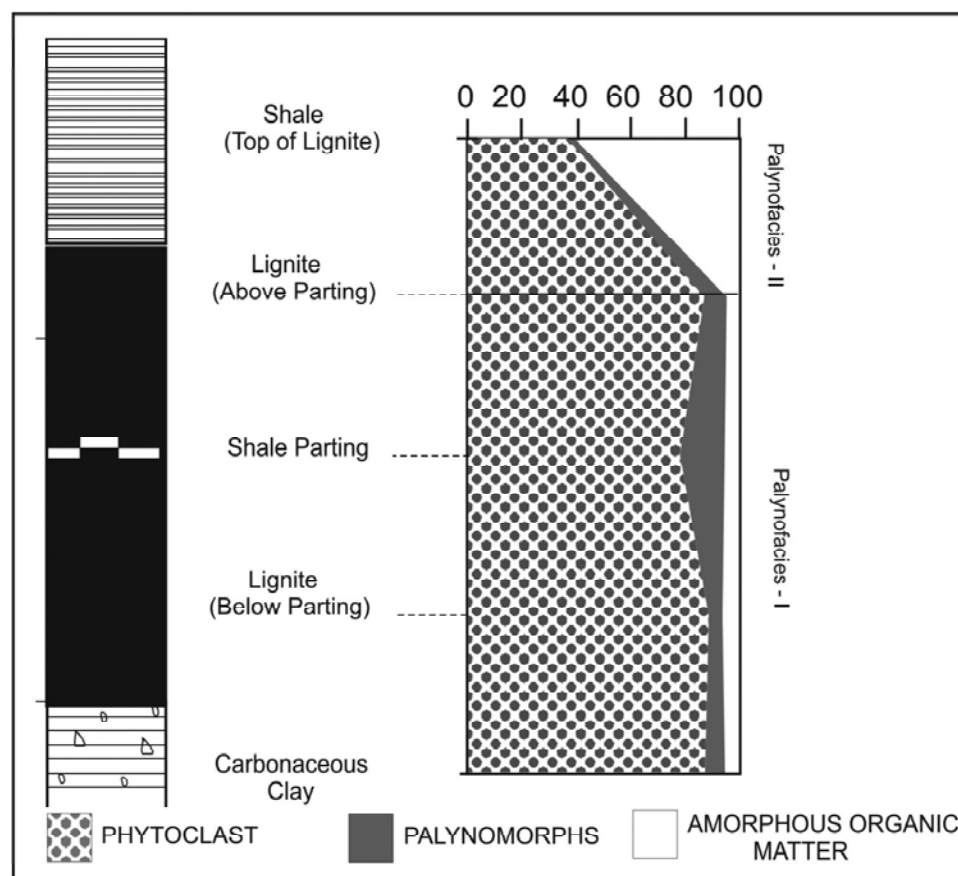
O.S. Sarate

Project- 7.2: Organic matter characterization of western Indian lignites through petrological studies

The petrological, palynological and palynofacies data accumulated on Eocene lignite from the Mangrol mine of Surat district (Gujarat) have been compiled in

order to characterize and assess the depositional conditions of the deposit. The petrological study reveals that the lignite is composed predominantly of huminite

macerals (average 44%) that were produced from a woody forest. The huminite reflectance values ($R_{r\text{ mean}}$: 0.27-0.32%) indicate its maturation is lignitic stage (low maturity). The variable Tissue Preservation Index (TPI) and Gelification Index (GI) values and maceral composition indicate fluctuating ground water conditions and difference in the type of vegetation during the accumulation of peat. The palynofloral spectrum suggests the presence of angiosperms (including mangrove) and pteridophytes as the source material for lignite. The palynomorphs indicate the tropical to sub-tropical climatic conditions were present during deposition of lignite and that the original mire likely occurred in a coastal setting. This interpretation is strongly supported by palynomorphs with affinity to brackish-water taxa.



Identified palynofacies in the lignite seam of Mangrol mine

Palynofacies studies suggest peat deposition under dysoxic conditions in a marginal marine setting. High amount of amorphous matter (kerogen type I) in the shale bed above the lignite suggests its potential for hydrocarbon generation.

The petrological data of lower Tertiary lignites from Amod mine (Bharuch district, Gujarat) has been documented. The lignites are found to be rich in huminite macerals (average 55%) followed by liptinite (av. 34%) and inertinite (av. 5%) macerals, along with low amount of associated mineral matters (argillaceous and pyrite: av. 5%). Among the huminite group of macerals, detrohuminite (attrinite+densinite) is dominant in these lignites followed by structured telohuminite (textinite+ulminite). The liptinites are chiefly constituted by liptodetrinite and resinite, besides sporinite, cutinite, suberinite, etc. Funginite, inertodetrinite and semifusinite/fusinite represent the inertinite group. The overall maceral composition indicates that the studied lignite seam is formed from mixed vegetal source (woody forest vegetation and herbs, shrubs) in sub-aqueous, wet-reducing environmental condition in a fast subsiding basin with only minor fluctuations in swamp water conditions. The rank ($R_{r\text{mean}}$ values: 0.27-0.32%) indicates that the studied lignites are less mature. The low rank and predominance of huminite macerals suggest for their utilization in thermal power plants and industries for heat/steam generation. In addition to this, fair amounts of hydrogen-rich macerals (liptinites + perhydrous or fluorescing huminite: 51-62%) point towards their potential

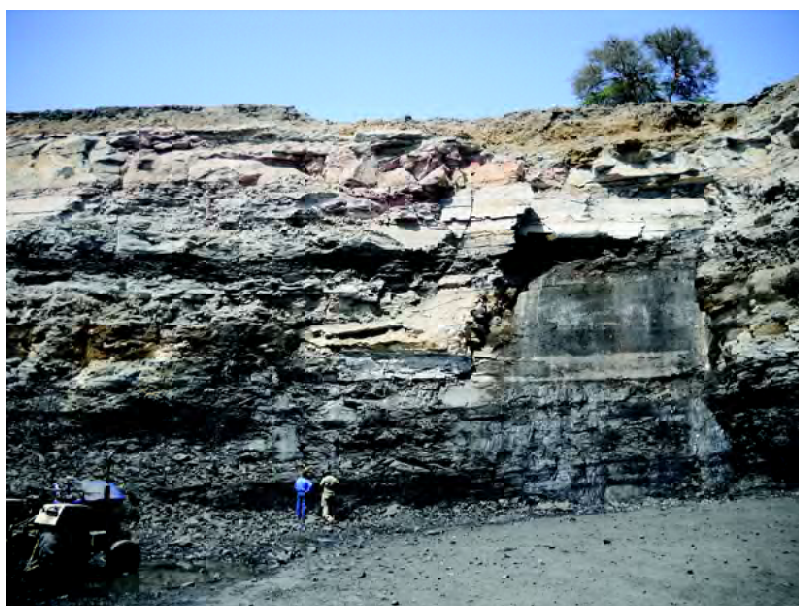
for oil/ gaseous hydrocarbon generation.

Coals and carbonaceous shales from the Thangad area of Surendranagar district (Gujarat) have been studied. The Early Cretaceous coal deposit in the area is associated with Than Formation of the Saurashtra Basin. The data generated on organic composition (macerals), mineral matter contents and rank, along with total organic carbon (TOC), biomarkers, etc., are utilized to characterize these western Indian coals for their optimal utilization. The quantitative estimation of macerals indicates that the coals are rich in vitrinite macerals (39-57%) followed by inertinite (9-33%) and liptinite (2-16%) macerals. Among the vitrinite group of macerals, telovitrinite (collotelinite + telinite) is dominant in these coals followed by detrovitrinite (collodetrinite + vitrodetrinite). The liptinites are chiefly constituted by liptodetrinite and bituminite. Semifusinite/fusinite and inertodetrinite represent the inertinite group. The coals have moderate to high contents (8-36%) of associated mineral matters represented mainly by clastic minerals and pyrite (10-12%). The extrapolation of GI and TPI indices indicate that the coal has been formed in limnic to back barrier of deposition. The Ground Water (GWI) and Vegetation Indices (VI) suggest that the peat has been subjected to intermittent flooding of the mire and the maceral data show a shift from mesotrophic to ombrotrophic and back to mesotrophic conditions. The rank, determined through vitrinite reflectance measurements ($R_{r\text{mean}}$ values: 0.86-1.05%), indicates that the studied coals are of high-volatile bituminous A stage.

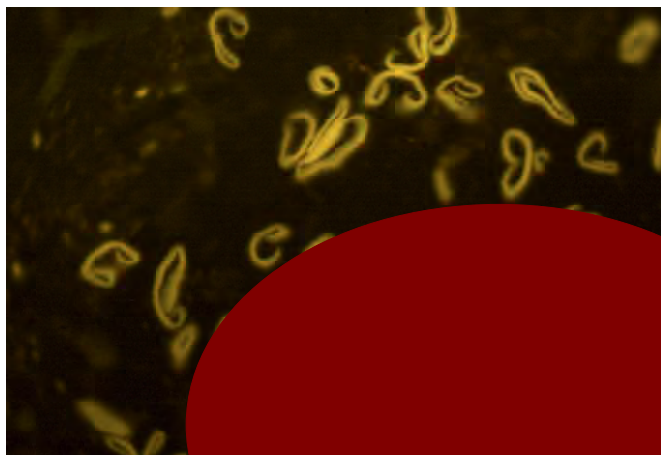
The rank data, TOC content, presence of Type III kerogen, etc. indicate that the studied coal-bearing sequence has the potential to generate gaseous hydrocarbon.

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

Field work has been undertaken in lignite-bearing areas of Barmer (Sonari, Kapurdi and Giral mines), Bikaner (Gurha East mine) and Nagaur (Matasukh mine) districts after discussion with officials of the Rajasthan State Mines and Minerals Ltd. (RSMML) in Jaipur. Collection of lignite and associated sediments (carbonaceous shale, shale, etc.) has been made from working mines for organic petrological study. SM and VPS also visited office of the Gujarat Mineral Development Corporation (GMDC) in Ahmedabad and had discussions on lignite mining activities in



Coal seam exposed in a mine near Thangad (Gujarat)



Saurashtra Basin. The lignite-bearing areas of Khadsalia mines), and collected sediments (carbonaceous shale, shale, clay, etc.) for organic petrological and palynofacies studies.

B.D. Singh, S. Mahesh & V.P. Singh

Tertiary lignites from the Surkha mine of Bhavnagar district (Gujarat) have been studied in terms of their

maceral composition and rank. The maceral studies reveal the dominance of huminite macerals in both the Bottom (43-64%) and Top (56-72%) seams, represented mainly by structured telohuminite and detritus detrohuminite. The recorded liptinite macerals range between 13 and 36% in the Bottom Seam, and 13 to 20% in the Top seam. They are constituted mainly by resinite (resin/waxes), catodetrinite (detrital), sporinite (pollen-spores), and cutinite (cuticles). Inertinite macerals range between 3% in the Bottom Seam and between 7 and 11% in the Top seam. The lignites also have moderate to high ash content (av. 22%) of associated mineral matters. The reflectance values ($R_{r\text{ mean}}$ 0.27-0.34%) indicate the studied lignites are less matured, and fall in the sub-bituminous stage/rank. The overall petrographic properties of the lignites point towards their utilization in thermal power plants and other industries for steam/ heat generation. The extrapolation of ground water index (GWI) and vegetation index (VI) values suggests that the peat precursors of Surkha lignite accumulated under meso-/ rheotropic regimes.

V.P. Singh, B.D. Singh & Alpana Singh

Project- 7.3: Biopetrological characterization of Tertiary lignitic beds from Cauvery Basin and adjoining areas

Field work in Neyveli and adjoining areas has been carried out in order to study the new sections of lignite horizon being mined. The lignite in the area forms the part of the Cuddalore Series of Miocene age and is mostly incropping in nature. In order to study the variations in the biopetrological and geochemical characteristics of lignite in time and space, three new sections are delineated from Mine I, Mine IA, Mine II and adjoining areas. The necessary collections are made from all the seam sections at the interval of 1 meter. The banding of resin content of fleshy colour has been noticed. Resins are mostly fine impregnated in nature. Rarely lump occurs in Mine I. Lignite also shows the association of mineral matter (pyrite/marcasite) of disseminated nature. The characteristic thinly laminated carb. shales are recorded in the roof parting of II seam in Mine II; showing the secondary mineral deposits on it. The prismatic, acicular pattern of radiating crystal from the centre giving flowering appearance suggests it to be Gypsum. The necessary picture and crystals/ samples are collected for

the study. But this is rare occurrence from Neyveli Mine area not reported earlier.

Lignite samples have been processed for making the pellets, and 20 pellets are prepared for the study. The work is in progress. The resin materials recorded from these lignites have been processed for its geochemical characterization with the help of IIT, Mumbai. The collected crystal is studied through XRF and XRD. The results show it to be composed of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and suggest it to be Gypsum. Besides, Ratnagiri lignites are studied in detail under normal reflected light microscopy for their maceral characteristics. Typical framboidal pyrite has been noticed in the samples; suggesting the role of euxinic condition for the genesis of these lignites in the coastal lagoonal area. Further, a new algal thallus has been recorded and being studied for its identification and palaeogeographical significance. In addition, the fossil resin material recorded from these lignites is being studied for FTIR and Pyrolysis GCMS studies.

Rakesh Saxena

Thrust Area 5: QUATERNARY PALAEOCLIMATE RECONSTRUCTIONS, VEGETATION DYNAMICS AND RELATIVE SEA LEVEL CHANGES

Quaternary Palaeoclimate Group

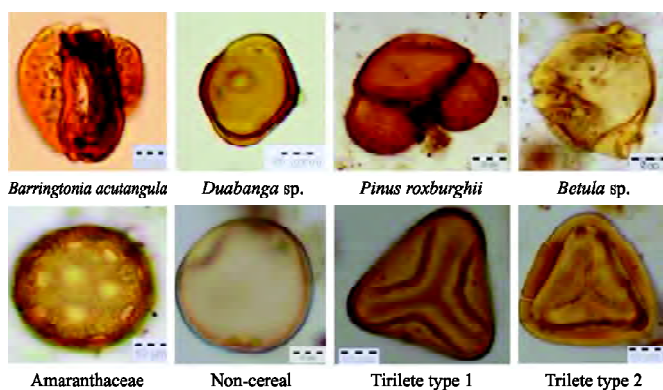
Project- 8.1: Holocene climatic variations and vegetation succession in endangered wetland ecosystems and adjacent reserve forests in Brahmaputra and Barak valleys, Assam

Prepared pollen key of 45 major arboreal taxa belonging to semi-evergreen and mixed deciduous forest of Barak valley for the precise identification of sub-fossil pollen to reconstruct palaeovegetation and climate of the region. Modern pollen/vegetation relationship is established from Patharia reserve forest under Patharkhandi range of Karimganj district situated at Indo-Bangladesh border. Study portrays the existence of mixed

with that of surface pollen samples. Two sediment cores along with four trench sedimentary profile are collected for the palaeoclimatic interpretation.

S.K. Bera, Swati Dixit & Kanupriya Gupta

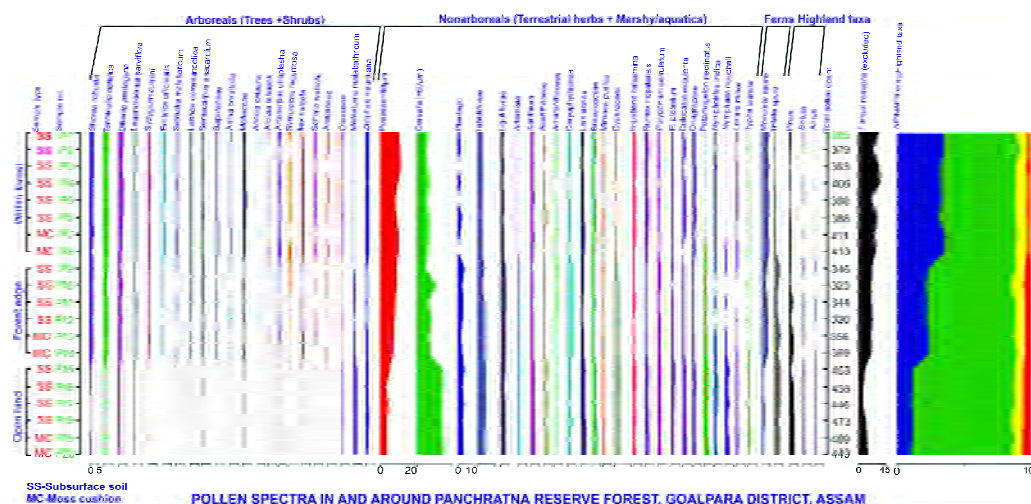
Palynological assessment of 20 surface samples from the Panchratna reserve forest of Goalpara district, western Assam has been carried out to explore the relationship between modern pollen assemblages and contemporary vegetation patterns. Seven spider web samples have also been examined in order to conceive air pollen-spore and its relation to soil/moss pollen data. The surface sample has depicted the occurrence of mixed pollen assemblage comprising Angiosperms, Gymnosperms and Pteridophytes among which nonarboreals (terrestrial herbs and marshy/aquatic taxa) dominate over arboreals (trees and shrubs). The comparison between pollen spectra and vegetation reflects site to site variation in pollen assemblage in relation to heterogeneity of the forest. The study predicts that inspite of only partial coherence between modern pollen rain and extant vegetation due to differential pollen productivity,



Palynomorphs recovered from Patharkhandi Reserve Forest

deciduous forest comprising *Mesua ferrea*, *Schima wallichii*, *Amoora toona* and *Salmalia malabaricum*. High land taxa like *Pinus*, *Betula*, *Alnus* and *Corylus* are also observed in fair frequency. The pollen data from air catches and spider webs has partially supported pollen dispersal from surface sample data.

Different localities of Karimganj, Silchar and Kamrup districts of Assam has been surveyed and procured about 110 surface samples (soil samples and moss cushion) for the pollen/vegetation relationship. The spider webs and honey comb have also been procured from Patharia RF for comparison of data



POLLEN SPECTRA IN AND AROUND PANCHRATNA RESERVE FOREST, GOALPARA DISTRICT, ASSAM

dispersal and deposition, pollen frequencies of surface samples somehow portrays the extant floral distribution in and around the reserve forest.

Swati Dixit & S.K. Bera

Project- 8.2: Reconstruction of Quaternary vegetation dynamics and climate change in southern Madhya Pradesh

Pollen analysis of 8 surface samples from Simariya Tal, Chhindwara district shown the relatively high frequencies of the non-arbores (herbs) compared to arbores (trees and shrubs). The trees are few and among them, *Madhuca indica* and *Acacia* are consistently represented in moderate values, reflecting their frequent presence in the region. Others such as *Syzygium*, *Terminalia*, *Holoptelea*, *Symplocos*, *Lannea coramandelica*, *Bombax ceiba*, etc. are extremely sporadic. The under-representation of these taxa could be attributed to their low pollen productivity as well partial preservation of pollen in the sediments. The non-arbores largely comprise grasses followed by Asteraceae (Tubuliflorae and Liguliflorae), *Impatiens*, *Alternanthera* and *Xanthium*, and their record in the pollen rain corresponds with the factual presence of these taxa in the local flora. The encounter of culture pollen taxa viz., Cerealia, *Alternanthera*, *Cannabis sativa*, etc. in appreciable numbers implies the proximity of the cultivated land.

Pollen analysed 10 samples from a 2.2 m deep

sediment core from Simariya Tal. The retrieved pollen assemblage has revealed the dominance of non-arbores and sporadic occurrence of arbores. Trees such as *Madhuca indica*, *Acacia*, *Butea*, *Syzygium*, *Adina cordifolia* are recovered very sporadically along with shrubby elements such Fabaceae, Acanthaceae, etc. Among the non-arbores grasses followed by Cheno/Am, *Justicia simplex*, Asteraceae, etc. are very frequent. In general, the pollen assemblage demonstrates the existence of open grassland vegetation with scanty trees during the course of sediment accumulation. The encounter of aquatic elements viz., *Lemna* and *Potamogeton* suggests the existence of the lake. Besides, field work in southern Madhya Pradesh has been undertaken and collected 8 sediment profiles from the extinct and extant lakes of Chhindwara and Narsinghpur districts for the Quaternary palaeovegetation and palaeoclimatic studies. In addition, 74 surface samples and 4 honey samples are also picked up from the forest stands and adjoining open areas to study pollen deposition pattern in the region.

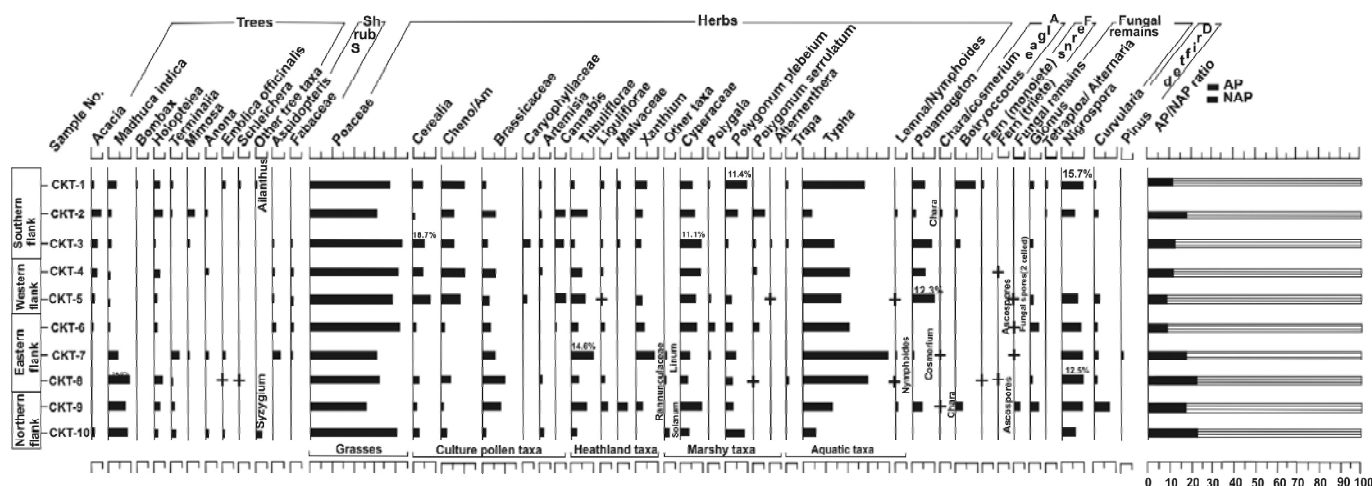
M.S. Chauhan

Project- 8.3: Quaternary palaeoclimate reconstruction and palaeovegetation dynamics in the central Ganga Plain

Pollen analytical investigation of 20 samples has been accomplished from 2.1 m thick sediment profile collected from Chaudhari-ka-Tal in Raebareli district (UP). The pollen assemblage obtained has shown the dominance of non-arbores and relatively reduced frequencies of arbores (trees and shrubs). Trees are few and among them *Madhuca indica*, *Acacia*, *Holoptelea*, *Syzygium* are in moderate to low frequencies, whereas *Terminalia*, Sapotaceae as well as the thickets of *Adhatoda vasica*, *Mimosa* and *Aspidopterys* are scanty. The flora is characterized by the dominance of grasses (Poaceae) followed by Tubuliflorae, Liguliflorae, *Xanthium*, Malvaceae, etc. The overall vegetation composition reflects the presence of open grassland vegetation with sprinkle of trees in the region during the course of sediment accumulation. The frequent retrieval of pollen of Cerealia and other ruderal plant taxa viz., *Artemisia*, *Cannabis sativa*, Cheno/Am and Caryophyllaceae in good numbers implies the intense agricultural practice in the area adjoining to the lake site. Furthermore, the encounter of the aquatic elements viz.,

Typha, *Potamogeton*, *Lemna* and freshwater algae-*Botryococcus*, *Zygnema*, *Spirogyra* and *Pseudoschizea* indicates the existence of the lake during the past.

The pollen assemblage retrieved from 10 surface samples of Chaudhari-ka-Tal has shown the dominance of non-arbores herbs and relatively low frequencies of arbores. Among the tree taxa *Acacia*, *Madhuca Indica*, *Holoptelea* and *Terminalia* are the major elements and are recorded consistently present in the moderate values. The representation of these taxa compares more or less with their frequent presence in the floristic of the region. However, other tree species viz., *Bombax*, *Mimosa*, *Terminalia*, *Emblia officinalis*, *Schleichera* and *Annona* are encountered sporadically. The low pollen frequencies of arbores could be inferred to their sparse presence as well as low pollen productivity since most of them are entomophilous. Among the non arbores, grasses followed by Cheno/Am, Tubuliflorae and *Xanthium* are the prominent constituents and their representation corresponds with their actual presence in the local flora. The record of Cerealia and other culture



Pollen spectra from the surface samples of Chaudhari ka Tal

pollen taxa such as *Cheno/Am*, *Cannabis sativa*, *Brassicaceae* reflects the proximity of human habitation to the lake site. The excessive high frequency of *Typha* suggests its local abundance along the lake margin. The fungal spores *Nigrospora*, *Tetraploa*, *Glomus*, etc. are met with in variable frequencies.

Pollen analysis of 2.4 m thick sediment profile collected from Lashoda Tal of Raebareli district has also been carried out. The pollen assemblage shows open type of vegetation mainly comprising grasses, *Asteraceae*, *Tubuliflorae*, *Brassicaceae*, *Cyperaceae*, *Polygonum* with

scanty presence of tree taxa such as *Madhuca indica*, *Syzygium*, *Acacia*, *Adina cordifolia*, *Holoptelea*, *Alanthus*, etc. together with thickets of *Aspidopterys*, *Acanthaceae*, etc. The record of *Cerealia* and other crop land weed taxa such as *Artemisia*, *Cheno/Am*, and *Brassicaceae* suggest that the area was the agricultural practices during the course of sediment accumulation. Fungal spore such as, *Nigrospora*, *Glomus*, *Curvularia*, and *Alternaria* etc. has also been recovered frequently in the sediments.

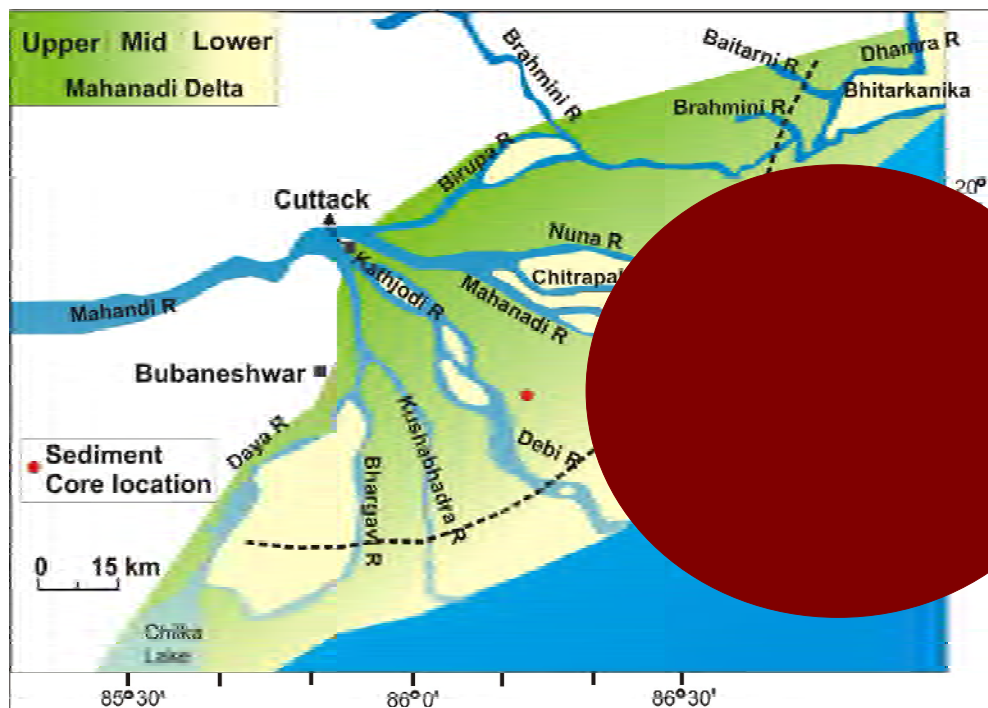
Anju Saxena, Anjali Trivedi & M.S. Chauhan

Project- 8.4: Late Quaternary vegetation and climate studies from lakes of Andhra Pradesh and northwest Uttar Pradesh

Palynological study has been carried out in a 2.5 and 2.0 m cores sediment from Visakhapatnam harbor (mangrove zone). Between 5.0-3.5 kyrs the diversity of mangroves was high in association with moist deciduous and semi-evergreen vegetation. Most of these taxa come under category of riparian forest. The dominant pollen assemblage belong to family *Rhizophoraceae*, *Meliaceae*, *Sapotaceae*, *Anacardiaceae*, *Euphorbiaceae*, *Tiliaceae* and *Aquifoliaceae* followed by *Chenopodiaceae* and *Poaceae*. The *Avicennia* and *Suaeda* pollen along with *Meliaceae* and *Sapotaceae* show abundance after 3.5 kyrs that gradually terminated into abundant *Poaceae* pollen along with stray occurrence of arboreal pollen. It is inferred that gradually the climate changed towards aridity leaving an impact on vegetation, particularly mangroves which was largely enhanced by anthropogenic activity in the harbor area.

Palynological study has also been carried out in a 19 m sediment core from Mahanadi upper delta in order

to address climate, vegetation and palaeoshoreline along the south-east coast. On the basis of pollen/spores the entire core is divided into four phases representing vegetation, climate and palaeoshorelines during pre and post LGM. Prior to LGM, the presence of 11 species belonging to evergreen rain forest and 7 species of mangroves in the vicinity indicate low seasonality. During the LGM, the expansion of herbaceous vegetation is observed along with the pollen of *Madhuca*, *Mangifera* and *Hopea* indicating savanna type of vegetation. Post LGM during middle Holocene there was 57.14% reduction in mangrove diversity and 71.42% reduction in evergreen forest indicating deterioration in ecological conditions due to climate and coastal geomorphological changes. During late Holocene the coastal and hinterland vegetation deteriorated further replaced by dry deciduous vegetation and a fairly good percentage of exotic pollen due to climatic conditions that was enhanced by anthropogenic activity.



Mahanadi Delta and its river system: Palynological record in Sediment Core shows the extent of Holocene Transgression (6-7 ka) in middle deltaic part

The exhaustive survey of coastal areas of Krishna River Delta is done. Deep core samples and surface samples are collected from areas ranging between 5 and 12 km from the present shoreline. The areas recognized for core samples are Avanigadda (Vengal Rao), Machilipatnam (M. Kanuru), Budhumeru (Puttagunta) in the delta and Visakhapatnam (Visakhapatnam harbor). All the core samples range between 3 to 5 m deep. The samples are rich in organic matter, clayey/ sandy clay and good palynological result is expected.

Anjum Farooqui & Ranjana

Project- 8.5: Vegetation succession and climate change in Garo Hills, Meghalaya and adjoining areas since Holocene

Pollen morphology of 65 major arboreal taxa with their phenology has been studied from south Garo and east Khasi hills and its surrounding areas for proper identification of the fossil pollen. Field work has also been conducted in these areas to collect polleniferous material, surface, cave and sedimentary soil samples for palynological study. Chemical analyses of 15 surface samples from Balpakram Valley and identification with observation of palynomorphs are in progress. However,

studied fungal diversity recovered from the east Garo hills sub-surface and profile soil sediments. The good abundance of fungal diversity, i.e. Microthyriaceae, *Cookeina*, *Alternaria*, *Diplodia*, etc. is suggestive of warm and humid climatic condition in the region. The high frequency of *Glomus* in the assemblage indicates the soil erosion which can use as a counter part of palynodata to palaeoecological interpretation in Garo hills and its neighboring areas.

S.K. Basumatary

Project- 8.6: Quaternary mangrove ecosystem dynamics and sea level changes of the Mahanadi Delta and comparative assessment with Sundarbans Delta

For the modern pollen rain studies, 15 surface samples have been palynologically studied from Sajnekhali Island, Sundarbans. In total, 25 pollen taxa are found in the surface sediment samples, of these 6 taxa are true mangrove species. Pollen rain studies indicated that the pollen of local vegetation is more dominant than the pollen of regional vegetation. Furthermore, the local pollen is strongly related to the proximity of source vegetation. A 1.5 m deep sediment profile is also collected and sub-sampled at an interval of 5 cm each from Pakhiralaya

village for palynological investigations. Thirty samples have been analyzed, the overall frequency of occurrence reveals that the genera *Rhizophora* and *Sonneratia* dominated the assemblages throughout the core. Other taxa such as *Acanthus*, *Avicennia*, *Excoecaria*, *Bruguiera*, *Xylocarpus*, *Heritiera*, *Nypa fruticans*, *Suaeda* and *Phoenix palludosa* are abundant in restricted stratigraphic sequences. *Acrostichum aureum*, the only mangrove fern, is abundant in some stratigraphic sequences and particularly in the upper part of the core.

The remaining taxa ranged from common to rare. There is a gradual rise in the pollen frequencies of mangrove taxa, especially *Acanthus ilicifolius*, *Aegiceras corniculatum*, *Excoecaria agallocha*, *Avicennia marina*, *Xylocarpus granatum* and *Aegialitis rotundifolia* in the middle part of the core. The peripheral mangroves, such as *Terminalia* sp., Fabaceae, *Barringtonia racemosa*, *Pongamia pinnata* and Palmae are also represented in good values. Most of the recovered palynomorphs are comparable with the extant mangrove vegetation of the modern Sundarbans.

Islands and buffer areas of Sundarbans, South 24 Pargana Division has been surveyed and surface (mud), sediment profiles, honey and spider web samples are

collected for palynological investigations. Ethnobotanical survey has also been carried out from Pakhiralaya village during the field work. In order to understand the medicinal properties and uses of different mangrove species, interviews are conducted with the traditional medical practitioners. Based on observations, 12 mangrove species belonging to 8 families have been reported, whose various plant parts are extensively used by the local communities for curing different diseases and ailments. This continued practice of consuming valuable medicinal mangrove plant parts through generations have resulted in the decrease in species diversity. In this light, it is imperative to practice practical conservative methods to ensure the preservation of ethnomedicinally important mangrove species.

Shilpa Singh

Project- 8.7: Geomorphological and tectono-climatic signatures in Trans and Tethyan Himalaya during Quaternary Period: A multi-proxy approach

Indus river valley basin in north-west Indian Himalaya is tectonically unstable, exhibiting a complex topography, landscape relief and varied Quaternary sedimentation. A 422 km transect along the Indus river valley from Nyoma to Batalik in Ladakh (Trans Himalayas) reveals the damming of the river four places and existence of four major palaeolakes in the Late Quaternary Period. The commencement and breaching of the palaeolake sequences and the seismites preserved therein mark of the tectonic pluses in the area but the contribution of climate cannot be ruled out. The major geomorphic landforms are alluvial fans, debris cones, unsorted pedestals, fluvio-lacustrine deposits, scree, talus cone, etc. The 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 for forming lakes (preserved as thick piles of fine sediment), while the out burst floods redistributed the sediment down valley. Chronologies of two lakes are available which reveal the presence of one during post LGM times around 17000 yrs BP which breached out

prior to Older Dryas 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 ~1000 yrs BP indicative of the Holocene warming responsible for its sustenance.

To look into the glacial lakes, multi-proxy studies have been undertaken in two glacial lakes of the world's highest pass (Khardungla) at South and North Pulu. The lakes are cored and also a pit and channel sampling is done. A record from 5000 yrs BP to 320 yrs BP years is retrieved from North Pulu, whereas at South Pulu the section is from 4000 to 800 yrs BP. Mineral magnetic parameters have been studied along with the texture, geochemistry, palynofacies and diatoms of these cores. The data is being compiled which will throw light on the variation in the westerly intensity pattern and the ISM spells (if any) during this period in the Trans-Himalayan region. During the field work, lower reaches of Indus valley between Gupuk and Batalik are mapped for Quaternary deposits, and four sections are sampled at cm level for detailed palaeoclimate work.

Binita Phartiyal & Debarati Nag

Project- 8.8: Late Quaternary climate and glacial history from the western Himalayan region

Field work has been undertaken in the glaciated area of Gangotri and Din Gad glacial valleys in Uttarkashi district and collected surface sediments and moss polsters. Subsurface profiles are also collected for the reconstruction of late Quaternary vegetation and climate

vis-à-vis glacial history. The maceration of sediment samples for the palynological analysis is in progress. The palynological data of few earlier surface samples from Gangotri Valley are analyzed to study the pollen dispersal with respect to present vegetational distribution around

the glacier area within the valley. The results are finalized. The sedimentology of a subsurface profile from Tapovan palaeolake, Gangotri Valley has also been done to interpret

fluvial and lacustrine depositional phases. Also the XRD data has been generated for the mineralogical analyzed from IIS, Bangalore.

P.S. Ranhotra

Project- 8.9: Vegetation based reconstruction of Late Quaternary climate of the eastern Himalayas

Reconstructed climatic history since ca. 46.6Ka to present using palynomorphs and non-pollen palynomorphs preserved in two sections (Neora river cutting section and Murti river cutting section) of eastern sub-Himalayan foothill region of Jalpaiguri district (WB). The data suggest that a tropical moist-semi evergreen type of closed forest was prevailing in the region during ca. 46.6 to 21.6Ka, which gradually altered towards a less humid tropical open forest dominated by grasses during LGM. Later on, the climate became humid during 5.4Ka and further shifted towards a less humid condition supporting an open forest. Additionally, field visit is

undertaken in Darjeeling and adjoining areas to collect surface and sub-surface samples to establish a relationship between modern pollen/phytolith spectra reflected in surface sediments of different vegetation zones of eastern Himalayas along altitudinal gradient. The data may provide a basis for the reconstruction of Late Quaternary environmental changes in area. A paper on 'Man-environment interaction and its impact since ca. 3,600 years in West Bengal, India: a multiproxy approach' has been finalized.

Ruby Ghosh

Project- 8.10: Quaternary vegetation and climate change in north and northwestern regions of Chhattisgarh

The palynoassemblages from 12 surface samples collected from Manendragarh Forest Range in Koriya district revealed the dominance of non-arboreals over the arboreals. The trees constitute average 35% pollen in the total pollen rain as compared to lower shrubs upto only 3%. The prominent trees are *Madhuca indica*, *Terminalia*, *Emblica officinalis*, and Sapotaceae. Acanthaceae and *Rungia* are the shrubby elements. Among herbs, grasses have the relatively high frequencies followed by Cereal, Chenopod and Tubuliflorae. However, Liguliflorae, Malvaceae, *Justicia*, *Tribulus*, *Pedaliaceae*, etc. are scanty. Cereal, Chenopod, Caryophyllaceae, Brassicaceae, *Artemisia* and *Alternanthera* document the agrarian activities in the study area. Also pollen analysed 10 surface samples collected from newly planted sal (*Shorea robusta*) forest from Chainpur area of Manendragarh Forest Range. The palynoassemblage has demonstrated the dominance of non-arboreals over the arboreal taxa. Among the arboreals, *Shorea robusta* is recovered with average low pollen value of 0.63% in the samples. The erroneous behaviour of sal pollen could be ascribed to its poor preservation in the sediment samples as well as its low dispersal efficiency. The present finding is in agreement with the results drawn from eastern MP and Chhattisgarh.

The recovered palynoassemblages from 12 moss polsters collected from Lakadandh Swamp, Baikunthpur Forest Range demonstrate the dominance of non-arboreals

over the arboreals. Among the tree taxa, *Shorea robusta* is recorded with average 1% pollen in the sediments. *Madhuca indica* is encountered in high frequencies. In addition, *Terminalia*, Sapotaceae, *Emblica officinalis*, *Lagerstroemia*, *Syzygium*, *Lannea coromandelica*, *Diospyros*, and *Holoptelea* are meager. Among the non-arboreals, grasses contribute in high frequency in the total pollen rain. Cereal, Chenopod, Caryophyllaceae, Brassicaceae, *Alternanthera* and *Artemisia*, etc. indicate the agriculture practice and other human activities around the study area. Pollen analysis of a 1.8 m deep sediment profile containing 36 samples from Lakadandh Swamp is in progress. However, the preliminary investigation of 6 profile samples has revealed the pollen assemblages comprising grasses, cereal, and other culture pollen taxa comprising Chenopod, Caryophyllaceae, though scatteredly, Asteraceae (Tubuliflorae) together with the sporadic presence of *Holoptelea*, *Acacia*, *Terminalia*, *Lannea*, *Diospyros*, *Butea*, *Shorea robusta*, *Lagerstroemia*, except *Madhuca indica*. The vegetation composition indicates the presence of open mixed tropical deciduous forest during the period of deposition of sediments. The encounter of zygospores of *Zygnema* and *Spirogyra* along with *Lemna* and *Potamogeton* signify the presence of wider water body in the past in and around the study area.

S.K. Bera & Md. Firoze Quamar

Polar Research Group

Project- 9.1: Deciphering the Quaternary climate history of the Polar regions: Multi-proxy studies from Antarctica and Arctic

Twenty samples from a 1 m trial-trench from Kolhamna Lagoon, Ny-Alesund, Svalbard, have been processed for palynomorphs. The upper part of the trench (up to 70 cm) comprises of terrestrial sediments having peat, clay, silt, sand and grits, while the lower part has marine influence. Though dispersed organic matter is abundantly found throughout the profile, pollen-spores are conspicuous by their absence. Further, the profile is studied for foraminiferal content. Though, marine signatures are present in the lower part of the trench in the form of shell fragments, no foraminifera are found throughout the core. The samples are thereafter studied for quartz grain microstructure under SEM for their depositional characters. On the basis of grain morphology, glacial dominated, aeolian dominated and aqueous dominated sediments were deciphered.

For developing the aeropalynology of the region, dispersed air-borne palynomorphs caught in the exposed slides are being further studied. Though, Ny-Alesund is a vegetation sparse area, the slides have yielded a diversity of pollen, algal and fungal remains of both local and extra-local provenance. Besides, samples from other profiles are being processed for the release of palynomorphs and qualitative and quantitative studies of the same are continuing for the interpretation of Quaternary climatic changes of the Arctic region.

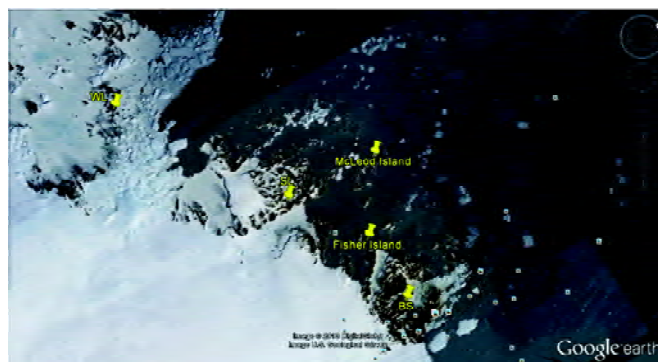
Ratan Kar

Collection of sediment cores has been done up to some limit during 32nd Indian Antarctic Expedition Summer. One sediment core of 90 cm has been obtained from the lake L3 of Bharati island. Another 4 cores from surrounding islands in Larsemann Hills area - one of 40 cm from McLeaod Island, one of 40 cm from Fisher Island, one of 30 cm from Broknes Island and one of 58 cm from Stornes Island are also obtained. In Schirmacher Oasis, many lakes have been observed for the sediment coring, but in beginning of ISAE lakes bed are covered with lots of glacial debris and very less sediment in it. However, due to lake is open in the month of January, immersion suits (water proof) are used to collect lacustrine sediment cores. To catch the sediment from the lakes of this area, the corers are modified and fabricated in the field and used as per the requirements of the lake beds and the sediment thickness over these. A total of 6 sediment cores, one of 30 cm from the eastern side, two of 50 cm each from the central side, and one of 96 cm from the north part of Oasis, one of 58 cm from EpiShelf area and one of 50 cm from one of the Nunatake away had been retrieved.

Pawan Govil

The samples (6) for the core of Antarctic lake L-49 (collected previously) have been processed for diatom and geochemical studies. Same sediment samples are also processed for 10 Be dating (in IUAC, New Delhi).

Pawan Govil & Abhijit Mazumder



Larsemann Hills (East Antarctica) Lake sediment coring and core locations

Project- 9.2: Study of Modern and Quaternary environmental/ climatic conditions of the river Ganga, India and Polar regions involving assessment of climate-human-environment interactions using integrated multi-proxy data

Quantitative data is generated from the Svalbard sediment samples of the Arctic region. Prepared slides have been scanned under the microscope for quantitative and qualitative study of dinoflagellates, diatoms and other dispersed organic matter contents. Slides are also prepared from the recovered siliceous organic matter of arctic lake and fjord sediments. Antarctic organic matter contents including fresh water diatoms are studied. Detailed study of Southwest Indian Ocean siliceous sediments down the core is being done including the study of SEM images for morphological study. Prepared and finalized two manuscripts, one on siliceous sedimentation and carbon dioxide transport in the Southwest Indian Ocean: Role of Antarctic Bottom Water, and another on Role of Antarctic Bottom Water in siliceous sedimentation and carbon transport to the Southwest Indian Ocean.

Sediment samples have been collected by trenching Quaternary sequence at two points (78°57'42.33° N: 11°27'23.25° E & 78°57'42.20° N: 11°27'23.06° E) in Svalbard area. The sequence is trenched up to the depth of 1.2 m and 0.8 m. Sampling is done at varying thickness, at 5-10 cm interval depending on the grain size of sediments, i.e. close sampling is done for fine grained sediments. Van Veen Grab Sampler has been used to collect surface sediments from the Kongsfjorden onboard the boat Tiesten. Grab sampling followed transects selected by the NCAOR for detailed study involving various proxies. Algae and sediment samples are also



Two overlapped dots represent the trench sampling locations

collected from various aquatic environments around Ny-Alesund.

Preliminary processing of sediments and algae samples has been done in the Kings bay Marine Laboratory, Ny-Alesund. Wet sediment samples are oven dried at 35°C for packing. Sediment samples are processed using palynological procedure involving acid treatments and sieving for extraction of palynomorphs. This is done to check the availability of various palynomorphs in varied environmental settings, in order to collect high yielding samples.

Vartika Singh

Dendrochronology Group

Project- 10.1: High-resolution palaeoclimatology of western Himalaya

The ring width chronologies of *Pinus gerardiana* and *Cedrus deodara* from different sites have been used to develop drought indices extending back to AD 1310 are developed. The 20th century features dominant decadal scale pluvial phases (1981-1995, 1952-1968 and 1918-1934) as compared to the severe droughts in early 17th (1617-1640) and late 15th, early 16th (1491-1526) centuries. The drought anomalies are positively (negatively) associated with central Pacific (IPWP) SST anomalies. However, non-stationarity in such relationships

appears to be the major riddle in predictability of long-term droughts much needed for the sustainable development of the ecologically sensitive region of the Himalayas. To extend the chronologies further back tree ring samples of *Pinus gerardiana* and *Cedrus deodara* are collected from different sites in Kinnaur, Himachal Pradesh. Over 1600 year long chronology of *P. gerardiana* is being developed.

R.R. Yadav & K.G. Misra

The tree-ring samples have been collected from various climate sensitive and open forests sites for long term climatic reconstruction in Chamba, Himachal Pradesh. The tree core samples (133) of *Cedrus deodara* (from 97 trees) are collected from areas around Pranghala,

Hadsar, Kugati and Sandi. Apart from tree cores, samples of mass cushions (66), sediments (24), and spider web (7) are also collected from the areas for modern vegetation analysis.

K.G. Misra

Project- 10.2: Tree-ring analysis from high altitude areas of Himalayan region: A comparative approach with emphasis on the eastern sector

Reconstructed summer month's (March-April) discharge data of Beas River back to AD 1834 using tree-ring data of *Cedrus deodara* growing within the Beas River Basin, Kullu valley in western Himalaya. The reconstructed data is spatially compared with regional gridded precipitation, PDSI and nearby longest instrumental precipitation records. Cross-dated Juniper scrub tree-ring samples collected near to Zemu glacier,

North Sikkim. Preliminary cross-dating of tree-ring samples based on 184 radii from 28 trees of Juniper showed possibility of chronology up to 140 years (AD 1881-2010). In addition, palynological study of sub-surface sediment profile from Ziro Valley Arunachal Pradesh is conducted (jointly with A. Bhattacharyya).

S.K. Shah

Thrust Area 6: DOMESTICATION OF PLANTS, EARLY FARMING AND ECOSYSTEM DYNAMICS DURING HOLOCENE/ANTHROPOCENE

Palaeoethnobotany Group

Project- 11.1: Palaeoethnobotany: Ancient man, plants and environment in northern, eastern and northwestern India

Morphological investigation of seed and fruit remains' samples has been carried out from Chalcolithic site Ghorakatora, the ancient habitation site lies in village Ghorakatora (lat. 25°01'23.73" N, long. 85°31'23.13" E) near Giriyaak in District Nalanda and situated in between Bihar sharif and Nawada. 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) and *Lens culinaris* (Lentil); along with indigenous *Oryza sativa* (Rice), *Vigna radiata* (Green gram), *Vigna mungo* (Black gram) and horsegram (*Dolichos biflorus*). In addition to these, crop remains Silk-Cotton are other finds. *Echinochloa crus-galli* (Sawar-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), *Cleome* sp. (Hurdhur), *Commelina benghalensis*, *Cyperus* sp. (Flat sedge), *Fimbristylis* sedge, *Scirpus* sp., *Chenopodium* sp. (White Goose foot/Bathua), *Medicago* sp., *Ziziphus* sp. (Jujube), *Coix lachryma-jobi* (Job's tears), *Polygonum barbatum*, *Desmodium gangeticum* (Tick clover), *Indigofera hirsuta* (Indigo), *Panicum* sp. (Panicum grass), *Sida* sp., *Solanum* sp.,

Trachyspermum sp., *Trianthema* sp., *Vicia sativa* (Common-vetch) of palaeo-ethnobotanical significance are also recorded.

The samples investigated have added data to advanced agricultural practices in this region of middle Ganga Plain in ancient times between Period I: Chalcolithic Period (c. 1500 BC- 800 BC), Period II: N.B.P.W. Period (c. 800 BC- 200 BC), Period III: Sunga-Kushana Period (c. 200 BC- 300 AD), and Period IV: Gupta and post Gupta Period (c. 300 AD-800 AD). In addition, re-visited the ancient site at Kampil, District Farrukhabad, UP and collected more botanical remains in collaboration with the excavation team from department of Ancient Indian History & Archaeology, University of Lucknow.

Chanchala Srivastava

Analyzed archaeobotanical samples collected from a Harappan settlement Khirsara in Kachchh district, Gujarat datable to 2800-2000 BC. The finds include the remains of *Hordeum vulgare* (Hulled barley), *Triticum aestivum* (Bread wheat), *Sorghum bicolor* (Jowar-millet), *Pennisetum typhoides* (Pearl millet), *Macrotyloma uniflorum* (Horse-gram), *Vigna radiata*



(Green-gram), and *Sesamum indicum* (Sesame). In addition to these, a fibre-crop represented by the presence of seeds of Cotton (*Gossypium arboreum/herbaceum*) has been identified in the collection. Associated with these crop remains as an admixture, the remains of the seeds

and fruits of weeds and other wild taxa have also been recorded. Besides, participated in the excavations and collected botanical remains from the Harappan sites Khirsara and Kotada-Badli in Kachchh.

A.K. Pokharia

Project- 11.2: Studies on floristics and ethnobotany including mangrove vegetation of Western Ghats (Tamil Nadu & Kerala States)

About 145 plant species belonging to 124 genera and 92 families have been identified from the Annamalai forest collected in 2010. Three plant species (*Solanum diphyllum*, *Solanum pimpinefolia* and *Cosmos caustatus*) are found to be new to Western Ghat and one plant species (*Phylla longifolia*) from India. Besides,

ethnobotanical data is collected from different Malasar tribe localities of the forest, and recognized under 10 plants used as food, 18 plant species as medicine, 2 plants as edible oil, and 3 plants used as fiber and cordage.

D.C. Saini

Thrust Area 7:

GEOCHRONOLOGICAL AND GEOCHEMICAL INPUTS FOR HIGH RESOLUTION DATING, CORRELATION, PALAEOCLIMATIC, TECTONIC AND PROVENANCE STUDIES

Geochronology and Geochemistry Group

Project- 12.1: Development and application of the integrated geochronometric, geochemical and isotopic approach in deciphering the palaeoclimatic and archaeological events

The radiocarbon laboratory and the elemental analyser are kept operational and dating of sediment and charcoal samples of palaeoclimatic and archaeological interest is carried out in addition to carbon, nitrogen measurements on sediments of palaeoclimatologic interest. Processing for benzene has been carried out on 130 samples and beta counting on 126 samples during this period. These included sediments, charcoal, wood samples and shells. A total of 125 sets of carbon, nitrogen measurements are carried out including standards and 63 samples from Phubla (Manipur), Mardunga and Nachiketa (Uttarkashi), Ermangalam lake (TN), and Antarctica.

During a field trip off the Jamnagar coast (Gujarat), as a part of team with GEER, Gandhinagar, collected coral samples from 4 islands and their radiocarbon dating is in progress. The radiocarbon dates on material of

archaeological interest, mostly from the Indo- Gangetic plains in India, compiled and reviewed with perspective, has appeared in a book. Basing on the growing evidences, the report concluded that the Indian cultural sites are in general older than earlier believed. A co-authored manuscript reporting joint work dealing with palaeoclimatic reconstruction based on the sediment samples from the Jalesar Tal in Unnao is revised as per referee's suggestions. The analyses of data for the eastern Himalayan foothills are continued with co-workers at the Institute and interpretation done. In addition, the maintenance/ repair works on electrical furnace and glass system, the procurement of the essential components like Bath, chemicals and standards, and maintenance of equipment are continued to keep the laboratory operational.

C.M. Nautiyal

Additional Research Contributions

Microbiotas from the laminated cherts of Chhattisgarh Supergroup exposed at the northern Bank of Mahanadi near the Saradih Township, Raigarh district have been studied. They include acritarchs (sphaeromorphs, acanthomorphs) and cyanobacterial remains (coccoïdes and filaments). The preliminary study shows Cryogenian age for this sequence of Raipur Group. Saradih stratigraphic position is uncertain based on earlier published rhyolitic Sukhda tuff data and more attention is needed before fixing the absolute age of Chhattisgarh Supergroup.

Identified 29 microbiotic distinct taxa of 17 genera comprising ovoid and fusiform acritarchs (21 taxa of 11 genera) and cyanobacteria (8 taxa of 4 genera) of trichomes and colonies from the grey-black shale belonging to Saraipali Formation, Singhara Group, exposed at 5 km along in Lat nala cutting section in Palsapali area, Chhattisgarh. Diversified distinct acritarchs are *Asperatopsospahera*, *Leiosphaeridia*, *Leiofusidium*, *Majasphaeridium*, *Microconcentrica*, *Podolina* sp., *Pseudofavospaera*, *Pterospermopsimorpha*, *Satka*, *Schizofusa*, *Trachysphaeridium* and *Valvimorpha* belong to Sphaeromorphida, Sphaerohystrichomorphida, Fusimorphida and Versimorphida subgroups. The cyanobacterial remains are solitary and colonies of sphaeroidal cells and unbranched trichomes both septate/aseptate with/without mucilaginous sheath are compared to known *Myxococcoides*, *Polysphaeroides*, *Qigshania*, *Siphonophycus* and *Taeniatum* from the sedimentaries of China and Australia. The comprehensive analysis of the recovered forms based on varied shaped morphologies— shape, size, and colour gradient indicate Statherian age (1800-1600 Ma) for the Saraipali Formation and evidence of Palaeoproterozoic diversification of eukaryotes, early eukaryotic algal reproduction, fluctuating, modern deep, warm marine water.

Microfossil assemblage, comprising colonial, filaments both branched and unbranched, chitinozoans, acritarchs, organic plates, fragmented multicellular and carbonized cuticular forms has been recorded for the first time from the dark grey shales of Permo-Triassic type section exposed in Guryul Ravine, Kashmir. The preliminary study of dark brown-black coloured microfossils indicates conjugated environment settings in type section and thermogenic activity in and around by any natural episode based on the nature of preservation and low frequency.

The report of 12 surface samples (2 shales and 10 limestone/dolomites), provided by Dr. Rajeev Bhoj, Dy.GM of Vindhyan Basin, Frontier Basins ONGC, Dehradun has been compiled to estimate the age based on yielded fossils. Dark grey colour limestones yielded stray and highly distorted, black microbiotic assemblage (30 taxa of 24 genera) comprising of algae (cyanobacteria and ?Chlorophyceae) including sphaeromorphs, acanthomorphs and scaphomorphs subgroups of acritarchs.

Rupendra Babu

Early Cryogenian organic-walled microfossils assemblage of 18 taxa of 12 genera belong to eukaryotes and prokaryotes have been recovered for the first time from the Saradih Formation of Raipur Group exposed on the right bank of Mahanadi River at Dhota village, Raigarh district, Chhattisgarh. The comprehensive account of microbiotic assemblage can be correlated with globally known Neoproterozoic (early Cryogenian) assemblages, deposited in tidal complexes of shallow sea.

Rupendra Babu & V.K. Singh

Fossil evidences for palaeofire from different regions of all over Gondwana have been summarized. Fossil charcoal has widely been accepted as a direct indicator for the occurrence of palaeo-wildfires. In Upper Palaeozoic sediments of Euramerica and Cathaysia, records of these remains are relatively common and (regionally and stratigraphically) more or less homogeneously distributed in terrestrial sequences. On the other hand, just a few records are known for the Permian of Gondwana and only recently it has been demonstrated that macroscopic charcoals are also common here. Most Permian macroscopic charcoal from Gondwana is gymnospermous and has been reported from coal-bearing strata. Macroscopic charcoal occurrences are spread out in different sequences and also in distinct stratigraphic intervals in the Permian [e.g., Paraná Basin (Sakmarian/ Artinskian of Brazil), Karoo Basin (Artinskian of South Africa), Damodar Basin (Lopingian of India) and Dead Sea area (Changhsingian of Jordan)]. They range from peri-glacial/post-glacial to warm temperate climatic systems throughout the Permian. Macro- and micro-charcoal occurrences have been compared to inertinite incidences to support the pyrogenic origin for these coal macerals and to provide an up to date overview on the known evidences of Permian wildfires on Gondwana in space and time (jointly with Andre Jasper, Margot Guerra-Sommer, Abdalla M.B. Abu

Hamad, Marion Bamford, M.E.C. Bernardes-de-Oliveira, Dieter Uhl).

Rajni Tewari

Documentation on three morphotypes of *Noeggerathiopsis hislopii* leaves recorded from the Pench Valley Coalfield of Satpura Gondwana Basin has been finalized. The external morphological features of *Noeggerathiopsis* recovered from different collieries are examined in detail. All the leaves are apparently comparable with *N. hislopii* Feistmantel (1879) in shape and venation pattern. Critical observation of leaves indicates variable nature in thickness of veins: i) veins thin and uniform throughout the leaves, veins dichotomizing 5-6 times, ii) veins thick towards base than the veins towards apex, dichotomizing 2-3 times, iii) veins in central part thick, dichotomizing 4-5 times. Morphotaxonomy and systematic analysis of seeds is being carried out (*Codaicarpus*, *Cornucarpus*, *Alatocarpus* and *Samaropsis*) from Rawanwara area. Additionally, field work has been carried out for collection of more plant fossils from the open cast and underground mines of Pench and Kanhan valley coalfields. The grayish black fossil bearing sediments of Ganapati (u/g), Chhinda (OCP), Shivpuri (OCP) Phase I & II, Thesgora (u/g), Mathani (u/g), Urdhan (OCP), Vishnupuri I (u/g), Vishnupuri II (u/g), and Pench East Incline belong to Barakar Formation. Fossils mostly belong to genera *Glossopteris*, *Gangamopteris*, *Noeggerathiopsis*, *Samaropsis*, *Cordaicarpus*, *Alatocarpus*, *Arberia* and equestalean axis. Two out crop sections are also sampled, i.e. Pench river section on the way to Shivpuri, and Motur (Bijori) Formation road section from Urdhan ghat near Shani Mandir for palynological study.

S.S.K. Pillai

In continuation with earliest record of *Williamsonia* flower from Washtawa Formation (Nara Shale Member) of Callovian-Oxfordian age, further detailed study with some new fossil plant remains is in progress. Besides, the study on fossil woods from Jaisalmer area of Rajasthan has been initiated. The preliminary study suggests its podocarpacean affinity.

Neeru Prakash

Plant mega remains recorded first time from the bore core samples of Chintalapudi sub-basin of Pranhita Godavari Valley at various depths (293-398 m) have been finalized. The samples contain megafossils of genus *Ptilophyllum* along with other plant remains like *Elatocladus*, *Pagiophyllum* species. The present floral assemblage shows resemblance with Gollapalle (Gollapalle

Formation) and Sehora (Jabalpur Formation) of India and Yaragadee Formation of Perth Basin, Western Australia. However the Antarctic flora does not show resemblance.

Neeru Prakash & Neerja Jha

The results of the analysis of samples from New Majri open cast mine of Wardha Basin have been finalized. Palynofacies analysis of samples from Raniganj Coalfield of Damodar Basin has also been carried out.

K. Pauline Sabina

Spores-pollen contents from the Barakar Formation exposed in Shivapuri open-cast coal mine near Parasias town, Chhindwara district, Pench Valley Coalfield has been finalized. Dominance of radial monosaccate pollen taxa (*Parasaccites* and *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 Formations of Early Permian age. In the upper section (31 m depth), an abundance of *Striatopodocarpites*, *Indotriradites* and *Scheuringipollenites* infers to the Barakar Formation and is considered late Early Permian in age. In the top section, an abundance of striate bisaccate pollen taxa (*Crescentipollenites*, *Striatopodocarpites* and *Faunipollenites*) represents Bijori Formation, which is equivalent to Raniganj Formation of Damodar Basin. The FAD's of *Arcuatipollenites* spp., *Klausipollenites schaubergeri* and *Playfordiaspora cancellosa* observed between samples SPO 34-36, enhance the end of Permian is suggested as these species mark the transition of the Permian level into the Lower Triassic.

Field work has been carried out around Badami Taluka (lat. 15°60' - 16°N and long. 75°40' - 75°45' E) of Bagalkot district, Karnataka. Samples have been collected from different stratigraphic units of Badami Group exposed in Kerur, Mahakut, Halgeri and Belikhindi villages, Katageri hillock, dolomite mine, Bilikhindi village, near Halakurki village and nala near Konkanakoppa village.

Srikanta Murthy

Coal samples from bore hole EBM-1 of Muditoli block East Bokaro Coalfield have been subjected to petrographic study to analyse their hydrocarbon potential. The samples at a depth of 984.95 m and 1142.15 m are found to be rich in vitrinite and liptinite (mainly represented by resinite) macerals inferring that the studied coals have the potential to generate hydrocarbons. Based on the reflectance of vitrinite ($VR_o = 0.62\%$) the coals are less thermally altered and are ascribed to high-volatile bituminous rank.

S. Mahesh & Srikanta Murthy

A fossil wood of *Eucalyptus* of the family Myrtaceae is described from the Deccan Intertrappean beds of Dindori district, Madhya Pradesh and comments are made on its palaeophytogeography.

R.C. Mehrotra & Anumeha Shukla

Few woods from the Cuddalore Sandstones near Pondicherry have been investigated. They are tentatively identified as *Eucalyptus* and *Melaleuca* (Myrtaceae), *Dipterocarpus* and *Shorea* (Dipterocarpaceae).

Rashmi Srivastava

Processing of samples (Miocene age) of Khari Nadi Formation has been done. The recovered palynoflora is mainly consists of angiosperm pollen grains and some pteridophytic spores. Besides, freshwater forms belonging to *Zygnema* and *Spirogyra* and fungal spores are also recorded. The assemblage is poor in both quality and quantity. Fossil taxa are assignable to the families—Zygnemataceae, Schizaeaceae, Cyathiaceae, Parkeriaceae, Liliaceae, Bombacaceae, Malvaceae and Brassicaceae. The palynological data indicate prevalence of tropical conditions and is assigned as Early Miocene in age. Processing of samples of Dayapar-Kara road section (Intertrappean beds) has also been done. Scanning, photo-documentation and identification of spore-pollen have been completed. Some of the important genera are—*Callialasporites*, *Araucariacites*, *Podocarpidites*, *Lygodiumsporites*, *Cyathidites*, *Todisporites*, *Cicatricosisporites*, *Concavisporites*, *Proxapertites* and *Palmidites*. Data interpretation has been taken and continued.

Sunil Bajpai, M.R. Rao & Poonam Verma

The palynoassemblage recovered from Dalamiapuram Formation (GVKC and Kallakudi Mine-II, Cauvery Basin) consists of dinoflagellate cysts (10 genera and 17 species), pteridophytic spores (17 genera and 20 species) and gymnosperm pollen grains (3 genera and 3 species). In addition to these, fragments of cuticles and some wood trachieds have also been recorded. The important genera are *Achomosphaera*, *Oligosphaeridium*, *Tenua*, *Thalassiphora*, *Cordosphaeridium*, *Cleistosphaeridium*, *Cannosphaeropsis*, *Polysphaeridium*, *Florentina*, *Hexagonifera*, *Cleistosphaeridium*, *Cyclonephelium*, *Ovoidinium*, *Odontochitina*, *Spiniferites*, *Trichodinium*, *Appendicisporites*, *Cicatricosisporites*, *Callialasporites*, *Osmundacidites*, *Cyathidites*, *Biretisporites*, *Impardecispora*, *Lycopodiacidites*, *Klukisporites*, *Equisetosporites*, *Araucariacites* and *Podocarpidites*. The assemblage is dominated by

dinoflagellate cysts (60%) followed by gymnospermous pollen (24%) and pteridophytic spores (16%). Abundance of dinoflagellate cysts with bisaccate pollen grain and less representation trilete spores, is suggestive of a comparatively of more open and the depositional environment was near shore, shallow marine.

M.R. Rao

Analysis of samples from Mine IA of Neyveli lignite deposits, Cauvery Basin (TN) has been completed. A diversified assemblage of dinoflagellate cysts namely *Glaphyrocysta*, *Adnatosphaeridium*, *Enneadocysta*, *Cordosphaeridium*, *Operculodinium*, *Spiniferites*, *Polysphaeridium* and *Xenascus* have been recorded for the first time from the mine. In addition to these, significant palynotaxa consisting of *Lygodiumsporites*, *Proxapertites*, *Palmaepollenites*, *Dorrenipites*, *Marginipollis*, *Dermatobrevicolporites*, *Lanagiopollis*, *Tribrevicolporites*, *Retitrescolpites*, *Meliapollis*, *Dipterocarpuspollenites*, *Rhoipites*, *Cruciferoipollenites*, *Ctenolophonidites* and *Clavaperiporites* are also recorded from the section; indicating Early to Middle Eocene age and coastal environment of deposition.

Analysis of samples from Neyveli Mine I and Mine II deposits 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*, *Dermatobrevicolporites*, *Pelliceroipollis*, *Lanagiopollis*, *Tribrevicolporites*, *Retitrescolpites*, *Meliapollis*, *Palaeosantalaceapites*, *Rhoipites*, *Dipterocarpuspollenites*, *Cruciferoipollenites*, *Verrutricolpites*, *Ctenolophonidites*, *Jacobipollenites* and *Clavaperiporites*. Dinoflagellate cysts are not recorded from these mines. A critical study reveals that the assemblage recovered indicates Early to Middle Eocene age and coastal environment of deposition. A Manuscript entitled 'First record of dinoflagellate cysts from Neyveli Lignite Mine, Cauvery Basin: Age and depositional environment' has been prepared.

M.R. Rao & Poonam Verma

The palynoassemblage, recovered from the Lower Siwalik sediments of Darjeeling district (WB) and the samples collected from a well exposed section in the Lish river about 1.5 km from Bagrakot, is dominated by gymnosperm (60%), but also has pteridophytes (2%) and angiosperm (25%). The fungal spores are also present in the assemblage. The following taxa have been identified:

Notothyrites sp., *Pluricellaesporites minusculus*, *P. subcapsularis*, *P. serratus*, *Multicellaesporites ellipticus*, *Trichopeltinites reccioides* sp. nov., *I. lanceolatus* sp. nov. (fungi); *Pteridacidites robustus* (pteridophyte); *Araucariacites* sp., *Pinuspollenites siwalikus*, *Abiespollenites undulatus* sp. nov., *Cycadopites* sp. *Podocarpidites naviculus*, *P. meghalayaensis* and *Podocarpidites* sp. (gymnosperm); *Neocouperipollis curvispinosus* sp. nov., *Palmidites* sp. and *Pseudonothofagidites cerebrus* (angiosperm). On the basis of their affinities with modern equivalents taxa, a humid tropical to sub-tropical climate has been inferred during the deposition of sediments. The plant mega fossil evidences from this area also indicate a tropical evergreen to moist deciduous vegetation during the Middle Miocene. The presence of *Neocouperipollis curvispinosus* sp. nov. and *Palmidites* sp. supports the existence of a humid environment in the study area. In the present assemblage the gymnospermous pollen taxa, *Pinus*, *Abies*, *Podocarpus* and *Araucaria* are considered to have been derived from a nearby high mountain area.

Hukam Singh, Mahesh Prasad & S.K. Singh

Coral and algal assemblages from some selected Andaman-Nicobar group of Islands, viz. Havelock, Neil, Ross, Jollybuoy and Chidiya Tapu beach near Port Blair have been studied using transect and quadrat analyses. A total of 144 coral and 78 algal species have been recorded from these Islands. A paper entitled 'Diversity of Corals and Benthic algae across the shallow water reefs of Andaman Islands: Need to roll the conservation band wagon in right direction' is finalized.

Samir Sarkar, Suman Sarkar & A.K. Ghosh

A review of Indian contribution in palaeobotanical studies of late Cretaceous-early Paleogene has been carried out. This includes the time of origin of grass family Poaceae and rice tribe Oryzae based on the analysis of late Cretaceous dinosaur coprolites and sediments bioevents at the K-Pg boundary in Um Sohryngkew River section in Meghalaya, NE India and the effects of environmental stress from Deccan volcanism on Palaeogene flora presently restricted to Western Ghats, the role of dinoflagellates in dating the highly diversified mammal-bearing levels within the Vastan lignite mine, and the presence of dipterocarp angiosperm trees in the Early Eocene of India.

Phytolith studies have been carried out from Harappan archeological sites Kaj and Kanjetar from mid-Saurashtra coast. Phytolith data shows low percentage of *Hordeum*, *Triticum* (well established winter season crops) and abundant cuticular remains of millets

(*Pennisetum* and *Avena*), drought tolerant plants in both the sites after 2000 yr BC. This is in contrast with the well established winter season crops (Wheat, Barley) of early Harappans, suggesting adjustment in terms of subsistence strategies and increasingly reliance towards more drought tolerant rain-fed crops (millets).

Vandana Prasad

Palynological studies have been conducted on yellow rain samples in Lucknow environ during early summer of 2013.

S.K. Bera, Kanupriya Gupta & Swati Dixit

A 5 m deep sedimentary profile is observed from South Tripura district in order to establish palaeovegetation and palaeoclimate of that area. Six different vegetation phases under warm and less humid to relatively dry climate is deciphered through palynological record. *Navicula*, *Gomphonema*, *Surirella*, *Fragilaria* and *Pinnularia* are the major diatom group encountered in the sedimentary sequence. Radiocarbon dating is in progress.

Swati Dixit, S.K. Bera, B.D. Mandaokar & C.M. Nautiyal

A 1.5 m deep river section has been pollen analyzed from the Chhattisgarh area. The palynodata displays three climatic regimes in the area since 3,500 years BP.

Swati Dixit, S.K. Basumatary, V.K. Singh, C.M. Nautiyal & S.K. Bera

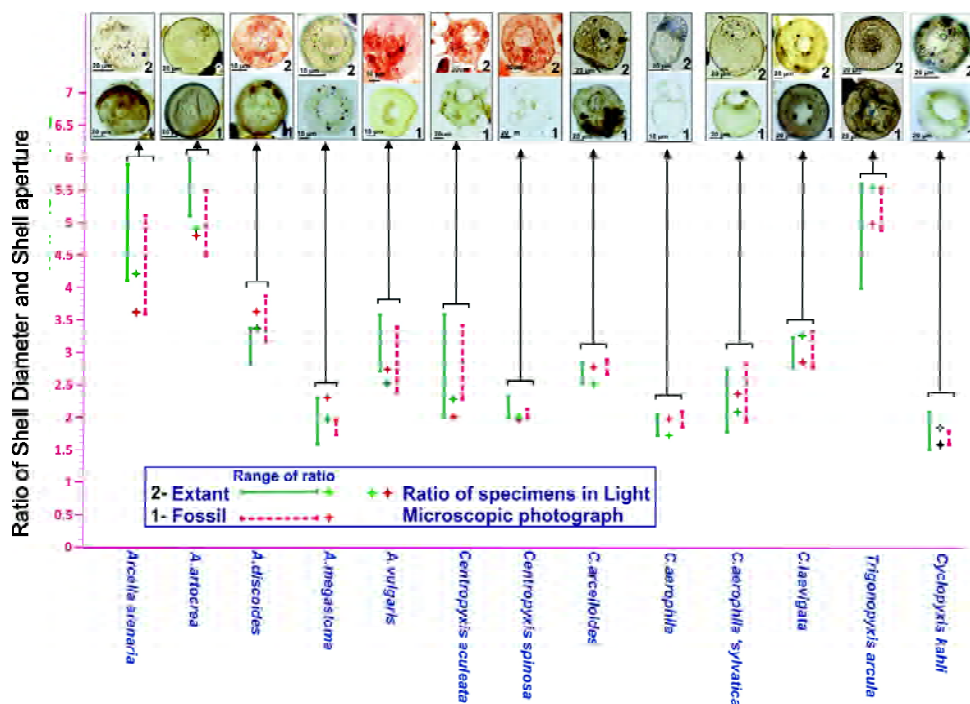
A 2 meter exposure section from Shillong-Cherrapunjee road (Duwan Sing Syiem Bridge area) has been studied. The study signifies the four vegetation succession under cold and dry to relatively less warm and humid climatic condition since 20,730 years BP.

S.K. Basumatary, S.K. Bera, Swati Dixit & C. M. Nautiyal

Ten surface samples have been pollen analysed from Chamarajnagar district, Karnataka. The overall palynodata reveals the openland vegetation consisting of *Syzygium*, *Meliaceae* and *Rutaceae* in the area. The continuous presence of *Cerealia* along with other cultural pollen, like *Chenopodiaceae* and *Lamiaceae*, is strongly suggestive for the anthropogenic activity in the area. The studied palynodata will be helpful for the precise interpretation in palaeoecological study in and around the study area.

S.K. Basumatary, S.K. Bera & S. Murthy

Diverse assemblages of thecamoebians (Arcellacians) are reported from Late Permian sediments of Godavari Graben in India. Sixteen thecamoebian species are identified and the morphometry of fossil and modern specimens is analysed. The result supports the current hypothesis of minimal evolution in thecamoebian



Comparative account of ratio between Shell diameter and Shell aperture in fossil and extant thecamoebians

lineages through geological time.

Anjum Farooqui, Neerja Jha & Neha Aggarwal

Manuscript entitled 'Role of tree-ring study in forest management: Prospects in Indian context' has been prepared. The manuscript dealt with the application of tree-ring analysis in relation to the forest resource inventory of India.

A. Bhattacharyya, M. Shekhar & S.K. Shah

The sediments collected from the exposed section along the Madhwali Nadi near Matanomadh village have been analyzed for the palynological assemblage. The section has yielded terrestrial palynoflora and dinoflagellate cysts. The assemblage containing pollen of gymnosperm *Podocarpidites* (Podocarpaceae) and angiosperms taxa, viz. *Graminidites* sp. (Poaceae), *Dipterocarpus* sp. (Dipterocarpaceae), etc. along with pteridophytic spores (sp. of *Striatriletes*, *Cyathidites*, *Acrostichum*, Polypodiaceae, etc.) and fungal bodies (*Phragmothyrites* sp.) indicates the humid tropical climate. The low amount of dinoflagellate cysts in the lower to middle portion of the section and their diversification in the upper part of the section with *Homotryblum* and *Polysphaeridium* spp. indicates marsh or back swamp to inner shelf depositional environment respectively. A 12 feet thick escarpment near Harudi village showing the contact of Harudi and Fulra

Limestone formations is palynologically barren, except two samples from Harudi Formation near the contact yielded dinoflagellate cysts, thus indicative of marine environment.

The environmental magnetic data has been generated (at IIG, Allahabad) for the collected samples, which is a first ever attempt to understand the past environment and source of the Tertiary deposits. The magnetic susceptibility (χ_f) data corresponds well with lithology of the formations. Few sediment samples from the Harudi, Fulra and Chhasra Formations are also analyzed (at NGRI, Hyderabad) for the $\delta^{13}C$ and $\delta^{18}O$ analyses. The $\delta^{13}C$ and $\delta^{18}O$ data range between 1 to -3‰ and -1 to -7‰ v-pdb respectively, thus indicating the marine depositional environment with transgression-regression cycles and fresh water influx.

P.S. Ranhotra

The organic matter (OM) recovered from the Permo-Triassic boundary section of Kashmir has been worked out. The OM preserved in the Guryul ravine section has revealed a persistence of anoxic conditions during the deposition, following the important PT boundary event in Kashmir. The OM as an element of organic facies/palynofacies has been studied for the first time from this section. Various workers from around the world have studied this section utilizing other parameters.

Vartika Singh

A sediment profile from Kumhar's Tal near an archaeological site of Ahirua Rajarampur, District Kannauj [Kushana Period (approx. 1000 BC–300 AD)] in Ganga Valley has yielded diverse palynomorphs as well as non-pollen palynomorphs throwing light on the vegetation and climatic scenario of the said past.

A ca. 4.7Ka record of climatic variability has been explored through study of phytoliths and stable isotopic signatures in Harappan archaeological site of Khirsara (Gujarat). The study reveals three short-term humid phases over a prolonged dry phase.

Ruby Ghosh

Collaborative Work

Benchmark microbiological remains have been investigated from the surface samples of Krol-Tal, Tal Group, Lesser Himalaya, and recorded biological remains comprising articulated demosponges (2 taxa) and animal embryo, acritarchs (4 taxa), cyanobacteria (4 taxa) of coccoidal and filaments and single taxa of vase shaped microfossil from the phosphatic chert bearing arenite of Chambaghat Formation, exposed in Solan and Sirmaur districts (HP). The finding is characterized by demosponges, viz. *Chalina* and *Otavia* confined essential characters bearing monaxonal spicules of different types preservations (celluloid to mineralized); gastrula of embryo of any invertebrate; sphaeromorphic and acanthomorphic acritarchs (*Micrhystridium* sp., *Meghystrichosphaeridium* sp., *Trachysphaeridium* sp., *Leiosphaeridia kulgunica*, *Eotylotopalla* sp.); cyanobacterial remains *Paratetraphycus* sp., *Palaeolyngbya* sp., *Oscillatoriopsis* sp.; and molded trichome cf *Siphonophycus* sp. Similar microfossil assemblage is also known from the equivalent sediments of China and Namibia. The invertebrate microbiotas are being recorded for the first time from the early Ediacaran sequences of Himachal Lesser Himalaya. Statistical analysis of these biological remains suggests a mixed deposition of deep and shallow marine, congenial environments. Cyanobacteria might be responsible for the existence of sponges and new offspring by embryogenesis.

The phosphatized globular to sub-oval metazoan eggs with distinctively ornamented covering and phosphatized polar lobe forming embryos have been recorded for the first time in thin sections and macerated organic residues from the black phosphatic chert lenticles and bands of chert member of Deo ka Tibba Formation, Tal Group, Uttarakhand Lesser Himalaya. The identified forms are *Archaeooides* sp., 4 types of *Olivoooides* sp. *Pseudoooides prima*, *Tianzhushania* like form- metazoan eggs, embryos and sickle shaped structures cf. annelids based on the SEM study. These are akin to earlier known from Early Cambrian rocks of China, northwestern Canada, Australia, Mongolia, Siberia and Kazakhstan. These eggs are found in association with Small Shelly Fossils (SSF) and may belong to them. These embryos are common in modern mollusks and bilaterian animals.

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

The stratigraphy and sedimentology of two of the best plant fossil localities in the Pir Panjal Range, near Gund and Arbal have been documented for the first time

in detail. A sequence of shallowing upward and deepening upward units indicates changes from shoreface to offshore and deeper shelf conditions, probably controlled by eustatic changes in an otherwise passive depositional system. Some of the finer-grained, shallow marine deposits have yielded fossil floras dominated by sub-arborescent *Sublepidodendron quadrata*, *Archaeocalamites radiatus*, cf. *Annularia* sp., *Nothorhacopteris kellybelenensis*, cf. *Botrychiopsis plantiana*, *Triphyllopteris* (?) *peruviana*, *Flabelllofolium* sp., and cf. *Cordaite* sp. The taxa *Flabelllofolium*, *Botrychiopsis*, *Annularia* and *Cordaite* have been recorded for the first time from Indian carboniferous sediments. The assemblage compares well with other Gondwanan floras of this age that have been assigned to the Paraca floral realm, and are taken to indicate relatively warm climatic conditions that existed just prior to the onset of the Carboniferous–Permian ice-age.

K.J. Singh & Anju Saxena [& Rajinder Singh (DGM, J&K) **& Chris Cleal** (Cardiff, UK)]

Study of organic remains recorded in Chamba valley has been compiled and finalized. Arcellacians, Bdelloid Rotifera recorded from Early Permian sediments of Chamba Valley.

Neerja Jha & Neha Aggarwal [& Prabhat Kumar (Lucknow Univ.) **& D.D. Bhattacharyya & A.C. Pande** (GSI, Lucknow)]

A few fossil woods belonging to the families Anacardiaceae and Sapindaceae are described from the Tertiary sediments of Yunnan, China.

R.C. Mehrotra [& Ye-Ming Cheng & Cheng-Sen Li (Institute of Botany, Beijing, China)]

Fossil leaf impressions comparable with extant taxa *Gynocardia odorata* R. Br. (Flacourtiaceae), *Milletia pachycarpa* Benth., *Cynometra polyandra* Roxb. (Fabaceae), *Ventilago calyculata* Tul. (Rhamnaceae), *Terminalia tomentosa* (Roxb.) W.&A. (Combretaceae) and *Daemonorops calycarpus* Mart. (Arecaceae) have been reported for the first time from Siwalik sediments exposed near Sarkaghat in Mandi district (HP). All species are presently distributed in the tropical evergreen to moist deciduous forests of northeast India and southeast Asia. Their occurrence in the Siwalik sediments suggests that tropical humid climate with high precipitation prevailed in the area during Middle Miocene. The occurrence of palm leaf in the area is of ecologically

importance as it indicates a characteristic feature of tropical vegetation where the temperature and humidity remain high throughout the year.

Mahesh Prasad [& Lalit Mohan (GSI)]

Palaeobotanical investigation on the plant fossils recovered from the beds of Cambay Shale Formation exposed in lignite mine at Vastan (Surat), western India revealed the occurrence of a variety of floral assemblage comprising both mega and micro species. These are based on silicified woods, leaf and fruit impressions and spores-pollen. The fossil woods are represented by 3 genera and 4 species, namely *Schleicheroxylon bharuchense* Singh *et al.*, *Pterospermoxylon Sahnii* n. sp., *Pterospermoxylon kutchensis* Awasthi *et al.* and *Ebenoxylon vastanensis* n. sp. The fossil leaves are represented by *Calophyllum vastanensis* n. sp., *Acronychia siwalica* Prasad, *Melanorrhoea eocenica* n. sp., *Swintonia miocenica* Awasthi & Prasad, *Combretum sahnii* Antal & Awasthi, *Lagerstroemia patelii* Lakhanpal & Guleria, *Gardenia paleocenica* n. sp., *Anthocephalus vastanensis* n. sp.. A single fossil fruit has been attributed to a new species, *Lagerstroemia eocenica* n. sp. The palynological assemblage comprises a variety of pollen and spores. The fossil taxa have been compared with the extant taxa of angiosperm, gymnosperm, pteridophyte and fungi. Habit, habitat and present day distribution of all the modern comparable taxa of the fossil assemblage recovered from Vastan suggest a terrestrial lowland environment. The mega fossil taxa in the fossil assemblage are indicative of mesophytic, mixed forest under tropical climate with enough humidity during early Eocene time.

Mahesh Prasad, Hukam Singh & S.K. Singh [& Kishore Kumar (WIHG, Dehradun)]

The results on carbonised wood samples from Late Quaternary (Holocene) sediments of Kerala have been finalized, and documented a paper entitled 'Vegetation response and landscape dynamics to Indian summer monsoon variations during Holocene: An eco-geomorphological appraisal of subfossil logs of tropical evergreen forests'.

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

Two silicified woods have been collected from north of Barkala village within sandstone of Nagri Formation (unit-I) of Middle Siwalik subgroup in Sarbar Rao Nala. The woods occur in a cluster of two logs exposed on the top of hill in a profile plane. Amongst them one has no preservation and another is identified as

Dipterocarpoxydon species.

Rashmi Srivastava [& R. Chandel (GSI, Lucknow)]

Work on the project 'Early Pleistocene environments and archaeology in central India' has been initiated. Undertook field excursion to Dhansi Formation exposed at Dhansi village, Sehore district, MP and collected rock samples for palynological study.

M.R. Rao & Poonam Verma [& Parth Chauhan (Stone Age Institute)]

Palynological study of the amber collected from the Tadkeshwar lignite mine (Surat district) has been carried out. The macerated residue yielded well-preserved palynoassemblage comprising of *Dandotiaspora telonata*, *Lygodiumsporites lakiensis*, *Acanthotricolpites* spp., *Ctenolophonidites* spp., *Lakiapollis ovatus*, *Longapertites veneendanburgii*, *Neocouperpollis kutchensis*, *Intrareticulites brevis*, *Palmaepollenites* spp., *Psilatricolporites* sp., *Pseudonothofagidites bengalensis*, *Polygaiacidites* sp., *Proxapertites operculatus*, *Polycolpites* spp., *Spinizonocolpites echinatus*, *Sapotaceoidaepollenites* sp. and *Retitricolpites* sp. Apart from these palynomorphs a large number of fungal spores epiphyllous fungi *Phragmothyrites eocenicus*, *Callimothallus pertusus*, testate amoeba, broken body part of insects have also been recovered from the amber samples. The overall palynoassemblage suggest prevalence of warm humid climatic condition at the time of deposition. The amber study is significant as amber yields soft and fragile microfossils.

Hukam Singh [& Bandana Samant (RTM, Nagpur Univ.)]

The genus *Spiloconis* Enderlein is comprised of six recent Asian and Pacific species, ranging in the west from Sri Lanka (and possibly Madagascar), east to eastern Australia and Fiji. *Spiloconis eominuta* Grimaldi & Engel, new species, is described in earliest Eocene Cambay amber from Gujarat, India, which has well-preserved male terminalia. *Neoconis paleocaribis* Grimaldi & Engel, new species, is described from Dominican amber; this Recent genus is known from the southern US and neotropics. The fossil *Spiloconis* may have significant biogeographic implications, but definitive determination of this requires a phylogenetic analysis of the 16 Recent genera in the monophyletic subfamily Aleuropteryginae. A Dominican amber–Australasian distribution pattern is known for 18 genera of insects in myriad orders (including *Spiloconis*), which are briefly reviewed. Here, assessed assignment of most of the Dominican species to *Spiloconis*, based on new specimens and restudy of the



Leptosalda dominicana n.sp. *Leptosalda niarchos* n.sp. *Leptosalda* sp.

Insects of Family Coniopterygidae

original specimens. The study was prompted by the discovery of two coniopterygids in a piece of amber from the Eocene of India, which also appear to be in *Spiloconis* or a related genus, and which are described.

The family Scelembiidae (Neoembioidea: Embiomorpha: Archembioidea) is recorded from Asia, based on two individuals preserved in Early Eocene amber from the Cambay Basin, western India. *Kumarembia cambayensis* Engel & Grimaldi, gen. et sp. nov., is described, figured, and distinguished from other archembioid genera. The genus shares male genitalic features with scelembiids, otherwise known from South America and Africa. The relationship of Embioidea (one of the more infrequently encountered and investigated orders of insects) to other orders has been problematic, much like everything pertaining to the phylogeny of webspinners. Considerable work continues documenting the diversity of the order, and revising hypotheses of relationship based on this growing knowledge of the range of morphological variation observed across this fascinating group. The recorded new genus and species of fossil webspinner are the first fossil webspinners from Asia and also the first records of their family Scelembiidae from the Oriental Region.

An apparently lichenicolous fossil fungus species (*Monotosporella doerfeltii* sp. nov.) of the anamorphic genus *Monotosporella* (Ascomycota) has been reported from an Early Eocene tropical angiosperm forest, and also described an extant resinicolous taxon of the same genus from the exudate of *Agathis ovata* (C. Moore ex Vieill.) Warb (Araucariaceae) in New Caledonia. The fossil is enclosed in a piece of 52 million-year-old Indian amber (from the Tadkeshwar lignite mine of Gujarat State, western India) produced by a tropical angiosperm tree of the family Dipterocarpaceae (Rust et al. 2010). The amber inclusion represents the second fossil record of *Sordariomycetes*, as well as the first fossil of its particular

order (either *Savoryellales* or *Chaetosphaeriales*). 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. Besides, a field work is successfully completed in Vastan, Mangrol and Tadkeshwar localities of Cambay Basin (Gujarat) and collected huge amount of amber, amber wood, leaf, seed and palynological rock samples.

Hukam Singh [& **David Grimaldi**, Paul Nash (American Museum of Natural History, New York), **Michael Engel** (Univ. of Kansas, Lawrence), **Jes Rust**, **Franke Stebner** (Univ. of Bonn, Germany) & **Alexander Schmidt** (Georg-August Univ. Göttingen, Germany)]

A manuscript entitled 'Palynofacies and sedimentology based high resolution sequence stratigraphy of the lignite bearing muddy coastal deposits of early Eocene age, Vastan lignite mine, Gujarat, India' has been finalized.

Vandana Prasad, **Rahul Garg**, **Biswajeet Thakur** & **Abha Singh** [& **I.B. Singh** (Lucknow Univ.), **S. Bajpai** (IIT, Roorkee), **N. Saravanan** (STLtd., Bangalore) & **V.V. Kapur** (Dadswood, UK)]

The samples from Ruata Quarry, Turial Bungalow Section and Turial Prayer Point Section representing Bhuban Formation have yielded datable nannofossil assemblages. Though the Bhuban 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-NN12 Late Miocene/ Early Pliocene in age. The Turial Bungalow Section has two productive levels represented by TB3 which is dated NN8-NN12 of Middle-Late Late Miocene age and the TB2 sample is dated NN13-NN19 zones of 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 NN5-NN11B of Middle to Latest Miocene age.

Field work to Mizoram area has been conducted and samples from Middle- upper Bhuban Formation exposed at Ruata Quarry Section, Bawngkawn-Durtlang section, Chatlang-Chandmari section, Turial Prayer point, Turial Road side and Turial Bunglaw sections, Tuithum Quarry Sairong section, are collected to find levels of

datable nannofossils in otherwise practically devoid of/ confined to very thin and limited levels of macro- and microfossils.

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

Collaborative research work incorporating integrated nannofossil and geochemistry of K/T section of Cauvery Basin is under progress.

Jyotsana Rai [& Mu. RamKumar] (Periyar University, Salem)]

Sixty-two samples with 2.0 cm. each of sample difference from a core of 124 cm depth from Bay of Bengal area bearing no. BOBCore1 have yielded calcareous nannofossils of Quaternary age. The assemblage is very diverse, well-preserved and indicates presence of *Braarudosphaera bigelowii*, *Calcidiscus leptoporus*, *Ceratolithus acutus*, *C. cristatus*, *C. simplex*, *C. telesmus*, *Coccolithus pelagicus*, *Cyclicargolithus abisectus*, *Dicoaster brouweri*, *D. calcaris*, *D. pansus*, *D. quinqueringus*, *D. surculus*, *D. triradiatus*, *Emiliania huxleyi*, *Gephyrocapsa caribbeanica*, *G. oceanica*, *G. parallela*, *G. sinuosa*, *Helicosphaera carteri*, *H. hyaline*, *H. inverse*, *H. pavimentum*, *H. wallichii*, *Neosphaera coccolithomorpha*, *Pontosphaera discopora*, *Pseudoemiliania lacunose*, *Reticulofenestra asanoi*, *R. haqii*, *R. pseudoumbilicus*, *Rhabdosphaera clavigera*, *R. stylifera*, *Scapholithus fossilis*, *Schypnosphaera globulata*, *S. intermedia*, *S. pulcherima*, *Sphenolithus abies*, *S. dissimilis*, *S. moriformis*, *Syracosphaera pulchra*, *Thoracosphaera albertosiana*, *T. heimii*, *T. operculata*, *T. pelagica*, *Triquetrorhabdulus rioi*, *Umbilicosphaera sibogae* var. *sibogae* and a variety of ascidian spicules. The decrease in calcium carbonate percentage is marked by sharp fall in productivity of coccoliths.

Jyotsana Rai [& Hema Achutan & Nagasundaram] (Chennai)]

Integrated Jurassic age calcareous nannofossil-ammonite from Jaisalmer Basin has been carried out. Mesozoic age productive levels are being used in erecting an integrated sequence biostratigraphy.

Jyotsana Rai & Abha [& D.K. Pandey] (Jaipur Univ., Jaipur)]

Moderately diversified low frequency nannofossil assemblage comprising over twenty species are recorded from one (S-13) calcareous marl sample of Ariyalur Formation 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^{TP} of Burnett in Bown (1998) of latest Maastrichtian age. It is a low latitude marker and is indicative of latest Maastrichtian age approximately 5,00,000 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 diameters) 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*, *Nannoconnus* 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 [& Malarkudi] (Bangalore Univ., Bengaluru)]

Palynological investigation of Neogene rocks of Andaman-Nicobar Group of Islands has been continued. Palynofloral data recorded from Inglis Formation at Kalapathar of Havelock Island is integrated with radiolarian data. Palynofloral composition suggests an Early Miocene age to the assemblage.

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

Palynological investigation of Siwalik group of rocks has been carried out from Tanakpur and its adjoining areas of Uttarakhand. The recorded palynofloral assemblage is dominated by pteridophytic spores, followed by gymnospermous pollen. The palynoflora includes 115 species referable to 59 genera of spores, pollen grains, and epiphyllous fungi. No major palynofloral break have been observed. However, distinct palynofloral assemblages have been encountered. The composition of the palynofloral assemblage suggests that the sediments were deposited under fresh water environment and the area was mainly inhabited by lowland rainforest type of vegetation during Late Miocene.

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

Chemical processing of more than 250 samples of the sediment cores (Site 1404 and 1405) belonging to Oligocene-Miocene age (received from the archive of Bremen Germany) for Post Cruise Research of IODP

Expedition 342, has been initiated with the shipboard and shore based scientists of Expedition 342. Preliminary microscopic study reveals that the sediments are rich in diatoms, silicoflagellates and radiolarians. Further analyses are in progress.

A.K. Ghosh [& Scientists (of IODP Expedition 342)]

A combination of petrological, Rock-Eval pyrolysis and Cupy-Gas Chromatography-Mass Spectrometry techniques has been applied for detailed characterization of the Early Cretaceous coals from Thangad area of Surendranagar district (Gujarat). The documentation of data, in relation to coal's economic potential, is under progress.

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

Pollen analysis of 10 samples has been accomplished from the Quaternary sections exposed in the Mandakini Valley, Rudraprayag district, Uttarakhand. The study has revealed that the area supported mixed broad-leaved forests comprising *Quercus* (oak), *Trewia*, *Grewia oppositifolia*, *Myrica esculanta* and *Celtis*, particularly in valleys and shady depressions, under a warm and humid climatic condition during the period of sedimentation. The frequent record of *Pinus roxburghii* (chirpine) suggests the presence of chirpine forests on the dry sunny slopes contiguous to the study site. In addition, the retrieval of pollen of high altitude broad-leaved elements such as *Alnus* and *Betula* in appreciable frequencies signifies the proximity of the temperate belt. The rich ground flora was constituted of grasses (Poaceae) along with the members of Asteraceae, *Artemisia*, *Xanthium* and *Thalictrum*. The area was under agrarian practice as evidenced by the presence Cerealia and other concomitant cropland weeds viz., *Artemisia*, *Cannabis sativa*, Cheno/Am, etc.

M.S. Chauhan [& Prathvi Singh & G.S. Agarwal (GSI, Lucknow)]

Texture, mineralogy, geochemistry, palynology and magnetic susceptibility studies of a 2 m deep sediment core from Padauna Swamp (Amarkantak) have been finalized. The paper is under review in Journal of Earth Science.

M.S. Chauhan, Binita Phartiyal & Kamlesh Kumar [& Anupam Sharma (Central Univ. of HP, Dharmashala)]

Palynological investigation is completed in a 5 m core from SK-129, and the manuscript is being prepared.

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

Mid Holocene climatic fluctuations, multi-proxy study involving palynology, phytolith, clay mineralogy, geochemistry and magnetic susceptibility have been carried out on Wadhavana lake sediments of main land Gujarat area. A research paper on the aspects is under review.

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

A 27,000 yrs BP vegetation and climatic record from Subankhata swamp (Indo-Burma range), Baksa district, Assam depicts the existence of savannah forest to deteriorated scattered tropical semi-evergreen forest admixture with deciduous elements under cool and dry to relatively dry climatic regime.

S.K. Basumatary, Swati Dixit, S.K. Bera & C.M. Nautiyal [& G.C. Sarma (Gauhati University, Assam)]

Pollen spectra from eastern buffer zone of Manas National Park, Baksa District showing the existence of tropical mixed deciduous forest under warm and humid climatic condition. The enhancement of *Melastoma malabathricum* and *Mimosa pudica* indicate the forest clearance affecting forest wealth and wildlife habitation.

S.K. Basumatary, S.K. Bera & R.C. Mehrotra [& G.C. Sarma (Gauhati University, Assam)]

Based on the ring-width and density data of Silver fir (*Abies pindrow*) and Himalayan pine (*Pinus wallichiana*) of Northwestern Himalayan region, mean temperature of August and September has been reconstructed from AD 1773 to AD 1995. The result of sequential change-point analysis in the climate reconstruction indicates the major regime shifts at AD 1783, 1794, 1805, 1827, 1862, 1873, 1898 and 1971.

Amalava Bhattacharyya & S.K. Shah [& V. Chaudhary (MoES, New Delhi), J. Guiot (CEREGE, CNRS, France), S.K. Srivastava (I.T.M, Gurgaon), J.L. Edouard & A. Thomas (IMPE, CNRS, France)]

Relationship between modern deltaic non-grass plant communities of the Indian part of the Sundarbans along salinity gradient with their predominant phytolith contents has been established and this study is the first step in identifying the environment associated with mangrove development.

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

Fossil floras ranging in age from the mid Miocene to the early Pleistocene from the eastern Himalayan

Siwaliks near Darjeeling and in Arunachal Pradesh have been compared taxonomically and subjected to CLAMP (Climate Leaf Analysis Multivariate Program) analysis using a new calibration dataset that includes sites from India, southern China and Thailand and high resolution gridded climate data. The data shows tropical Neogene forests of NE India experienced a weaker monsoon than now and by contrast 15 Ma old Tibetan leaf fossils indicate a cool climate, wetter than now.

Ruby Ghosh [& Subir Bera (Univ. of Calcutta, Kolkata) & **R.A. Spicer** (Open Univ., UK]

Under the proposal entitled 'Reconstruction of the chronostratigraphy of IODP 322, site NT1-01 (Hole C0012A), and NT1-07 (Hole C0011B) sediment core (north-west Pacific Ocean), using $^{10}\text{Be}/^{9}\text{Be}$ dating', chemical analysis on 28 samples has been done during one month (July-August, 2012) at Inter University Accelerator Centre (IUAC), New Delhi.

Pawan Govil [& Rasik Ravindra (MoES, New Delhi), **R.M. Gupta** (NCAOR, Goa), **G.S. Roonwal, S. Chopra & P. Baghel** (IUAC, New Delhi)]

Southwestern Indian Ocean lies in a transitional zone between the southernmost extremity of Indian Ocean and northern limit of the Southern Ocean. Sediments have been studied in order to assess the effect of oceanographic conditions on biogenic sediment deposition. The Southern Ocean diatoms and other siliceous remains transported and re-deposited in the Southwestern Indian Ocean, indicate transport of siliceous sediments and its redeposition in the SW Indian Ocean.

Vartika Singh [& Neelu Singh (NCAOR, Goa]

Working for initiation of dinoflagellates study from coastal sediments of western and southern India. The details of biogeographic boundaries of other marine biota are being studied for selection of specific sampling sites of the above mentioned parts of coastal India.

Vartika Singh [& Martin James (Brock University Canada)]

Discussion and literature review is being done to understand the fresh water ecosystem of the Indian river Ganga, to study present environmental conditions of the river. The interaction of environmental conditions and its effect on the biota is being studied specifically.

Vartika Singh [& Sophia Barinova, (Institute of Evolution, Haifa, Israel)]

The Holocene climate change is studied based on radiocarbon dates, carbon- nitrogen data, oxygen isotopic signals and pollen information in swamps in Kibber plateau, Spiti, which revealed weakening monsoon during 6.6 and 5 Kyr BP. The results are finalized.

C.M. Nautiyal [& I. Suryaprakash & colleagues (NCBS, Bengaluru) & **M. Sankaran** (Nature Cons. Foundation, Mysore)]

The manuscript on FTIR and Raman Spectral Analysis of Poly α , d-glutamic Acid for studying Helical Conformation and Thermal Decomposition is revised.

Subodh Kumar & C.M. Nautiyal [& P. Tandon & colleagues (Lucknow Univ.) & **D. Chaturvedi** (IISc, Bengaluru) & **Portilla-Arias José & colleague** (Spain)]

Sponsored Projects

- 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)

The project has been completed and submitted the detailed project report to the Convener, DST (SSS Programme), New Delhi.

S.K. Bera, Swati Dixit & Kanupriya Gupta

- 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)

The report of the project has been finalized. It includes mainly tree-ring data of fir (*Abies densa*) growing at the tree-line zone close to snout of the Zemu Glacier. Analysis of tree growth/climate (Response Function analysis) shows that temperature during pre monsoon (Feb.-April) and late summer (June-Sept.) are limiting factors to tree growth at this region. Moreover, we observe tree-ring width indices are low during AD 1988-2000, the period glacier advancements. Similarly higher tree growth during 1976-1978, 2001-2005 coincides with the periods of rapid retreat of glaciers. Based on these observations our tree-ring record of 250 yrs from this site provides a new insight towards understanding the dynamic behavior of the monsoonal glacier in the Eastern Himalaya in relation to climate. Cross dated tree-ring samples from 184 radii from 28 discs of *Juniperus squamata* scrub collected near to Zemu Glacier.

First draft of Ph.D. thesis of MS entitled 'Application of multi-proxy tree ring parameters in the reconstruction of climate vis-à-vis glacial fluctuation from the Eastern Himalaya' has been prepared. Finalization of thesis is in progress.

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

- Project— Late Pleistocene palynochronostratigraphy in northeastern 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)

The results on the palynological, geochemical and fresh water thecamoebians studies have been compiled

and finalized. The completion report of the project has been submitted to the DST.

Anjum Farooqui & Jyoti Srivastava

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

Field trip has been undertaken to Mizoram and adjoining area of Myanmar and collected subsurface sediments for pollen analysis. Maceration of samples is under progress.

A. Bhattacharyya

Ph.D. Thesis entitled 'Analysis of climate change since late Pleistocene from south-west continental margin of India using pollen and diatom data' has been finalized

A. Bhattacharyya & Sandhya Misra

- Project— Documentation of plant diversity through literature survey for development of Uttar Pradesh Biodiversity Information System** (sponsored by UP State Biodiversity Board, Lucknow)

The final technical report has been compiled and submitted to U.P. State Biodiversity Board, Lucknow. Database of plant diversity of Uttar Pradesh has been prepared for Uttar Pradesh Biodiversity Information System (UPBIS).

D.C. Saini, Shambhu Kumar, G.K. Mishra & D.K. Gond

- 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)

Research work on various aspects, namely Pennsylvanian megaspores and lycopsids from north-eastern border of the Paraná Basin (Brazil), palaeobotanical evidence of wildfire in the Upper Permian of India, Early Permian *Glossopteris* flora from the Umrer Coalfield, Wardha Basin (India), palynostratigraphic considerations on the Pennsylvanian interglacial microflora from Monte Mor (SP), Itararé Group, NE Paraná Basin (Brazil) and its diachronic correlations with Indian Gondwana microflora, stratigraphic ranges of dinoflagellate cysts from Cretaceous petroliferous basins of India and Brazil,

Permian fires on the southern continent, mesophytic Gondwanan paleofloras from Brazil and India with implications on palaeoclimate, has been carried out, finalized and a report on the work done is compiled. As a result of the collaboration, 9 papers have been published.

N.C. Mehrotra (up to 31.10.2012), **Neerja Jha & Rajni Tewari** [& Mary E.C. Bernardes-de-Oliveira, Maria Judite Garcia & Roberto Iannuzzi (Brazil)]

7. 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)

The report of the project has been finalized for submission to Frontier Basin, ONGC, Dehradun. The integrated studies of micro-megascopic remains (254 taxa) comprise morphology, TAI, SEM and XRD. The presence of biotic remains so called from the basement suggests that the basement rocks may be present in deep. The assemblages of Ganga Basin support the presence of hydrocarbons due to good representation of algae particularly cf. *Botryococcus*, *Pedistrum* and thalloid forms of Rhodophyceae and the presence of oil (petroleum) fly larvae. The sediments are in mature zone (TAI 2.5-3.5) at different depth intervals in Shahjahanpur and Ujhani structure wells. The akin OWM are also known from the Neoproterozoic sediments of Marwar Supergroup of Bikaner-Nagaur Basin, which is already known to contain liquid hydrocarbons. This similarity of biota suggests that the sediments of Marwar Supergroup may have extended up to Ganga Basin.

N. C. Mehrotra (up to 31.10.2012), **Rupendra Babu & V.K. Singh** [& P.K. Maithy & G. Kumar]

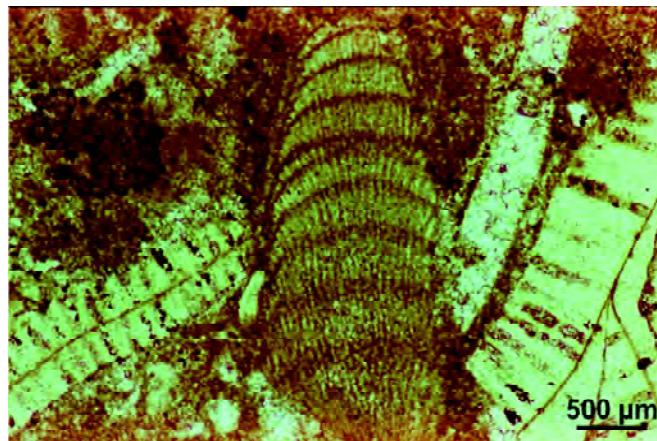
In continuation of Ganga Basin project, processed samples of Himalayan Foot Hills, Vindhyan Supergroup and Krol Belt of Himalaya. The preliminary report of Himalayan Foot Hill samples has been submitted to Frontier Basins, ONGC.

N. C. Mehrotra (up to 31.10.2012) & **Rupendra Babu** [& N.K. Verma, R. Bhoj, A. Nautiyal & U.C. Pradhan (ONGC, Dehradun)]

8. 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).

Work on the diversity, growth-form analysis, taphonomy, taxonomy and palaeoecological implications of Corallinacean Red Algae and Halimedacean Green Algae from the Lakadong, Umlatdoh and Prang Limestone

formations of South Shillong Plateau has been completed. Work on biofacies analysis of the Mio-Pliocene sequence of Andaman Nicobar Basin has also been finalized. It has been visualised that in addition to algal forms benthic foraminifera are also the dominating facies components in both Meghalaya and Andaman-Nicobar with the presence of more than 15 and 20 genera respectively.



Amphiroa with surrounding corals from the Guitar Formation, Car Nicobar Island

Diversification pattern of the family Sporolithaceae (Corallinales, Rhodophyta) in India has been studied. This work has established the genus *Sporolithon* as a disaster taxon with respect to the distinct rise in species abundance corresponding to Cretaceous-Tertiary and Cenomanian-Turonian episodes of extinctions. Analysis of the data recorded from India has been done and finalized. Besides, reviewed the potential of coralline algae in palaeoclimate reconstruction: need for suitable exploitation in India.

The vulnerable status of coral populations with respect to coral bleaching in some of the important Andaman Group Islands has been studied and analyzed their diversity as well as inadequacy of the various management strategies being implemented. Some realistic conservation strategies novel to India and several developing countries of the world also have been proposed. These ideas lay the foundation for a conservation paradigm considering both the changing biodiversity maintained by natural processes and rapid alterations brought about by humans. It has been interpreted that major as well as subtle modifications in the existing programs and formulation of an integrated pattern applied for reef conservation can prove to be substantial. In addition, the dynamics of algae and corals in the Andaman coral reefs with respect to their abundance has been studied. An attempt has been made to analyze the possible occurrence of phase shifts from coral-dominated to algae-dominated reefs in the Havelock, Neil, Ross, Jolly Buoy

Islands and Chidiya Tapu Beach. Future research on this aspect in different islands of Andaman will potentially provide substantial evidence with regard to phase shifts, extinction debt (for vulnerable and rare species) and instances of coral migration.

Suman Sarkar & A.K. Ghosh

9. 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 are studied to develop ring-width chronologies. The ring-widths measurements of crossdated samples have been completed.

R.R. Yadav, B. Sekar & A.K. Yadav

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

Tree ring chronologies from Lahaul region have been studied to develop winter snow fall variations. Using network of chronologies from six sites November-April snow water equivalent (SWE) extending back to AD 1460 are developed. The reconstruction revealed persistent severe droughts in 1780s followed by 1480s and relatively lesser magnitude droughts in 1540-1560s, 1740s, and early 20th century. The pluvial conditions observed in 1948-1958 and 1986-1996 stand out over any other period of such duration. The SWE reconstruction revealed large-scale spatial coherence with the corresponding month's Palmer Drought Severity Index (PDSI) over the western Himalayan region. Significant relationship observed between SWE reconstruction and January-March Chenab River flow revealed its potential utility in understanding water resource availability in long-term perspective.

R.R. Yadav

11. 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)

The Tangtse Valley in the Trans Himalayas shows a varied sedimentary architecture with fluvial episodes, lacustrine deposits, flood events and colluvial as well as aeolian deposits from ~50 ka to present. The valley is important, as it served as spillway of the Pangong Tso/Bangong Co (Tso/Co=lake) one of the biggest lakes in Tibet and has records of a lake environment in Late

Quaternary times. Today the Pangong Tso is a chain of five basins separated by shallow sills and evolves as a series of lakes of connected rivers. During high stands the lake drains into the Shyok river, through the Tangtse river valley. The sediment records from the region show evidences of a sixth basin of the Pangong Tso towards west occupying the present day Tangtse Valley during 42-31 ka BP and 20-2 ka BP, coinciding with the periods of high lake levels in Tibet and China as well as the intensified monsoon periods in the Indian subcontinent. This lacustrine environment is intermittently replaced by a fluvial regime between 48-43 and 30-21 ka BP as evident by river terraces with comparatively less humid conditions and dry phases. The paper on the aspect is finalized. Also undertook field work in the Tangtse Valley (Pangong Tso, Muglib, Sasakul, Durbuk, Shyok) for further observation and sample collection.

Binita Phartiyal & Randheer Singh [& G.C. Kothyari, ISR, Gandhinagar]

12. 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))

Work on the project is initiated from September 2012. Field excursion to Kachchh area has been conducted and samples are 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 are also covered and samples from Matanomadh section are also collected.

Jyotsana Rai & Abha (& Rahul Garg)

13. 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)

Study of the chert nodules from the Krol Formation exposed in the Solan area has revealed the presence of large acanthomorphic acritarchs and transverse sections body of sponges and spicules. Their presence shows the advent of sponges in the Vendian Period. Stromatolite collected from the Tal Formation has been processed. Contrary to the belief that stromatolites declined in the Cambrian the Tal stromatolites are well preserved.

Mukund Sharma & A.S. Rathore
[& V.N. Sergeev GIN, Moscow (Russia)]



The palaeofloral studies carried out in Tatapani-Ramkola Coalfield indicate the presence of the sedimentary succession across the Permian/Triassic boundary. It is marked by a gradual change in the taxonomical composition of the Raniganj floristic assemblage; also marked by the extinction of species of *Glossopteris* (i.e. *G. stenoneura*, *G. stricta* and *G. retifera*, which are typical of the Upper Permian Raniganj Formation), and by a first appearance of *Dicroidium*-flora. Decline of the *Glossopteris* flora is marked by the advent of the Triassic flora, but a few Permian genera survived, e.g. *Paracalamites*, *Schizoneura*, *Dizeugotheca*, *Glossopteris* and *Vertebraria* up to the Early Triassic. It is inferred that the plant life only transformed and evolved around the Permian-Triassic Boundary (PTB) in the Tatapani-Ramkola Basin and did not get completely extinct.

K.J. Singh [& S.V. Naugolnykh, GIN, Moscow (Russia)]

14. 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 16.11.2011).

Work has been initiated regarding field work pertaining to study of geomorphic features and identification of sampling sites, collection of profile sediments and maceration (chemical processing of samples for the release of pollen-spores). Field work around Chaurabari and Hamtah glaciers has been successfully undertaken. At Chaurabari Glacier (Kedarnath), the outwash plain of the glacier, the left lateral kame-terrace and the lake bed of the Chaurabari Tal are found to be conducive for the collection of stratified sediments. Trail trenches are dug on the above geomorphic features ranging from 1-2 m depth and samples have been collected at 5 cm intervals. Extensive traverses are made around the Hamtah Glacier, however as compared to the Chaurabari Glacier, sampling sites are not so well developed as the outwash plain and kame-terraces mostly comprise coarse grained sediments, boulders and cobbles, which are palynologically unproductive. Only one potential site is located on the outwash plain where a trial trench could be dug up to 90 cm. Further sampling is done around Chattru, where trial trenches are dug on the deposits of the Chattru Glacier. Samples are being chemically treated and found promising for palynological studies. ¹⁴C dating of selected samples is being done at BSIP and AMS dating at GADAM Centre, Gliwice, Poland. Efforts have further been initiated for geochemical and environmental magnetic

studies from collaborative Institutes. Palynological work on previous collections is also initiated.

N.C. Mehrotra (up to 31.10.2012), **Ratan Kar & A. Bhattacharyya**

15. Project— Analysis of Holocene climate change in northeast India based on pollen data (CSIR SRF {DIRECT} Fellowship: Grant- 09/528/(0017)/2012/EMR-I)

A 564 cm sub-surface sediment profile from Ziro Valley Arunachal Pradesh, having 47 previously collected samples, whose fossil pollen counts was completed and a manuscript is under preparation. Fifty-four moss cushions samples of transect from Lachen towards Zemu glacier in Sikkim are macerated for modern pollen studies. Palynological studies have been carried out on a 127 cm long sub-surface sediment profile collected from Yabuk, (which is at 4016 m, a.m.s.l.) near Zemu Glacier in Sikkim. Further data analysis is being carried out for interpretation. A 170 cm sub-surface sample profile from Chari Lam, Tripura having 16 samples is also studied. Identification of fossil palynomorphs and counting of 5 samples are completed. Completion of palynological studies of the remaining 11 samples and comparison with environmental geomagnetic data shall be further carried out.

Nivedita Mehrotra & A. Bhattacharyya

16. Project— Diversity and palaeoecology of the benthic and planktic biotic assemblages from the Neogene sequence of Andaman and Nicobar Islands (DST Inspire Fellowship: Grant- IF120842/2013-14).

Review of literature on the proposed research topic has been done. It is evident that Neogene sediments of this region confer a diversified ecology of different biotic components and accordingly a field work is carried out particularly for the collection of sediment and rock samples for diatoms and radiolarians mainly. The proposed objective will allow us to reconstruct the palaeoenvironment and that in turn will enable to reconstruct the palaeoclimate and their response to biotic events. Rock samples are collected from different islands and in addition, modern samples are also collected. Physicochemical parameters of sea water are recorded in the field. Preliminary analysis of the samples reveal well preserved diatoms and radiolarians which may be useful as marker taxa.

Arindam Chakraborty (w.e.f. 04.02.2013) & **A.K. Ghosh**

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- Babu R & Singh VK – An evaluation of carbonaceous Metaphytes from the Proterozoic Singhora Group of Chhattisgarh Supergroup, India. *J. Geol. Soc. India.*
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- Basumatary SK, Dixit S, Bera SK & Mehrotra RC – Modern pollen assemblages of surface samples from Cherrapunjee and its adjoining areas, Meghalaya, northeast India. *Quaternary Int.*
- Bera SK, Basumatary SK & Gogoi R – Evidence of deterioration in phytodiversity of Itanagar wildlife sanctuary, Arunachal Pradesh, India based on palynological evidence. *Int. J. Earth Sci. Eng.*
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- Trivedi A, Chauhan MS & Malik MA – Holocene vegetation and climate change in Jammu region, based on pollen evidence from the lake deposits. *Man & Envir.*
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- Verma P & Rao MR – Modern pollen and vegetation relationship in the Teak Deciduous Forest in Sehore District, Madhya Pradesh. *Palaeobotanist.*
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- Wasson RJ, Chauhan MS, Sharma C, Jaiswal M, Singhvi AK & Srivastava P – Erosion of river terraces as a component of large catchment sediment budgets: A pilot study from the Gangetic Plain. *J. Asian Earth Sci.*

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- Bajpai U & Bajpai SC 2012. Renewable energy in Power Sector: The present scenario and future action plan. *Proc. Int. Congr. Renewable Energy (ICORE-2012)*, Gandhinagar: 243-253.
- Bajpai U & Bajpai SC 2012. Sustainable building and climate change- An Indian perspective. LAP LAMBERT Academic Publishing, Deutschland, Germany, ISBN: 978-3-659-23074-5: 69p.
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- Nautiyal CM 2012. Writing Science for Radio. In: Pramila Majumdar & Biman Basu (eds.) *Effective Science Writing*, CSIR-North East Institute of Science & Technology, Jorhat: 98-115.
- Nautiyal CM 2012. Aasman mein Traffic Jam: Antariksh mein badhta Upgrahon ka kachra. *Vigyan*, June: 62-65. (in Hindi)
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Deputation to Conferences/Seminars

- Ratan Kar participated in the *18th International Symposium on Polar Sciences* held at Jeju Island, South Korea during May 22-24, 2012.
- Ratan Kar & Pawan Govil participated in the *National Workshop on Evaluation of Research Projects for Planning the XXXII Indian Scientific Expedition to Antarctica* held at NCAOR, Goa during June 27-28, 2012.
- S.S.K. Pillai participated in the *XV Argentine Symposium on Paleobotany and Palynology* held at Corrientes, Argentina during July 10-13, 2012.
- Mukund Sharma participated in the *34th International Geological Congress* held at Brisbane, Australia during August 05-10, 2012.
- N.C. Mehrotra, Ratan Kar, Srikanta Murthy, Ruby Ghosh, Swati Dixit, Anumeha Shukla & M.F. Quamar participated in the *13th IPC (International Palynological Congress)/ 9th IOP (International Organization of Palaeobotany) Conference* held at Chuo University, Tokyo, Japan during August 23-30, 2012.
- Vandana Prasad participated in the *4th International Geologica Belgica Meeting* held at Brussels, Belgium during September 10-14, 2012, and *Indo-German International Workshop on Environmental Challenges in Asia* held at GeoForschungs Zentrum Postdam, Germany during January 14-17, 2013.
- Alpana Singh participated in the *64th ICCP (International Committee for Coal and Organic Petrology)/ 29th TSOP (The Society for Organic Petrology) Meeting & Symposium on Coal and Organic Petrology* held at Beijing, China during September 15-24, 2012.
- N.C. Mehrotra, M.R. Rao, R.C. Mehrotra, A.K. Ghosh, Binita Phartiyal, Gaurav Srivastava & Anumeha Shukla participated in the *3rd Sino-Indian International Conference: Biodiversity and Environmental Changes in the Himalaya* held at Xinxiang Henan Province, China during September 18-24, 2012.
- Shilpa Singh participated in the *Seminar on Environment Conservation and Management* held at Itarsi, MP during October 30-31, 2012.
- S.K. Shah, P.S. Ranhotra & Nivedita Mehrotra participated in the *IGBP-PAGES Workshop on Holocene Land-cover Change in Eastern Asia for Climate Modelling* held at Hebei Normal University, Shijiazhuang, China during October 08-11, 2012.
- Nivedita Mehrotra participated in the *National Conference on Green Earth with Focus on Himalaya* held at Wadia Institute of Himalayan Geology, Dehradun during October 18-19, 2012.
- Rashmi Srivastava participated in the *International Symposium on Innovative Prospects in Angiosperm Taxonomy & XXII Conference of Indian Association for Angiosperm Taxonomy* held at Amravati (Maharashtra) during October 28-30, 2012.
- Jyotsana Rai, Binita Phartiyal & Randheer Singh participated in the *27th H-K-T Workshop on Geology of Himalaya-Karakoram-Tibet Region* held at Kathmandu, Nepal during November 28-30, 2012.
- P.S. Ranhotra participated in the *Workshop on Monsoonal Lakes & Discussion on Climatic Reconstruction* held at Uleimar, Germany during December 09-15, 2012.
- S.K. Bera participated in the *Seminar on Biodiversity* held at Lady Brabourne College, Kolkata during December 16-17, 2012.
- V.K. Singh & S.K. Pandey participated in the *56th Annual Meeting of the Palaeontological Association & Symposium and Conference Taphonomy and Fidelity of Fossil records* held at Dublin, Ireland during December 16-18, 2012.
- Chanchala Srivastava participated in the *Joint Annual Conference History and Archaeology-2012* held at M.S. University, Baroda, during December 22-24, 2012.
- R.R. Yadav, S.K.M. Tripathi, Mukund Sharma, Mahesh Prasad, S.K. Singh, S.M. Vethanayagam & Nilay

Govind participated in the *100th Session of Indian Science Congress Association* held at Kolkata during January 03-07, 2013.

Swati Dixit participated in the *PAGES 2nd Young Scientists Meeting* held at International Centre, Goa during February 11-12, 2013.

Sunil Bajpai, R.R. Yadav, Samir Sarkar, P.S. Ranhotra, Swati Dixit, Shilpa Singh, M.F. Quamar, Kanupriya Gupta, Mayank Shekhar & Suman Sarkar participated in the *PAGES 4th Open Science Meeting: The Past—A Compass for Future Earth* held at NCAOR, Goa during February 13-16, 2013.

Biswajeet Thakur & Abha participated in the *Indian Geophysical Union Workshop on Marine Geosciences Research in India: Current Status and*

Future Directions held at NIO, Goa during February 21-22, 2013.

R.R. Yadav participated in the *National Symposium on Current Status and new Horizons of Ecological Sciences and Environmental Biotechnology* held at BHU, Varanasi during March 01-03, 2013.

B.D. Singh participated in the *International Conference on Various Facets of Energy Technologies and its Management for Sustainable Development (ET & MSD-2013)* held at JNU, New Delhi during March 16-17, 2013.

A. Rajanikanth & Chinnappa Chopparapu participated in the *National Seminar on Recent Perspective on Lakes, Rivers and Coastal Wetlands* held at Annamalai University, Chidambaram, Tamil Nadu during March 24-25, 2013.



Dr. Shailesh Nayak, Chairman, GB looking into the Institute's Compendium Volume

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- Bera SK & Dixit S – Late Holocene vegetational and climatic changes as inferred from radiocarbon dates and palynodata of older alluvial sediments on the south bank of the Brahmaputra flood plain, Northeast India. *13th IPC & 9th IOP Conf.*, Tokyo, Japan, August 2012.
- Bera SK, Gupta K & Rehman A – Impact of monsoonal variation on vegetation and climate change as inferred from late Holocene sediment of Garbhanga reserve forest, Assam, north east India: A pollen based study. *PAGES 4th Open Science Meet.*, Goa, February 2013.
- Dixit S & Bera SK – Pollen recorded vegetation and climate dynamics since Late Quaternary from Deepor wetland-Ramsar site of Assam, Northeast India: In relevance to global climatic events and human impact. *13th IPC & 9th IOP Conf.*, Tokyo, Japan, August 2012.
- Dixit S & Bera SK – Late Holocene vegetation vis a vis climate dynamics from Hasila wetland, western Assam, Northeast India: Pollen and diatom record. *PAGES 4th Open Science Meet.*, Goa, February 2013.
- Ghosh AK – Diversity of calcareous algae from the marine Palaeogene sequence of North East Himalaya, India with special emphasis on palaeoenvironment. *3rd Sino-Indian Int. Conf.*, Xinxiang, China, September 2012.
- Ghosh R, Paruya DK, Yao Yi-Feng, Li Cheng-Sen & Bera S – A combined pollen and phytolith record for post-Siwalik vegetation change in Darjeeling foothill region, eastern Himalaya. *13th IPC & 9th IOP Conf.*, Tokyo, Japan, August 2012.
- Govil P & Kar R – Paleoclimatic studies from Antarctic Coastal areas with special reference to Larsemann Hills based on terrestrial and marine records. *Nat. Workshop on Evaluation of Research Projects for Planning the XXXII Indian Scientific Expedition to Antarctica*, Goa, June 2012.
- Kar R & Ranhotra PS – Palynological studies from Ny-Alesund, Svalbard: Interpreting the Late Quaternary climate of the Arctic Region. *The 18th Int. Symp. Polar Sciences*, Jeju, Korea, May 2012.
- Kar R & Singh RS – Palynological implications of the Deccan Intertrappean sediments (Maastrichtian-Danian): A review. *13th IPC & 9th IOP Conf.*, Tokyo, Japan, August 2012.
- Mehrotra N, Bhattacharyya A, Basavaiah N, & Shah SK – Holocene climate variability vis-à-vis vegetation changes in Southern Tripura, Northeast India based on pollen and geomagnetic data. *Workshop Holocene land-cover change in Eastern Asia for climate modelling*, Shijiazhuang, China, October 2012.
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- Mehrotra NC – Establishing high resolution biostratigraphic and biochronostratigraphic framework of Mesozoic and Tertiary subsurface sediments of petroliferous basins of India. *13th IPC & 9th IOP Conf.*, Tokyo, Japan, August 2012.
- Mehrotra RC, Tiwari RP, Srivastava G & Shukla A – The study of a Neogene petrified wood forest of Mizoram, India. *3rd Sino-Indian Int. Conf.*, Xinxiang, China, September 2012.
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- Phartiyal B – Landscape evolution of the NW Himalayas (Ladakh and Lahaul sectors) during the Late Quaternary: Implications to tectonics and palaeoclimate. *3rd Sino-Indian Int. Conf.*, Xinxiang, China, September 2012.
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- Prasad M – Dipterocarpaceous macrofossils from Churia group of western Nepal: Palaeontological distribution and palaeoclimatic interpretations. *100th Indian Sci. Congr. Session*, Kolkata, January 2013.
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- Sarkar Suman – Coralline algal and larger benthic foraminiferal facies in an Upper Palaeocene shallow water, reefal carbonate platform (Meghalaya, North-Eastern India): Exploring the palaeoenvironmental implications. *PAGES 4th Open Science Meet.*, Goa, February 2013.
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- Singh S – Ethnomedicinal studies of mangroves from Sundarbans, India: need for their conservation. *Sem. Environment Conservation & Management*, Itarsi, October 2012.
- Singh S – Mangrove and coastal environment changes during the Holocene in the Mahanadi Delta, India. *PAGES 4th Open Science Meet.*, Goa, February 2013.
- Singh VK & Babu R – Shale facies microfossils from the Proterozoic Chhattisgarh Supergroup, India. *56th Annual Meet. Palaeontol. Assoc.*, Dublin, December 2012.
- Srivastava C & Tewari DP – Emerging trends of palaeo-ethnobotanical investigations at ancient site in Upper Ganga Plain. *Joint Annual Conf. History & Archaeology*, Baroda, December 2012.
- Srivastava G & Mehrotra RC – Low latitude floral assemblage from the Late Oligocene sediments of Assam and its palaeoclimatic and palaeogeographic significance. *3rd Sino-Indian Int. Conf.*, Xinxiang, China, September 2012.
- Suryaprakash I, Anusree AS, Nautiyal CM, Mishra CD & Sankaran M – Mid to Late Holocene climatic history of Rangelds Spiti Valley, Trans-Himalayas. *PAGES 4th Open Science Meet.*, Goa, February 2013.
- Tewari DP, Srivastava C & Pande D – Food economy and dietary habits in Ganga plain during Mahabharat times. *World Archaeol. Conf.*, Jordan, January 2013.

Symposium for Young Scientists

Under the aegis of BSIP Young Scientists' Forum, a one-day *Symposium for Young Scientists* was organized on October 29, 2012. The symposium had the participation of Research Scholars, Research Associates and Scientists-B & C, and involved invited lectures by eminent scientists and an Interactive Poster Session by the participants. The Director, Dr. N.C. Mehrotra, in his welcome address, recounted how the Institute had witnessed a quantum jump in the numbers of Research Scholars, Research Associates and Young Scientists in the recent past and further plans being formulated for the youngsters in the Institute.

The symposium was inaugurated by the Chief Guest, Dr. Akhilesh Gupta, Advisor DST and Member, Governing Body (GB), BSIP. In his inaugural address, he stressed the need for inducting more fresh blood in science and applauded the efforts of BSIP for creating ample opportunities for youngsters in the Institute. The Guest of Honour, Shri N.K. Datta, Ex-Director General, GSI and Member, GB, spoke about his experiences with reference to young researchers in GSI and BSIP. Prof. C.L. Verma, Member, Research Advisory Council (RAC),

BSIP, extolled the virtues of youth and reminisced about his experiences as a teacher. Prof. S.N. Bhalla, Chairman, RAC, in his Presidential Address, concluded the efforts of the RAC in inducting more researchers at the entry levels and the policies being implemented in this regard.

The following invited lectures were delivered in the symposium:

- *A scenario of microbiota from Proterozoic sedimentary basins of southern peninsular India: with special reference to Kaladgi Basin* (by Prof. V. Venkatachalapathy, Head (Retd.), Geology Department, Mysore University)
- *Holocene climate, vegetation dynamics and culture in southwestern India* (by Dr. K.P.N. Kumaran, Emeritus Scientist, Agarkar Research Institute, Pune)
- *Nuclear Power: A boon or bane for India* (by Dr. Prabhas Pande, Ex-Additional Director General, GSI)
- *Climate change: Causes and consequences* (by Dr. R.R. Yadav, BSIP)



A view of the Inauguration Ceremony of the Symposium for Young Scientists

Thereafter, an interactive Poster Session was organized in which there was spirited participation of the youngsters. The following posters were displayed:

Title of Posters	Author(s)
<i>Proterozoic microbiotic fossil assemblage from the Chitrakoot Formation, Semri Group, Vindhyan Supergroup, Central India</i>	V.K. Singh & S.K. Pandey
<i>Morphotaxonomical analysis of plant fossils of Satpura Gondwana Basin, Madhya Pradesh and its biostratigraphical implication</i>	Deepa Agnihotri
<i>The Glossopteris flora of Manuguru Area, Godavari Graben: Palaeoecological implications, evolutionary perspectives and basinal correlation</i>	Arun Joshi & Rajni Tewari
<i>Late Cretaceous nannofossil biostratigraphy from subsurface sediments of Tanot Bore Well-1, Jaisalmer Basin, Rajasthan</i>	Abha & Jyotsana Rai
<i>Fossil fruits and ichnospecies Teridolites longissimus from Early Eocene of Vastan lignite mine from Cambay basin, Surat District, Gujarat</i>	Hukam Singh
<i>Palaeobotanical evidence for the early development of the South Asia monsoon</i>	Gaurav Srivastava & Anumeha Shukla
<i>Modern pollen rain in relation to vegetation in Jammu, Jammu and Kashmir, India</i>	M.F. Quamar & Jyoti Srivastava
<i>Holocene climate change in the North-East India based on pollen data</i>	Nivedita Mehrotra, A. Bhattacharyya & S.K. Shah
<i>Modern pollen assemblages of surface samples from Cherrapunjee and its adjoining areas, Meghalaya, northeast India: a future threat to environment</i>	Swati Dixit, S.K. Basumatary, S.K. Bera & R.C. Mehrotra
<i>Unwinding the mysteries of climate and tectonic interplay in Ladakh, NW Himalayas: Records hidden in the Quaternary sediments of Indus river catchment</i>	Binita Phartiyal & Debrati Nag
<i>Geomorphological Evolution and Sedimentary Architecture of the Tangtse Valley, Ladakh, NW Himalaya</i>	Binita Phartiyal & Randheer Singh
<i>Holocene mangrove ecosystem dynamics of the Chilka Lagoon, Mahanadi Delta, India</i>	Shilpa Singh
<i>Diatom diversity and species richness in an estuarine setting: A case study from Vembanad estuary</i>	Biswajeet Thakur, Vandana Prasad & Rahul Garg
<i>Multiple applications of tree-ring data from the Himalayan regions</i>	S.K. Shah
<i>Climate change study in Western Himalaya using tree-ring data</i>	Akhilesh K. Yadav
<i>Diversity of Opal A silica in some panicoid grasses: A preliminary study from Lower Gangetic plains of West Bengal</i>	Ruby Ghosh & Subir Bera

Training/Study Visits

Binita Phartiyal visited KSKGR Laboratory, Allahabad in April 2012 for mineral magnetic analysis of samples collected from Ladakh.

Alpana Singh & B.D. Singh attended National level Meeting of Coal Petrographers and Brainstorming Session on 'Increasing Relevance of Coal Petrography for Industrial Utilization of Coal and our Preparedness for Future' held at CIMFR (Digwadih Campus), Dhanbad during May 07-08, 2012. Also attended Meeting of the Coal Petrological Society of India at CIMFR on May 08, 2012.

AS also attended the 10th Meeting of Solid Mineral Fuels Sectional Committee, PCD-7 and its Sub-Committees held at Bureau of Indian Standards, Manak Bhavan, New Delhi during March 21-22, 2013.

BDS also attended the 7th CGPB (Central Geological Programming Board) Committee-X Meeting held at Geological Survey of India (Northern Region), Lucknow on July 24, 2012, and discussed the role and achievement of BSIP, especially about fruitful collaborations with GSI.

A.K. Ghosh deputed (funded by IODP, US Implementing Organization and National Science Foundation, USA) to IODP Expedition-342 during June 02 to August 01, 2012, and visited Bermuda, New Jersey Margin, North Atlantic and Newfoundland (Canada). Also attended the Indian IODP participants meeting at NCAOR Goa during January 14-15, 2013.

Ruby Ghosh availed 'INSA Visiting Fellowship for 2012-2013' and worked in National Stable Isotope Facility, Department of Geology and Geophysics, IIT, Kharagpur under the supervision of Prof. Anindya Sarkar. Work was done during June 20 to September 20, 2012.

C.M. Nautiyal attended meeting of the Vigilance Officers of DST Institutions at ARIES, Nainital held during June 26-27, 2012. Also attended Ujala Foundation: An interaction with Prof. Yash Pal on November 23, 2012.

Pawan Govil visited Inter University Accelerator Centre (IUAC), New Delhi for chemical analysis on 28 samples during one month from July to August, 2012. Also participated in 32nd Indian Scientific Expedition to Antarctica (ISEA 2012-2013) from November 2012 to February 2013.

Vartika Singh participated in Indian Arctic Summer Expedition-2012 and conducted field work in Ny-Alesund, Svalbard area during July-August, 2012 to collect Quaternary and recent sediments of the High Arctic. Also visited NCAOR, Goa prior to the Arctic Expedition.

Mukund Sharma visited Monash University, Melbourne, Australia from August 11-14, 2012. Also under INSA-CAS Exchange of Scientists Programme, visited Institute of Botany, Chinese Academy of Sciences, China University of Geosciences, Beijing Natural History Museum, Institute of Geology in Beijing; Nanjing Institute of Geology, Palaeontology and Stratigraphy, Nanjing Palaeontological Museum, Botanical Garden and Zhonghoan Mountain Park in Nanjing; Hefei Technology University, Hefei; College of Paleontology, Shenyang Normal University Shenyang in Liaoning Province; Institute of Geology and Mineral Resources, Dalian, China for a period of one month (October 09 to November 08, 2012).

Rajni Tewari & Deepa Agnihotri visited Wadia Institute of Himalayan Geology, Dehradun in August 2012 to carry out the geochemical analysis (including Major, Trace and Rare Earth elements) of the samples collected from Kashmir region for the interpretation of palaeoenvironment and palaeoclimatic conditions including the changes during the catastrophic event.

Shilpa Singh participated in the training on 'Quaternary setup of Arid NW Himalaya: Main focus on Ladakh' sponsored by DST, New Delhi and organized by Wadia Institute of Himalayan Geology, Dehradun at Ladakh from August 18 to September 06, 2012.

Mahesh Prasad attended DST sponsored General Management Programme for Scientists organized at Administrative Staff College of India (ASCI), Hyderabad during August 27-September 08, 2012.

S.K.M. Tripathi visited the Palaeobotany Unit of W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland for a period of three weeks (September 05-24, 2012) under the INSA Exchange of Scientists Programme between INSA, New Delhi and Polish Academy of Sciences. Studied and observed modern pollen grains of the families: Arecaceae, Dipterocarpaceae, Ericaceae, Euphorbiaceae, Fagaceae, Myrtaceae, Nyssaceae, Nyctaginaceae, Nymphaeaceae, Oleaceae,



Pandanaceae, Polygalaceae, Potamogetonaceae, Proteaceae and Rununculaceae.

Rupendra Babu attended the World Hydro Power Convention: Dual Theme– Bilateral cooperation and partnering India's growth with speedier development of Hydropower potential held at New Delhi on September 11-12, 2012. Visited various laboratories of KDMIPE, ONGC, Dehradun on September 16-17, 2012 along with participant trainees of the Training Programme on Palynology in Fossil Fuel Exploration held at BSIP during September.

Neerja Jha attended DST sponsored programme on Multidisciplinary Perspective on Science, Technology and Society with a core theme on 'Technology, Innovation and Development' organised by National Institute of Advanced Studies (NIAS) during September 23-October 05, 2012 at Indian Institute of Science, Bangalore.

Vandana Prasad attended the 1st Group Monitoring Project Review Meeting cum 1st Meeting of the SERB (Science and Engineering Research Board, DST) held at M.S. University, Badodara during October 06-07, 2012.

Chinnappa Chopparapu attended the training program on Bioresource Management held at Madurai Kamaraj University, Madurai, Tamil Nadu during October 08-22, 2012.

S.K. Shah attended 2nd Meeting of the Programme Advisory Committee on Earth Sciences (PAC-ES) held at M P Council of Science and Technology, Bhopal during November 19-20, 2012.

M.F. Quamar attended 2nd High Noon Spring School on Adaptation to Changing Water Resources and Water Demand with Glacier Retreat, Changing Monsoon Precipitation and related Science policy Interaction, sponsored by UKaid Department for International Development and held at the Department of Civil Engineering, IIT, Delhi from February 04-07, 2013.

Mayank Shekhar attended the High Noon Spring School programme under EU funded project 'Adaptation to changing water resources availability in northern India with Himalayan Glacier retreat and changing monsoon pattern' held at Department of Civil Engineering, IIT Delhi during April 02-06, 2012.

P.S. Katiyar attended the 1st National Knowledge Network Annual Workshop organised jointly by National Informatics Centre (NIC) and Indian Institute of Technology (IIT), Bombay during October 31-November 01, 2012 at IIT, Mumbai.

S.C. Bajpai attended International Congress on Renewable Energy (ICORE-2012) held at Pandit Deendayal Petroleum University, Gandhinagar during December 06-07, 2012. Also attended Energy Conservation Day Seminar, Institution of the Engineers at Lucknow on December 12, 2012.

Lectures Delivered

- *Paleontology : An Interface between and Earth and Life Sciences* INSPIRE Lecture sponsored by DST at CET, SRMS Bareilly (January 27, 2013) – delivered by Sunil Bajpai
- *Climate Change and Plant Diversity in Earth's History* (Special Lecture) in Plant Sciences Section of Indian Science Congress at Kolkata (January 06, 2013) – delivered by R.R. Yadav
- *Application of Tree Rings in Environmental studies* in UGC Refresher Course at the Botany Department of Lucknow University (February 01, 2013) – delivered by R.R. Yadav
- *Palynology and its application in Dating and Correlation of Coal-bearing Horizons in India* in the Session Sharing of Experiences in Training Programme at NIAS, Bangalore (September 28, 2012) – delivered by Neerja Jha
- *Tertiary Palynology in India with special reference to the Spore/Pollen Assemblages from Palaeogene Sediments* at Palaeobotany Unit of W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland (September 20, 2012) – delivered by S.K.M. Tripathi
- *Antarctica: A unique natural Biodiversity Reserve in one end of the Globe* at the UGC sponsored Seminar on 'Biodiversity', Lady Brabourne College, Kolkata (December 17, 2012) – delivered by S.K. Bera
- *Cenozoic Flora of Western India and its significance in Palaeoclimatic and Palaeophytogeographic Interpretations* at Govt. Dungar College, Bikaner (February 11, 2013) – delivered by R.C. Mehrotra & Anumeha Shukla
- *Paryavaran tatha Oorja: Svachchh Oorja ki Talash* (two lectures) in the Workshop on Environment Awareness at Brahmanand College, Kanpur (in April 2012) – delivered by C.M. Nautiyal
- Lecture in the Hindi Training Workshop at CSIR-NBRI, Lucknow (in June 2012) – delivered by C.M. Nautiyal
- Lecture on Science Quizzing for Haryana Council of S&T, Chandigarh (in July 2012) – delivered by C.M. Nautiyal
- *Saur Mandal and Isotopes* (two talks) for Gyan Vani, Lucknow (in July 2012 & March 2013) – delivered by C.M. Nautiyal
- *Climate Change, Water and Energy Crisis* in a Seminar by Swayam Siddha at IRTI, Lucknow (in August 2012) – delivered by C.M. Nautiyal
- *Hamari Prithvi: Kal, Aaj aur Kal* in a Workshop by Homi Bhabha Centre for Science Education (TIFR), Mumbai at Vigyan Parishad, Prayag (in November 2012) – delivered by C.M. Nautiyal
- *Mme Curie Memorial Lecture on Radiocarbon Dating* at St. Longowal Institute for Engineering & Technology, Sangroor (in November 2012) – delivered by C.M. Nautiyal
- Three lectures during the Science Journalism Workshop by Manipur Science Technology and Environment Council (in November, 2012) – delivered by C.M. Nautiyal
- *Isotopes in Astrosciences* (two lectures) at UGC Staff College, Lucknow Univ. (in January 2013) – delivered by C.M. Nautiyal
- *Nuclear Energy* in a workshop by Vigyan Prasar, Noida at Regional Science City, Lucknow (in February, 2013) – delivered by C.M. Nautiyal
- *The Past, Present and Future of Earth* at Amity University (INSPIRE programme, DST; February, 2013) and two Face-to-Face sessions at University campuses at Noida and Jaipur – delivered by C.M. Nautiyal
- *Fun with Science* at RC Singh Mahavidyalay, Faizabad (March 08, 2013) – delivered by C.M. Nautiyal
- *East Coast Cretaceous: A palaeoecological perspective* (Invited talk) at Annamalai University, Chidambaram, Tamil Nadu (March 24, 2013) – delivered by A. Rajanikanth
- *Biodiversity in biotic realm of Marwar Supergroup, Rajasthan* at Monash University, Melbourne, Australia (August 14, 2012) – delivered by Mukund Sharma

- *Cyanobacteria: the successful survivors* at Institute of Botany, CAS, Beijing, China University of Geosciences, Beijing (October 12, 2012) – delivered by Mukund Sharma
- *Chuarina circularis and its preservation and affinity* at Nanjing Institute of Geology, Palaeontology and Stratigraphy, Nanjing (October 19, 2012) – delivered by Mukund Sharma
- *Evolution and diversification of angiosperms in the Deccan Intertrappean Flora of India: Phytogeographical and Palaeoclimatological aspects* (Lead Lecture) in the International Symposium and Conference at S.G.B. Amravati University, Amravati (October 29, 2012) – delivered by Rashmi Srivastava
- *Palynodata of the wet land in assessing Biodiversity and its impact on climate change: An overview in Indian context* at Symposium on 'Wetland 2012', Silchar, Assam – delivered by A. Bhattacharyya
- *Phyto-evolution revisited: Interpretations from Palaeobotanical studies from Indian subcontinent* on the occasion of mid year meet organized by Indian Academy of Sciences, Bangalore (in July 2012) – delivered by Vandana Prasad
- *Journey from Ocean to Mountain: An overview of the Oligo-Miocene fluvial sediments from NW Himalaya, India* at Seminar in the Expedition Ship Joides Resolution during IODP Expedition 342 (July 07, 2012) – delivered by A.K. Ghosh
- *Major Catastrophic Events in the History of Plant Earth and their Effects on the Diversity of Plants* in 4th Refresher Course in Life Science at Academic Staff College, University of Burdwan (November 21, 2012) – delivered by A.K. Ghosh
- *Reconstruction of past vegetation and interpretation of past climate with the aid of plant fossils* in 4th Refresher Course in Life Science at Academic Staff College, University of Burdwan (November 22, 2012) – delivered by A.K. Ghosh
- *IODP Expedition 342* in Indian IODP Participants Meeting at NCAOR, Goa (January 14, 2013) – delivered by A.K. Ghosh
- *Himalayan Pollen studies in relation to land-cover reconstruction and climate modelling in Northern*

India (Invited talk) at Workshop in Hebei Normal University, Shijiazhuang, China (in October, 2012) – delivered by S.K. Shah

- *An Overview of Sustainable Aspects of Energy usages in Buildings* (Invited talk) at the Department of Pure and Applied Physics, University of Kota, Rajasthan (June 29, 2012) – delivered by S. C. Bajpai
- *Energy Management in Buildings* at Energy Conservation Day Seminar, The Institution of Engineers, UP Chapter Lucknow (December 12, 2012) – delivered by S. C. Bajpai
- *Solar Radiation and Solar Photovoltaic Power Generation* in the Training Programme at the Alternative Energy Research, Development and Training Centre of Non-Conventional Energy Development Agency, UP, Lucknow (March 20, 2013) – delivered by S. C. Bajpai

By outside scientists in the Institute:

Prof. Kotha Mahender, Department of Earth Sciences, Goa University, Goa

- *Geological Software, Usage of Mapping Software, GPS and related gadgets & Applications of Tilia Programme* (series of lectures: June 27-29, 2012).

Dr. R.K. Saxena, Ex-Scientist, BSIP, Lucknow

- *Erstwhile International Code of Botanical Nomenclature (ICBN) versus Melbourne Code* (Dr. B.S. Venkatachala Memorial Lecture; January 02, 2013)

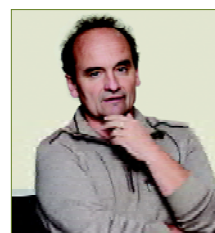


Prof. B.S. Kotlia, Center of Advanced Study in Geology, Kumaun University, Nainital

- *Multi-annual to Decadal Scale Climate changes in Central Indian Himalaya for the last 4,500 yrs, as inferred from Speleothems* (January 18, 2013)

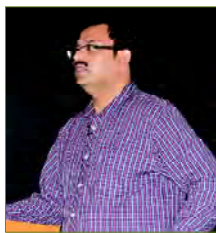
Dr. Thierry Adatte, University of Lausanne, Switzerland

- *Timing and Tempo of Deccan Volcanism and relation with K/T Extinction Event* (February 01, 2013)



Dr. S.V. Sawant, Principal Scientist 'E', NBRI, Lucknow

- *G M Crops: A Fading Opportunity in India* (National Science Day Lecture; February 28, 2013)



Prof. J.G.M. Hans Thewissen, Department of Anatomy and Neurobiology, Northeast Ohio Medical University, USA

- *Beyond Fossils: Interfaces with Ecology and Developmental Biology* (March 20, 2013)



Prof. A.K. Singhvi, Geosciences Division, Physical Research Laboratory, Ahmedabad

- *Future Earth Societal Relevance of – and Scientific Challenges– for Geosciences as Services* (March 04, 2013)



Retired and serving staff offering *Pushpanjali* at *Samadhi* of Prof. Birbal Sahni on Founders' Day

Consultancy/Technical Support Rendered

The **Radiocarbon Laboratory** also served as a national facility for researchers across the country for dating materials. Radiocarbon dates under consultancy have been provided to the scientists/ workers from the following organisations during the year:

- Centre for Earth Science, Trivandrum
- Indian Institute of Science, Bengaluru
- Geological Survey of India, Shillong
- Agharkar Research Institute, Pune
- University of Agricultural Sciences, Bengaluru
- Archaeological Survey of India, Patna
- Gujarat Ecological & Environmental Research Foundation
- Postgraduate Institute of Archaeology, Colombo (Sri Lanka)

The electron microscopes equipped in **SEM unit** are being used as a central facility in the Institute. The facility has also been provided to other institutions in spare times. The unit has rendered consultancy services in investigating the ultra structural morphology and micro-analysis of varied samples of 76 researchers from following organizations/ universities:

- Department of Botany, Lucknow University, Lucknow
- Department of Chemistry, Lucknow University, Lucknow
- Department of Physics, Lucknow University, Lucknow
- National Botanical Research Institute, Lucknow
- Central Institute of Medicinal and Aromatic Plant, Lucknow
- Central Drug Research Institute, Lucknow
- Indian Institute of Toxicology Research, Lucknow
- Central Institute for Plastic Engineering & Technology, Lucknow
- King George Medical University, Lucknow
- Integral University, Lucknow
- Amity University, Lucknow
- Allahabad University, Allahabad
- Aligarh Muslim University, Aligarh
- Banaras Hindu University, Varanasi
- Bundelkhand University, Jhansi
- Kumaun University, Nainital (Uttarakhand)
- Sant Gadge Baba Amravati University, Amravati
- BBD National Institute of Technology & Management, Lucknow
- Rameshwar Institute of Technology & Management, Lucknow
- Motilal Nehru National Institute of Technology, Allahabad
- Career Post Graduate College of Dental Sciences, Lucknow
- Saraswati Dental College, Lucknow

- Sardar Patel P.G. Institute of Dental and Medical Sciences, Lucknow
- Kothiwal Dental College and Research Centre, Moradabad
- Institute of Dental Sciences, Bareilly
- Vyas Dental College and Hospital, Jodhpur
- Thirthankar Mahaveer College of Pharmacy, Mooradabad
- Department of Physics, Agra College, Agra
- Department of Physics, Jadhavpur Vishwavidhyalaya, Kolkata

Provided scientific assistance on palynological identification, dating and correlation of coal-bearing Gondwana horizons to Dr. B.R. Jha of Geology Department, Ranchi University, Ranchi. – by Neerja Jha

Supervised Dissertation of Mr. Abhishek Sinha, student of B. Tech., Geosciences Engineering, UPES, Dehradun (during June-July, 2012). – by Ram Awatar

Imparted training on ‘Palynology of Neyveli lignite deposit, Cauvery Basin’ to Mr. M.S. Anis (M. Phil) of Department of Geology, University of Madras (during April-May, 2012). – by M.R. Rao

Imparted training on ‘Palynofossils from Khari Nadi Formation (Early Miocene), western India’ to Ms. Poorti Gusain (B.Sc. Hons) of Ram Lal Anand College, Delhi University, New-Delhi (during May-June, 2012). – by M.R. Rao

Imparted training on ‘Palynological study of Palaeocene-Eocene boundary sections in Kutch and Rajasthan’ to Dr. Jyothi Sharma, Women Scientist under DST Project, New-Delhi (during May-June, 2012). – by M.R. Rao

Imparted training to Ms. Jyoti Shukla and Ms. Sandhya Verma of M.Sc. (Final) students from CAS in Geology, Lucknow University, Lucknow on Tertiary palynology and its application with special reference to spore-pollen and dinoflagellate cysts of western Kutch, Gujarat (during January-February, 2013). – by M.R. Rao

Imparted training (Dissertation project) on ‘Tertiary palynology and its applications with special reference to Matanomadh lignite, Kutch Basin, Gujarat’ to Mr. Deepak Agarwal, B. Tech. (Geoscience Engineering, Semester-VI) student of University of Petroleum &



- Energy Studies (UPES), Dehradun (during June-July 2012). – by M.R. Rao & Poonam Verma
- Provided palynological training to Mr. Akash Tyagi, B. Tech. (Geoscience Engineering, Semester-VI) student of University of Petroleum & Energy Studies (UPES), Dehradun (during June-July 2012). – by Samir Sarkar
- Imparted training for palynological studies to Mr. Abhishek Sharma, student of B. Tech. (Geoscience Engineering, Semester-VI), Department of Petroleum Engineering and Earth Sciences, UPES, Dehradun (during June-July 2012), and Miss Rupal Dubey, student of M.Sc. (Tech.) Semester-II, Department of Geology, BHU, Varanasi. – by S.K.M. Tripathi & Hukam Singh
- Guided Dissertation Project on 'Proterozoic Paleobiology of the Singhora Group, Chhattisgarh Basin' of Mr. Mohil Giri, B.Tech. (Geoscience Engineering, Semester-VI) student of UPES, Dehradun (during June-July 2012). The report contains on macroscopic (13 taxa) microbiological remains (13 genera), comprising remains of algae- epilithic megafossils and entombed microfossils in sedimentary rocks (shales and chert) belonging to Chhuipali Formation exposed in and around Tushgaon, Mahasamund district. – by Rupendra Babu
- Provided guidance for the interpretation of the palynological sequences pertaining to thesis work of Ms. Suman Rawat, Research Scholar, Wadia Institute of Himalayan Geology, Dehradun (during July 23-26, 2012). – by M.S. Chauhan
- Imparted training to Mrs. Deepika Tripathi, Research Scholar, Allahabad University, Allahabad regarding the maceration technique used in Quaternary palynology and pollen morphological studies of modern plants (during October-November, 2012). – by M.S. Chauhan
- Discussed and interpreted Quaternary palynological data from Sangari, Gujarat with Mr. Yogendra Babu Sharma, Research Scholar, University of Oxford, Oxford, U.K. (during December 18-22, 2012). – by M.S. Chauhan
- Imparted training to Mr. Ajay Kumar of Jawaharlal Nehru University, New Delhi, regarding the maceration technique used for palynological studies of aerosols. Also examine the aerosol samples and carried out the photodocumentation of pollen and spores recovered in the sample (during January 23-25, 2013). – by M.S. Chauhan
- Guided Dissertation project on 'Late Middle Eocene calcareous nannofossil biostratigraphy of Tanot Bore well-1, Jaisalmer Basin and its hydrocarbon implications' of Mr. Divyam Gulati, B.Tech. (Geoscience Engineering, Semester-VI) student of UPES, Dehradun (during June-July 2012). – by Jyotsana Rai
- Guided Dissertation (M.Sc. Geology) project on 'Carbonaceous macrofossil remains from the Kurnool Group, Andhra Pradesh' of Mr. Vivek Singh Chauhan of Department of Geology, Bundelkhand University, Jhansi, U. P. – by Mukund Sharma
- Guided Dissertation (B.Tech) project on 'Biodiversity in carbonaceous macrofossils of the Semri Group, Suket area, Madhya Pradesh' of Mr. Abhishek Shukla of UPES, Dehradun (during June-July, 2012). – by Mukund Sharma
- Provided guidance in documentation of petrological data (lithotypes, macerals and vitrinite reflectance) accumulated on Lakhanpur coal samples to Ms. Prabha Sharma, Research Scholar of Vikram University, Ujjain (in August 2012). – by Alpana Singh
- Provided consultancy services in observation and quantitative estimation of maceral groups (through Single-Scan method), mineral matters and in measurement of vitrinite reflectance (to assess the rank) on 30 Permian Gondwana coal samples to Central Institute of Mining and Fuel Research (Barwa Road Campus), Dhanbad (during September-October 2012). A report containing these data, in relation to coal bed methane, is forwarded to the said organization. The samples were sent by Dr. A.K. Singh, Head, Methane Emission Division. – by B.D. Singh, Alpana Singh & Mahesh S.
- Provided scientific assistance in measurement of vitrinite reflectance on coal samples of Damodar Basin to Mr. Srichandan Biswal, M.Tech. (Petroleum Exploration) Student of Indian School of Mines University, Dhanbad (in April-May 2012). – by B.D. Singh
- Provided scientific assistance in measurement of huminite reflectance on Neyveli lignite samples to Mr. M.S. Anish, M.Phil. Student of Department of Geology, University of Madras, Chennai (in May 2012). – by B.D. Singh

Guided Dissertation Project on 'Petrological characterization of Kapildhara coals from Sohagpur Coalfield (MP), India' of Mr. N.S. Jaggi, B.Tech. (Geoscience Engineering, Semester-VI) student of UPES, Dehradun (during June-July 2012). – by B.D. Singh

Provided scientific assistance in measurement of vitrinite, semifusinite and fusinite reflectances, to assess the maturity (rank) pattern of Korba coals (Mahanadi Basin), to Mr. S.K. Banerjee of Central Mine Planning and Design Institute, Ranchi for a period of two weeks (in November 2012). – by B.D. Singh

Guided Dissertation Project on 'Petrological evaluation of Kurja coals from Sohagpur Coalfield (MP), India' of Mr. P.N. Mishra, M.Sc. (Geology) Student of Bundelkhand University, Jhansi (during January-March 2013). – by B.D. Singh

Provided consultancy services on palynological study of the samples in a sediment profile provided by GSI, Jaipur. Further work is under progress. – by Anjum Farooqui

Guided Dissertation work (Masters in Marine Geology; final year) of Ms Pillai Surabhi Ramachandran, a student of Department of Marine Geology and Geophysics, School of Marine Sciences, Cochin University of Science and Technology, Kerala. – by Abhijit Mazumder & S.K. Bera

Supervised the Dissertation entitled 'Integrated study of calcareous algae and benthic foraminifera from Palaeocene sequence of Assam shelf' of Sri Shubham Singh, B. Tech. Geo-Science Engineering student of UPES, Dehradun. – by Abhijit Mazumder & A.K. Ghosh



Shri R.N. Chaubey, DG, Directorate General of Hydrocarbons visiting Radiocarbon Dating Laboratory

Recognition

Sunil Bajpai

Elected Member Editorial Board, *Journal of the Geological Society of India* (for Fast Track Articles).
Elected Member Editorial Board, *Current Science*.
Elected Co-leader, International Geoscience Programme Project 608 on “Cretaceous ecosystems and their responses to palaeoenvironmental changes in Asia and the Western Pacific”.

Neerja Jha

Chaired a Session of the Training Programme on ‘Multidisciplinary Perspectives on Science, Technology and Society: Innovation and Development’ held at the NIAS, Bangalore (on September 28, 2012).

C.M. Nautiyal

Awarded ‘Vigyan Parishad (Prayag) Shatabdi Samman-2013’.
Awarded ‘Bharatiya Bhasha Pratishthapan Parishad (Mumbai) Samman-2013’.

A. Rajanikanth

Session Chairman, National Seminar on ‘Recent Perspective on Lakes, Rivers and Coastal Wetlands’, Annamalai University, Chidambaram, Tamil Nadu (24-25 March, 2013)

O.S. Sarate

Elected ‘Fellow’ of The Palaeobotanical Society of India, Lucknow.

Mukund Sharma

Selected for Indo-Australian Senior Scientist Fellowship of DST-ASA.
Nominated as ‘Voting Member’ of Cryogenian Sub-commission of ICS (2012-17)
Opted as Corresponding Member, Ediacaran Sub-commission of ICS (2012-17)
Elected as Member IGCP-587 (2011-2014)

Alpana Singh

Nominated ‘Alternate Member’ of a newly constituted Sub-Committee– Methods for the Petrographic Analysis of Coal, Coke and Lignite (PCD-7:5) of Solid Mineral Fuel Sectional Committee (PCD-7), Bureau of Indian Standards, New Delhi.

B.D. Singh

Nominated ‘Principal Member’ of a newly constituted Sub-Committee– Methods for the Petrographic

Analysis of Coal, Coke and Lignite (PCD-7:5) of Solid Mineral Fuel Sectional Committee (PCD-7), Bureau of Indian Standards, New Delhi.

Rashmi Srivastava

Invited to deliver Lead Lecture, and also Chaired a Technical Session in the International Symposium and XXII Conference of Indian Association for Angiosperm Taxonomy (October 28-30, 2012) held at S.G.B. Amravati University, Amravati.

Vandana Prasad

Nominated as guide for Summer Research Fellowship Programme (Inspire/Kvyp)-2012, jointly sponsored by the three National Science Academies of the country.

Selected as Member in Indian delegation to attend Indo-German Workshop on ‘Environmental challenges in Asia’ sponsored by DST and DFG and held at GeoForschungs Zentrum Potsdam in January, 2013.

A.K. Ghosh

Nominated by IODP India as a Shipboard Scientist in ‘IODP Expedition 342— Newfoundland Sediment Drifts in North Atlantic’.

Recognized as a Research Guide of Department of Botany, University of Burdwan for Ph. D. students.

Ratan Kar, P.S. Ranhotra & Anjali Trivedi

Awarded Chinese Academy of Sciences (CAS) and Third world Academy of Sciences (TWAS) Postdoctoral Fellowship-2012 to carryout researches at Institute of Botany, Chinese Academy of Sciences, Beijing, China.

Swati Dixit

Awarded “Young Scientist Award (Cash Prize)” for attending 13th International Palynological Congress/ 9th International Organization of Palaeobotany Conference held at Chuo University, Tokyo, Japan during August, 2012.

Anumeha Shukla

Awarded “Young Scientists Award and Mike Boulter Award” at the 13th International Palynological Congress/ 9th International Organization of Palaeobotany Conference held at Chuo University, Tokyo, Japan during August, 2012.



Representation in Committees/Boards

Sunil Bajpai

- Chief Editor, *The Palaeobotanist* (since February 2013).
- Member, CSIR Research Committee on Earth and Atmospheric Sciences (2011-ongoing).
- Member, Governing Council, National Centre for Antarctic & Ocean Research, Goa. (since January 2013).

N.C. Mehrotra

- President, The Palaeobotanical Society, Lucknow (till December 2012).
- Chief Editor, *The Palaeobotanist* (till October 2012).
- Member, Council of the Geological Society of India, Bangalore.
- Member, Governing Council, National Centre for Antarctic & Ocean Research, Goa (till October 2012).
- Member & Indian Correspondent for Newsletter, American Association of Stratigraphic Palynologists.

R.R. Yadav

- President, The Palaeobotanical Society, Lucknow. (since January 2013)
- Member, Editorial Board, *Himalayan Geology*.
- Member, Editorial Board, *Phytomorphology*.

Neerja Jha

- Vice-President, The Palaeobotanical Society, Lucknow. (since January 2013)

Ram Awatar

- Treasurer, The Palaeobotanical Society, Lucknow (till December 2012).

R.S. Singh

- Secretary, The Palaeobotanical Society, Lucknow. (since January 2013)
- Editor, *Geophytology*.

Rupendra Babu

- Liaison Officer SCs/STs employees, BSIP.
- Course Co-coordinator, Training Program on *Palynology in Fossil Fuel Exploration*, BSIP (September 2012)

M.S. Chauhan

- Councillor, The Palaeobotanical Society, Lucknow. (since January 2013)

Madhav Kumar

- Course Co-coordinator, Training Program on *Palynology in Fossil Fuel Exploration*, BSIP (September 2012)
- Councillor, The Palaeobotanical Society, Lucknow. (till December 2012)

R.C. Mehrotra

- Councillor, The Palaeobotanical Society, Lucknow. (till December 2012)
- Convener, Smart Administration Cell, BSIP.

C.M. Nautiyal

- Member, National Committee on Archaeological Sciences.
- Member, Local Advisory Committee, Regional Science City, Lucknow.
- Member, Science Expo-2013 Committee, Regional Science City, Lucknow
- Chief Advisor, Organising Committee, National Children's Science Congress, UP.
- Bahya Antarangi in Antarang Sabha, Vigyan Parishad, Prayag.

Mahesh Prasad

- President, BSIP Employee Co-operative Credit and Thrift Society, Lucknow.
- Treasurer, The Palaeobotanical Society, Lucknow. (since January 2013)

Vandana Prasad

- Expert Member, DST Fast Track Programme for Young Scientists (Earth Science; 2012-2015).
- Councillor, The Palaeobotanical Society, Lucknow. (since January 2013)

Jyotsana Rai

- Member, International Nannoplankton Association.
- Member, Core Scientific Committee, 9th International Congress on the Jurassic System (to be held in 2014).
- External Examiner, M.Sc. (Geology), Mizoram University, Mizoram.
- Executive Member, Palaeontological Society of India, Lucknow.

**Mukund Sharma**

- President, Society of Earth Scientists, Lucknow.
- Convener, Research Development Cell, BSIP.
- Joint Secretary, The Palaeontological Society of India, Lucknow

Alpana Singh

- Member, Solid Mineral Fuel Sectional Committee– PCD-7.4: Methods of Analysis Subcommittee, Bureau of Indian Standards, New Delhi.
- Member, Executive Council, Coal Petrological Society of India.
- Member, The Society for Organic Petrology (TSOP).
- Councillor, The Palaeobotanical Society, Lucknow. (since January 2013)

B.D. Singh

- Associate Member, International Committee for Coal and Organic Petrology (ICCP).
- Principal Member, Solid Mineral Fuel Sectional Committee– PCD-7.4: Methods of Analysis Subcommittee, Bureau of Indian Standards, New Delhi.
- Member, Executive Council, Coal Petrological Society of India.
- Member, Research Planning and Coordination Cell, BSIP.
- Member, Board of Examiners (Ph.D. Thesis), Vinoba Bhave University, Hazaribagh.
- Course Co-coordinator, Training Program on *Palynology in Fossil Fuel Exploration*, BSIP (September 2012)

Chanchala Srivastava

- Executive Member, Indian Society for Prehistoric and Quaternary Studies, Pune.
- Councillor, The Palaeobotanical Society, Lucknow. (since January 2013)

Rashmi Srivastava

- Editor, *Geophytology*. (till December 2012)
- Member, Editorial Board, Indian Journal of Scientific Research, Varanasi.

Rajni Tewari

- Editor, *The Palaeobotanist*.
- Councillor, The Palaeobotanical Society, Lucknow. (till December 2012)

B.D. Mandaokar

- Joint Secretary, The Palaeobotanical Society of India, Lucknow. (since January 2013)

Neeru Prakash

- Editor, *Geophytology*. (since January 2013)

Anjum Farooqui

- Executive Member, International Society of Environmental Botanists.

A.K. Ghosh

- Member, Academic Council, 3rd Sino-Indian International Conference & 16th Annual Meeting of the Palaeobotanical Branch, Botanical Society of China (September 2012).
- Councillor, The Palaeobotanical Society, Lucknow. (since January 2013)

Ratan Kar

- Member, Terrestrial Working Group, International Arctic Science Committee.
- Assistant Editor, *The Palaeobotanist*.
- Organising Secretary, *One-day Symposium for Young Scientists*, BSIP (October 2012).

Binita Phartiyal

- Field Expert, Training Workshop on *Quaternary Setup of Arid Himalaya NW Himalaya: Main focus on Ladakh* organised by WIHG, Dehradun (August 18-September 05, 2012).

P.S. Katiyar

- Chairman, Selection Committee, Project Fellow in CDRI (22.8.2012)
- Member, Selection Committee, Data Entry Operator in CDRI (08.09.2012)
- Member, Selection Committee for the post of Technician (1) in CDRI (29.11.2012)

S.C. Bajpai

- Editor, Journal of Chemical, Biological and Physical Sciences (an International Peer Review E-3 Journal of Sciences).
- Reviewer, People's Journal of Science & Technology, People's College of Research and Technology, Bhopal.
- Judge, Projects Completion on National Science Day, Seth Swami Dayal Educational Institution, Fatehpur, Barabanki.



Doctoral Degree Awarded

Name	Subject	Date	University	Supervisor	Title of Ph.D. Thesis
Abha	Geology	September 17, 2012	Lucknow University	Dr. Jyotsana Rai	Subsurface Cretaceous age calcareous nannofossils biostratigraphy from Tanot well-1, Jaisalmer Basin, Rajasthan
Deepak Singh	Geo-sciences	October 11, 2012	UPES, Dehradun	Dr. Mukund Sharma Dr. Pradeep Joshi (Co-Supervisor)	Palaeobiology, Biostratigraphy and organic matter Maturation of the Bhandar Group sediments, Maihar area, Satna District, Madhya Pradesh
Udai Bhan	Geo-sciences	October 11, 2012	UPES, Dehradun	Dr. Mukund Sharma Dr. Pradeep Joshi (Co-Supervisor)	Palaeobiology and organic Geochemistry of the Semri Group Sediments, Maihar area, Satna District, Madhya Pradesh
Biswajeet Thakur	Geology	November 05, 2012	Lucknow University	Dr. Dhruvsen Singh	Surface and shallow subsurface study of Rapti-Gandak Interfluvium

Distinguished Visitors

Shri R.N. Chaubey, IAS, Director General, Directorate General of Hydrocarbons, New Delhi

Shri Kuldeep Chandra, Advisor (Research), University of Petroleum and Energy Studies, Dehradun

Dr. D.S.N. Raju, Consultant for ONGC, Dehradun & Rajahmundry

Prof. K.G. Saxena, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi

Prof. Rengaswamy Ramesh, Physical Research Laboratory, Ahmedabad

Prof. A.K. Varma, Indian School of Mines University, Dhanbad

Dr. C.S. Nautiyal, Director, NBRI & CIMAP, Lucknow

Dr. Baleshwar Kumar, National Geophysical Research Institute, Hyderabad

Dr. Anjali Midha Sharan, Programme Director, Univ. of Petroleum and Energy Studies, Dehradun

Dr. Thierry Adate, University of Lausanne, Switzerland

Prof. J.G.M. Hans Thewissen, Northeast Ohio Medical University, USA

Dr. Rajni Sharma, Executive Director, IUSSIF, New Delhi

Dr. S.B. Upadhyay, Director, State Forensic Laboratory, Lucknow

Shri K.C. Bhattacharyya, Ex-Director, Northeastern Space Application Centre, ISRO, Shillong

Dr. S.V. Sawant, Principal Scientist, NBRI, Lucknow

Units

Publication

Journal— *The Palaeobotanist*

This year two numbers of BSIP's flagship journal *The Palaeobotanist* were published. The first 61(1) was a Special Issue on papers from 'Indo-Brazilian Symposium

Cyanobacteria, and three more papers by foreign scientists.

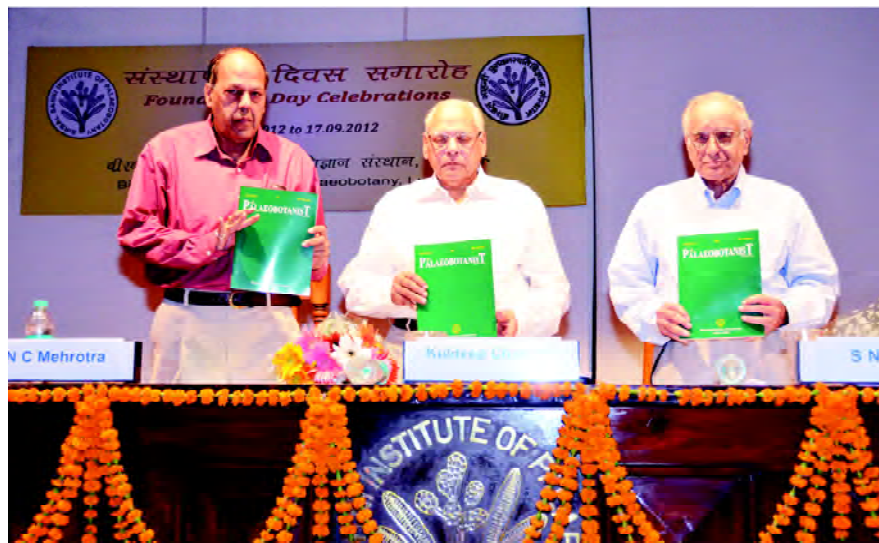
Annual Report

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 April 01, 2011–March 31, 2012. Besides, research papers published/accepted, conference participation, awards, training/deputation, Foundation/Founders' Day celebration, reports of different Units, annual accounts and related aspects with relevant graphics and photographs were included.

Miscellaneous

Biographical profiles and abstracts of lectures delivered by eminent speakers on various functions were printed.

on Glimpses of Gondwana Research', which incorporated 14 research papers mainly as an outcome of the collaborative investigations carried out between Indian and Brazilian earth scientists. The first Symposium in the series was organised by BSIP on November 24, 2010 at Lucknow, and a second meeting was organised on October 27, 2011 at Natal, Brazil as a special session in 'XXII Brazilian Congress of Palaeontology' (October 23-28, 2011). The abstracts of all the research papers were also published in both Hindi and Portuguese languages—a first for *The Palaeobotanist*. The second 61(2) contained a monographic work *Proterozoic Fossil*



Knowledge Resource Centre

Knowledge Resource Centre (KRC) is committed to provide best information services and support to its users in the era of information sharing and fulfill its mission to disseminate the knowledge.

Besides holding an excellent collection of Palaeobotany and its allied subjects, KRC also provides immediate access of articles by subscribing online databases, e-journals and through National Knowledge Resource Consortium of CSIR-DST. Weekly services of 'New Arrivals' having content pages of journals/ books acquired by KRC and *News Clippings* having scientific contents from Newspapers and magazines purchased by KRC are regularly being communicated to its 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. The procured new literature is continuously added to the database.



The current holdings of KRC are as under:

Particulars	Additions during 2012-13	Total
Books	105	6,089
Journals (bound volumes)	196	16,437
Reprints	-	40,097
Reference Books	5	346
Books in Hindi	15	510
Ph.D. Thesis	-	102
Reports	-	46
Maps & Atlases	-	61
Microfilm/ Fisches	-	294
Compact Disk	-	74

Currently the library is receiving 166 journals (96 through subscription and 70 through exchange). There are 172 registered card holders using the library facilities.

Exchange Facility

Institutions on exchange panel with our in-house journal *Palaeobotanist* 40

Journals received from different institutes on exchange basis 70

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/>), Nature Publishing Group (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>); 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 scientists, 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.

Consulting

The following Institutions/ Organizations availed the KRC facilities:

Jaypee University of Engineerings Technology, Guna (MP)

Department of Botany, University of Calcutta, Kolkata
Botany Department, Lucknow University, Lucknow

Isabella Thouburn College, Lucknow

National Institute of Technology, Karnataka, Surathnal.

Training

KRC is providing 12 months training to two Apprentice Trainees for library working.

Museum

Museum plays a vital role in popularizing and dissemination of the palaeobotanical knowledge amongst students, scholars and common man. In this connection, BSIP participated in National *Science Congress* from January 03-07, 2013 at Calcutta University, Kolkata (WB) and in the *Science Expo* at Regional Science City, Lucknow from January 30th to February 3rd, 2013. Participants and the visitors took keen interest in Institute's exhibitions depicting palaeobotanical marvels and the achievements.

Research materials have been collected from 280 localities spreading in different parts of the country by the scientists working on different projects as well as on various sponsored projects including DST. The samples concerning 21 research papers have been submitted during this period. The conservation work has also been done. The relief map of India and adjacent countries displayed in Museum Hall-1, has been repaired and re-colored. The digital photography of most of the fossil specimens and other exhibits located in various showcases inside the museum has been completed. Seven sets of plant fossils and slides have been gifted to various Universities/ Colleges with in the country, and fossil specimens are also presented to the distinguished guests.

Museum Holdings

Particulars	Addition during 2012-2013	Total
Type and figured specimens	58	7,789
Type and figured slides	187	14,225
CD/Negatives	18	40

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

Project	Specimens (Megafossils)	Samples
Project- 1	-	188
Project- 2	450	42
Project- 3	11	406
Project- 4	1377	128
Project- 5	200	895
Project- 6	-	203
Project- 7	-	297
Project- 9	19	799
Project- 10	-	350
Project- 11	-	65
Project- 12	-	551

Samples deposited under Sponsored/ Collaborative Projects:

D.S.T. Project No. SR/S4/ES-521/2010/G	: 251
D.S.T. Project No. CCP/DR/07/2011/6	: 134
D.S.T. Project No. SR/FTP/ES-723/2009	: 35
D.S.T. Project No. CCP/PR/07/2011/A	: 187
D.S.T. Project No. SR/S4/ES-264/2007	: 52

Specimens / Slides gifted

Department of Geology, Govt. Art College, Salem
University Art and Science College, Subedari, Warangal (AP)

R. P. J. S. S. M. Inter College, Tetri Bazar, Sidharth Nagar (UP)

Department of Geology, University of Delhi, Delhi
Department of Botany, Dharam Samaj College, Aligarh (UP)

P. G. Department of Botany, Nowrojee Wadia College, Pune

P. G. T. Biology, Holy Child Sr. Secondary School, New Delhi

Institutional Visitors

Department of Botany, University of Calcutta, Kolkata (WB)

Department of Botany, N. Wadia College, Pune (Maharashtra)

Navayugan Radiance Sr. Secondary School, Rajendra Nagar, Lucknow (UP)

Arya Vidyapeeth College, Gopi Nath Nagar, Guwahati (Assam)

6th M.P. Mission Excellence Vigyan Manthan Yatra- 2012, MP CST, Bhopal (MP)

Department of Geology, M. G. C. G. University, Satna (MP)

Department of Botany, N. S. M. Coty College, Cuttack (Odisha)

Forest Training Research Institute, Kanpur (UP)

Department of Botany, Ulubenia College, Hawrah (WB)
R. P. J. S. S. M. Inter College, Tetri Bazar, Sidharth Nagar (UP)

Bhilai Mahila Mahavidyalay, Bhilai (Chhattisgarh)



Shri R.N. Chaubey, DG, Directorate General of Hydrocarbons
visiting our Museum



Herbarium

About 200 angiosperm plant specimens, 8 bryophytes, 10 pteridophytes, 12 lichen, 25 leaf specimens, 3 wood blocks, 100 wood cores, and 25 seeds have been added to the repository.

Holdings

Particulars	Addition during 2012-2013	Total
Herbarium		
Plant specimens		
Angiosperms	200	24,524
Bryophytes	8	80
Pteridophytes	10	80
Lichen	12	57
Leaf specimens	25	1,192
Laminated mounts of venation pattern	-	66
Xylarium		
Wood blocks	3	4,161
Wood discs	-	68
Wood cores	100	7,515
Wood slides	-	4,318
Palm slides (stem, leaf, petiole, root.)	-	3,195
Sporothek		
Polleniferous materials	-	3,016
Pollen slides	-	12,284
Carpothek		
Fruits & seeds	25	4,299
Museum Samples		
Medicinal & food plant	-	91

Scanning Electron Microscopy

The Electron Microscopes (Leo 430, Philips 505) equipped in SEM unit are being used as a central facility in the Institute. The aim of this unit is to provide scanning electron microscopy infrastructure and back scattered electron images, which are supporting frontline research in the palaeobotanical, palynological, geological and biological sciences, for the scientists and research scholars of the Institute. In spite of Institute's scientific works, such facility has been rendered in spare time to the 76 researchers of other academic institutions of the country. The SEM (Leo 430) is well maintained which is displaying clear images of the objects at the desired magnifications.

Electronic Data Processing

NKN (National Knowledge Network) connectivity in the Institute has been commissioned and working as a primary Gateway. In addition, Internet Connection 2 MBPS (1:1) with Radio link facility from Software Technology Park of India, Lucknow is also running in the Institute. Proxy, Mail and DNS Servers are successfully running and provides 24 hours Internet facility to the Institute Staff.

Computer Section has procured one HP DL 380 G7 server and 18 Computers with 1000VA UPS for Scientists/Units.

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. Computerized Visitor Gate Pass Entry System has been installed at the Main Gate for visitor Gate Pass and working satisfactorily. Wireless Internet Connectivity has been running within the campus.

In addition, Payroll, Form16 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.

Section Cutting

In the unit fossil and rock samples are cut and their thin sections are prepared. During the year total 480 samples have been cut and 2175 slides are prepared. In addition, more than 250 slices are also cut and polished.

A number of scientists, students and teachers visited the unit and they were given live demonstration of cutting, grinding and polishing etc.

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 continues to strive to reach the set target for Official Language implementation. The Institute participated in both the Half Yearly meetings of Town Official Language Implementation Committee during the year 2012-13. The 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.

Hindi Fortnight

Hindi Fortnight was celebrated from September 14-28, 2012. During the Hindi Fortnight forty-four staff members participated in a series of competitions including *Hindi Typing* (Computer), *Spot the Errors*, *Essay* and *Research Highlight Presentation* by young researchers. The Director encouraged the participants during the competitions too. The prize distribution was held on 28th September in the main auditorium, in which Hindi books of reputed authors were given away as prizes.

Results of various competitions are given below:

<i>Typing</i>	:	I – Mr. Rahul Gupta II – Mrs. Sudha Kureel III – Ms. Anupam Jain
<i>Spot the Errors</i>	:	I – Mr. Avanish Kumar II – Mr. Randheer Singh III – Mr. Rajesh Awasthi
Encouragement	:	Dr. Deepa Agnihotri Mrs. Sandhya Misra Mrs. Richa Tiwari Dr. Anju Saxena
<i>Essay</i>	:	I – Mr. Arun Joshi II – Mrs. Sandhya Misra III – Ms. Kusum Lata Verma

Research Highlight Presentation by Young Researchers— Mr. Randheer Singh, Mr. Deepak Kumar Gond, and Mrs. Nivedita Mehrotra made presentations of their research work in Hindi on September 28, 2012.

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:

Google Indic par Hindi mein Tanka kaise ho [by Dr. C.M. Nautiyal & Mr. P.S. Katiyar of BSIP] on June 29, 2012.

Hindi mein Takniki lekhan [by Dr. Mukund Sharma of BSIP] on September 28, 2012.

Hindi mein Vijnan tatha Praudyogiki Sampreshan [by Dr. C.M. Nautiyal] on September 28, 2012.

Vidhi Vijnan [by Dr. Shyam Bihari Upadhyay, Director of State Forensic Laboratory, Lucknow] on December 31, 2012.



Sangha ki Rajbhasha Neeti [by Dr. Vijay Narayan Tiwari, Sr. Hindi Officer of CDRI, Lucknow] on March 25, 2013.



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 of all the

research papers in Hindi 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, Half Yearly and Annual Reports to DST, New Delhi, Regional Implementation Office, Official Language Department (Ghaziabad), and Nagar Rajbhasha Kaaryaanvayan Samiti were prepared and regularly sent. Thus, the Institute is continuously abiding by the rules and direction of the Official Language *in extenso*.



A view of Hindi Fortnight celebration and prize distribution

Staff

Director

Dr. Naresh C. Mehrotra (retired w.e.f. 31.10.2012)
 Dr Ram R. Yadav (In-Charge, w.e.f. 01.11.2012-
 23.01.2013 FN)
 Prof. Sunil Bajpai (w.e.f. 23.01.2013 AN)

Scientists

Scientist 'G'

Dr Ram R. Yadav (w.e.f. 01.01.2013)

Scientist 'F'

Dr (Mrs) Neerja Jha
 Dr Ram Awatar
 Dr Mulagalapalli R. Rao
 Dr Samir Sarkar
 Dr Rama S. Singh
 Dr Surya K.M. Tripathi

Scientist 'E'

Dr Rupendra Babu
 Dr Samir K. Bera
 Dr Mohan S. Chauhan
 Dr Madhav Kumar
 Dr Bhagwan D. Mandaokar
 Dr Rakesh C. Mehrotra
 Dr Chandra M. Nautiyal
 Dr (Mrs) Neeru Prakash
 Dr Mahesh Prasad
 Dr (Mrs) Vandana Prasad (w.e.f. 01.01.2013)
 Dr (Mrs) Jyotsana Rai
 Dr Annamraju Rajanikanth
 Dr Dinesh C. Saini
 Dr Omprakash S. Sarate
 Dr Rakesh Saxena
 Dr Anupam Sharma (w.e.f. 01.01.2013)
 (on lien w.e.f. 30.04.2012)
 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 Gyanendra K. Trivedi

Scientist 'C'

Dr Sadhan K. Basumatary (w.e.f. 01.01.2013)
 Dr Ratan Kar
 Dr Abhijit Mazumder
 Dr Srikanta Murthy (w.e.f. 01.01.2013)
 Dr (Mrs) Binita Phartiyal
 Dr Anil K. Pokharia
 Dr Santosh K. Shah (w.e.f. 01.01.2013)
 Dr Hukam Singh (w.e.f. 01.01.2013)
 Mr Veeru K. Singh (w.e.f. 01.01.2013)
 Dr Biswajeet Thakur (w.e.f. 01.01.2013)

Scientist 'B'

Dr (Ms) Ruby Ghosh
 Dr Pawan Govil (relieved w.e.f. 18.09.2012)
 Dr Krishna G. Misra
 Dr S. Suresh K. Pillai
 Dr Parminder S. Ranhotra
 Dr (Mrs) K. Pauline Sabina
 Dr (Mrs) Anju Saxena
 Dr (Ms) Vartika Singh
 Dr (Mrs) Anjali Trivedi
 Dr (Mrs) Poonam Verma

Scientist Emeritus

Dr Amalava Bhattacharyya

Birbal Sahni Research Associate

Dr (Mrs) Neha Aggarwal
 Dr (Ms) Deepa Agnihotri (relieved w.e.f. 17.09.2012 AN)
 Dr (Ms) Swati Dixit (relieved w.e.f. 17.09.2012 AN)

(The names are in alphabetical order according to 'surnames')



Dr S. Mahesh
Dr Santosh K. Pandey
Dr Md. Firoze Quamar
Dr (Mrs) Anumeha Shukla (relieved w.e.f. 25.09.2012 FN)
Dr (Mrs) Yogmaya Shukla
Dr (Mrs) Shilpa Singh (relieved w.e.f. 18.09.2012 AN)
Dr Gaurav Srivastava (relieved w.e.f. 25.09.2012 FN)

Birbal Sahni Research Scholar

Ms Kanupriya Gupta
Mr Harinam Joshi

Technical Personnel

Technical Officer 'D'

Mr P.S. Katiyar
Dr E.G. Khare
Mr T.K. Mandal
Mr V.K. Singh

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 Avinash 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

Consultant

Dr B. Sekar, Ex-Technical Officer 'D'

Administrative Personnel

Registrar: Dr Suresh C. Bajpai

Accounts Officer: Mr N.B. Tewari

Private Secretary

Mrs M. Jagath Janani (on deputation)
Sri Murukan Pillai (officiating)

Section Officer

Mrs Ruchita Bose (officiating)
Mr Hari Lal (officiating)
Mrs V. Nirmala
Mr Koshy Thomas (officiating)
Mrs Pennamma Thomas

Accountant: Mrs Swapna Mazumdar (officiating)

Assistant

Mr Mishri Lal (officiating)
Mr S.S. Panwar (officiating)

(The names are in alphabetical order according to 'surnames')

Mr Rameshwar Prasad (officiating)

Mr Gopal Singh

Mr K.P. Singh

Mrs Renu Srivastava (officiating)

Mr N.Unnikannan (officiating)

Hindi Translator: Mr Ashok Kr. Sharma

Upper Division Clerk

Ms Chitra Chatterjee

Mrs Sudha Kureel

Mr Avinash K. Srivastava

Ms Manisha Tharu

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)

Mr K.C. Chandola

Attendant 'III'

Mr Kesho Ram

Mr Haradhan Mahanti

Mr Prem Chandra

Mr Ram Deen

Mr Ram Singh

Mr Shree Ram

Attendant 'II'

Mr K.K. Bajpai

Mrs Maya Devi

Mr Hari Kishan

Mr Kailash Nath

Mr D.B. Kunwar

Mr Mani Lal Pal

Mr Ram Dheeraj

Mr Mohammad Shakil

Mr Bam Singh

Mr K.N.Yadav (under suspension)

Attendant 'I'

Mr R.K. Awasthi

Mrs Beena

Mr Deepak Kumar

Mr V.S. Gaikwad

Mr Inder Kumar

Ms Nandani

Mrs Ram Kali

Mr Ramesh Kumar

Mr Ravi Shankar

Mali

Mr Ram Chander ('I')

Mr Ram Kewal ('I')

Mr Mathura Prasad ('I')

Sponsored Project Personnel

Dr Arjun S. Rathore, RA

Dr Shambhu Kumar, SRF (tenure completed w.e.f. 08.05.2012)

Mr Suman Sarkar, SRF

Ms Abha, JRF (resigned w.e.f. 21.01.2013 AN)

Mr Deepak K. Gond, JRF (tenure completed w.e.f. 08.05.2012)

Mr Gaurav K. Mishra, JRF (tenure completed w.e.f. 08.05.2012)

Mr Randheer Singh, JRF

Ms Richa Singh, JRF (resigned w.e.f. 01.07.2012)

Ms Jyoti Srivastava, JRF

Mr. Raja Ram, Project Assistant

Mr. Saheb Lal Yadav, Field Assistant



Obituary

Shri Ram Dhari, Ex-Chowkidar
passed away on 17.09.2012.

(The names are in alphabetical order according to 'surnames')

Appointments

Professor Sunil Bajpai, Director w.e.f. 23.01.2013 (AN).
 Dr. Pawan Govil, Scientist-C w.e.f. 18.09.2012.
 Dr. (Ms) Deepa Agnihotri, Scientist-B w.e.f. 18.09.2012.
 Dr. (Ms) Swati Dixit, Scientist-B w.e.f. 18.09.2012.
 Dr. Kamlesh Kumar, Scientist-B w.e.f. 18.09.2012.
 Dr. (Mrs) Shilpa Singh, Scientist-B w.e.f. 19.09.2012.
 Dr. (Mrs) Anumeha Shukla, Scientist-B w.e.f. 25.09.2012 (AN).
 Dr. Gaurav Srivastava, Scientist-B w.e.f. 25.09.2012 (AN).
 Dr. (Ms) Abha, Scientist-B w.e.f. 22.01.2013.
 Ms. Shreya Mishra, Birbal Sahni Research Scholar w.e.f. 02.04.2012.
 Ms. Mridul Gupta, Birbal Sahni Research Scholar w.e.f. 04.04.2012.
 Ms. Debrati Nag, Birbal Sahni Research Scholar w.e.f. 12.04.2012.
 Mr. Daramsothu Seetharam, Birbal Sahni Research Scholar w.e.f. 12.04.2012 (AN).
 Ms. Ranjana, Birbal Sahni Research Scholar w.e.f. 16.04.2012.
 Ms. Priyanka Monga, Birbal Sahni Research Scholar w.e.f. 16.04.2012 (AN).
 Mr. Vikram Partap Singh, Birbal Sahni Research Scholar w.e.f. 19.04.2012.
 Ms. Bandana Dimri, Birbal Sahni Research Scholar w.e.f. 23.04.2012.

Mr. Arun Joshi, Birbal Sahni Research Scholar w.e.f. 25.04.2012.
 Ms. Reshmi Chatterjee, Birbal Sahni Research Scholar w.e.f. 01.05.2012.
 Mr. Chinnappa Chopparapu, Birbal Sahni Research Scholar w.e.f. 07.05.2012.
 Mr. Mayank Shekhar, Research Associate under Emeritus Scientist Scheme w.e.f. 17.09.2012.

Sponsored Project Personnel

Ms. Nivedita Mehrotra, CSIR-Senior Research Fellow w.e.f. 01.04.2012.
 Mr. Ansuman Misra, Junior Research Fellow w.e.f. 23.04.2012 (resigned w.e.f. 15.10.2012).
 Mr. Abhishek Kumar Singh, Junior Research Fellow w.e.f. 23.04.2012.
 Mr. Shakti Kumar Yadav, Junior Research Fellow w.e.f. 23.07.2012 (resigned w.e.f. 08.10.2012 AN).
 Mr. Akhilesh Kumar Yadav, Junior Research Fellow w.e.f. 23.07.2012 (AN).
 Ms. Ruchika Bajpai, Junior Research Fellow w.e.f. 31.10.2012.
 Mr. U. Premraj, Junior Research Fellow w.e.f. 05.11.2012.
 Mr. Arindam Chakraborty, Junior Research Fellow w.e.f. 04.02.2013.



Farewell to Dr. N.C. Mehrotra, outgoing Director



Prof. Sunil Bajpai paying his obeisance on the *Samadhi* of Late Prof. Birbal Sahni on assuming the charge of the Directorship

AUDIT REPORT

**To,
The Governing Body of
'The Birbal Sahni Institute of Palaeobotany',
53, University Road, Lucknow**

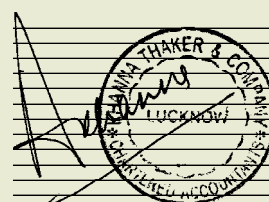
We have audited the attached Balance Sheet of "*Birbal Sahni Institute of Palaeobotany, Lucknow*" as at 31-Mar-2013 and also the Income and Expenditure account and Receipt & Payment account for the year ended on that date annexed thereto. These financial statements are the responsibility of Institute's 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 statements. 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 to above, we report that:

- (i) (i) We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purposes 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, 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, the said accounts 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 2013;
 - b) In the case of the Income and Expenditures account, of the surplus for the year ended on that date; and
 - c) In the case of Receipt & Payment account, of the receipts and payments of the Institute for the year ended on that date.

For Khanna Thaker & Company
Chartered Accountants



CA. Abhinav Khanna
(Partner)
Membership No- 405987
FRN-001265C

Place : Lucknow
Date : September 23, 2013

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.	<u>ACCOUNTS:</u> Single entry system was prevalent till 2012, in current year double entry system have been adopted throughout the year but still it needs improvement in some areas. Further, the Institute has also implemented computerised accounting from FY 2012-13. However, final accounts have been compiled mainly from manual records.	The efforts are being made to overcome the areas identified by the Chartered Accountants in implementing double entry system.																																																		
02.	Advances unsettled and pending for recovery/ adjustment as on 31.03.2013. Rs. 41,03,158.28 under different heads out of amount advanced upto 2011-12, are to be properly taken care of at Institute level for early adjustment thereof. Details of which are available in annexed schedule of unsettled advances.	Most of the advances of the amount Rs. 41,03,158.28 have been settled. Efforts are being made to settle the advances pending on 31.03.2013.																																																		
03.	Filing system of documents say vouchers, etc. is also not adequate. There are no separate files for General / Imprest Vouchers.	The suggestion of the Chartered Accountants to maintain separate files for general/imprest vouchers shall be implemented from the next financial year.																																																		
04.	A certificate in prescribed format from school principals should be taken from employees while claiming RTF but such format found blank in all cases.	Those employees who deposit original receipts of the banks for claiming RTF are not required to get it verified by school as per rules on the subject. In other cases School Principals verify the claim of RTF.																																																		
05.	TDS amounting to Rs. 33,14,362.00 is pending for refund/ adjustment with Income Tax Department. Mainly this issue is pending for want of Exemption Certificate from the Department and as per concerned authority of the institute, it 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. Fund wise TDS details are given as follows: <table><tr><th>Financial Year</th><th>GPF</th><th>CPF</th><th>Pension</th><th>Total</th></tr><tr><td>2012-13</td><td>284,217.00</td><td>8,483.00</td><td>785,487.00</td><td>1,078,187.00</td></tr><tr><td>2011-12</td><td>161,052.00</td><td>16,927.00</td><td>581,873.00</td><td>759,852.00</td></tr><tr><td>2010-11</td><td>354,549.00</td><td>18,167.00</td><td>475,352.00</td><td>848,068.00</td></tr><tr><td>2009-10</td><td>125,377.00</td><td>2,238.00</td><td>108,904.00</td><td>236,519.00</td></tr><tr><td>2008-09</td><td>116,654.00</td><td>-</td><td>2,223.00</td><td>118,877.00</td></tr><tr><td>2007-08</td><td>21,033.00</td><td>-</td><td>2,880.00</td><td>23,913.00</td></tr><tr><td>2006-07</td><td>28,916.00</td><td>-</td><td>71,663.00</td><td>100,579.00</td></tr><tr><td>2005-06</td><td>86,188.00</td><td>-</td><td>62,179.00</td><td>148,367.00</td></tr><tr><td>Total</td><td>1,177,986.00</td><td>45,815.00</td><td>2,090,561.00</td><td>3,314,362.00</td></tr></table>	Financial Year	GPF	CPF	Pension	Total	2012-13	284,217.00	8,483.00	785,487.00	1,078,187.00	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	-	2,223.00	118,877.00	2007-08	21,033.00	-	2,880.00	23,913.00	2006-07	28,916.00	-	71,663.00	100,579.00	2005-06	86,188.00	-	62,179.00	148,367.00	Total	1,177,986.00	45,815.00	2,090,561.00	3,314,362.00	The Institute is continuously following up the matter with the Income Tax Authorities for the current Tax Exemption as well as the previous ones.
Financial Year	GPF	CPF	Pension	Total																																																
2012-13	284,217.00	8,483.00	785,487.00	1,078,187.00																																																
2011-12	161,052.00	16,927.00	581,873.00	759,852.00																																																
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Total	1,177,986.00	45,815.00	2,090,561.00	3,314,362.00																																																

S No.	Comments/Observations by the Chartered Accountants	Actions taken by the Institute
06.	<p><u>EMPLOYEES PROVIDENT FUND(GPF/CPF):</u> The investment of GPF includes Rs. 1,24,800.00 unadjusted amount of premium paid on RBI Bonds, which were redeemed in the year 2006-07 and remains pending for suitable action/ 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 and confirmation of Governing 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.</p>	The matter is being put up to the Finance and Building Committee for transfer of Rs. 1,24,800/- to expenditure accounts.
07.	<p><u>STORES, WORKS & BUILDING:</u> Fixed Assets Register haven't been maintained properly, FAR should disclose opening balances, acquired assets during the year, assets disposed off and closing balances. But FAR kept by institute only shows acquisition/ disposal during the year and it will result in difficulty of calculation of depreciation. Fixed assets schedule of previous year could not be reconciled with Current FAR due to lack of proper information.</p>	The comments of the Chartered Accountants have been noted for implementation within the current financial year i.e. 2013-14.
08.	Proper records/ Stock Register is to be maintained in every department for items issued to them from stores.	The records/Stock Register are being maintained in the Store and Purchase Section, laboratory/type of item-wise.
09.	<p><u>LEGAL CASES AND CONTINGENT LIABILITY:</u> List of Legal Cases was provided to us but amount of 'Contingent liability', if any is not mentioned. As per list provided to us, 13 cases are pending upto July'2013. The Institute should assess the possible obligation and same should also be mentioned in foot note to Balance Sheet.</p>	Action is being initiated to this effect and the same will be reflected in the Balance Sheet of the next financial year.

(N B Tiwari)
Accounts Officer

(Suresh C. Bajpai)
Registrar

(Sunil Bajpai)
Director



Form of Financial Statements (Non-Profit Organizations)

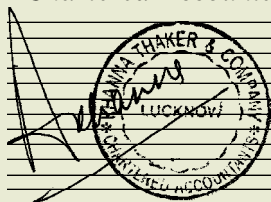
Birbal Sahni Institute of Palaeobotany, Lucknow

Balance Sheet as at March 31, 2013

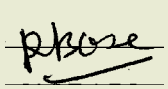
(Amount - Rs.)

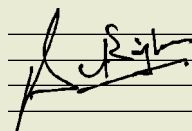
CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	Current Year	Previous Year
CORPUS/CAPITAL FUND	1	125,512,850.14	114,089,874.67
RESERVES AND SURPLUS	2	38,210,903.00	48,010,903.00
EARMARKED/ENDOWMENT FUNDS	3	232,048,125.49	187,857,038.99
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFERRED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	2,831,104.64	7,522,995.64
TOTAL		398,602,983.27	357,480,812.30
ASSETS			
FIXED ASSETS	8	92,538,258.50	102,870,104.88
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS	9	232,048,125.49	187,857,038.99
INVESTMENTS-OTHERS	10	24,000,379.00	44,915,514.00
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	50,016,220.28	21,838,154.43
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)			
TOTAL		398,602,983.27	357,480,812.30
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

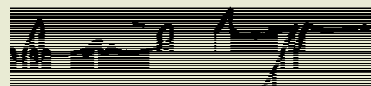
For **Khanna Thaker & Company**
Chartered Accountants



CA. Abhinav Khanna
(Partner)


(Ruchita Bose)
Section Officer


(Suresh C. Bajpai)
Registrar


(Sunil Bajpai)
Director

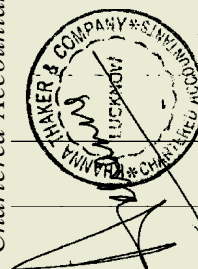
Form of Financial Statements (Non-Profit Organizations)

Birbal Sahni Institute of Palaeobotany, Lucknow

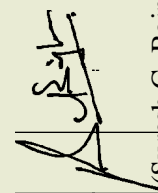
Income and Expenditure Account for the period / year ending March 31, 2013

INCOME	Schedule	Current Year	Previous Year
Income from Sales/Services	12	877,935.00	708,955.00
Grants/ subsidies (OB, Deposit A/C and Transfer from Cap. Fund)	13	212,762,000.00	186,550,000.00
fees/Subscriptions	14	-	-
Income from Investments (Income on Invest. From earmarked/endow. Funds transferred to Funds)	15	984,865.00	2,584,406.00
Income from Royalty, Publication etc.	16	405,719.00	272,715.00
Interest Earned	17	2,241,123.00	1,216,285.00
Other Income/ Adjustments	18	953,794.00	792,041.00
Increase/(decrease) in stock of Finished goods and works-in-progress	19	-	-
TOTAL (A)		218,225,436.00	192,124,402.00
EXPENDITURE			
Establishment Expenses	20	145,307,569.00	143,636,348.00
Other Administrative Expenses etc.	21	34,266,805.10	31,011,478.86
Expenditure on Grants/Subsidies etc.	22	-	-
Interest	23	-	-
Depreciation (Net Total at the year-end-corresponding to Schedule 8)		14,128,086.43	16,134,386.85
TOTAL (B)		193,702,460.53	190,782,213.71
Balance being excess of Income over Expenditure (A-B)		24,522,975.47	1,342,188.29
Transfer to Special Reserve (Specify each)		13,100,000.00	11,550,000.00
Transfer to/from General Reserve to Pension Fund			20,900,000.00
BALANCE BEING SURPLUS/DEFICIT CARRIED TO CORPUS/CAPITAL FUND		11,422,975.47	(31,107,811.71)
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

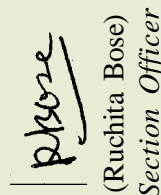
For Khanna Thaker & Company
Chartered Accountants



CA. Abhinav Khanna
(Partner)


(Suresh C. Bajpai)
Registrar


(Sunil Bajpai)
Director


(Ruchita Bose)
Section Officer



Form of Financial Statements (Non-Profit Organizations)
Birbal Sahni Institute of Palaeobotany, Lucknow
Receipts and Payments Account for the period / year ended March 31, 2013

Fig. in Rupees

RECEIPT		PAYMENTS	
	Current Year	Previous Year	
L. Opening Balances			Previous Year
a) Cash in hand	-	446.00	
b) Bank Balances	78,827.00		145,307,569.00
i) In current accounts			34,266,805.10
ii) In deposit accounts			
iii) Endowment deposits			
iv) Salary Account	2,297,212.00	2,760,231.77	
II. Grants Received			
a) From Government of India	212,762,000.00	186,778,000.00	
b) From State Government			
c) From other sources (details)			
(Grant for capital & revenue exp.			
To be shown separately)			
d) Deposit Account			
III. Income on Investment from			
a) Earmarked/Endow. Funds			
b) Own Funds (Utilized)			
IV. Interest Received			
a) On Bank deposits	1,596,921.00	1,281,134.00	
b) Loans, Advances etc.	1,629,067.00	762,165.00	
V. Other Income (specify)			
i) Sale proceeds of Publications	405,719.00	102,202.00	
ii) Miscellaneous Income	953,794.00	334,790.00	
iii) Sale of Services (Consultancy)	877,935.00	864,958.00	
iv) Group Insurance	155,830.00	320,736.00	
VI. Amount Borrowed			
VII. Any other receipts (give details)			
(Pension Contribution)			
Transfer from Reserve Fund	55,000,000.00	18,000.00	
Net Receipt from Project	2,271,748.00		
i) Recovery of Advances	20,103,737.85	2,842,154.00	
ii) Earnest Money Deposit			
iii) FDR Matured			
iv) Recovery from Parties	10,000.00	10,000.00	
VIII. Closing Balances			
a) Cash in hand			
b) Bank Balances			
i) In current accounts			
ii) In deposit accounts			
iii) Saving account			
iv) Endowment deposit account			
v) Excess Expenditure			
TOTAL	298,142,790.85	196,074,816.77	196,074,816.77

CA. Abhinav Khanna
(Partner)

(Ruchita Bose)
Section Officer

(Suresh C. Bajpai)
Registrar

(Sunil Bajpai)
Director