

## Conference/Symposia/Workshop Reports

### **International conference on the Climate and Biota of the Early Paleogene**

3-8 July, 2001

Powell, Wyoming, USA

An International Conference entitled, "Climate and Biota of the Early Paleogene" was held at Northwest College, Powell, USA from July 3-8, 2001. The Conference was sponsored by the Smithsonian Institution and University of Michigan. It was the third in a series of conferences on the Paleogene; the previous two were held in Albuquerque, New Mexico (1997) and Goteborg, Sweden (1999).

The conference started with a welcoming reception on July 3<sup>rd</sup> at the Powell Valley Chamber of Commerce. Oral presentations and poster sessions were held on 4<sup>th</sup>, 5<sup>th</sup> and 7<sup>th</sup> July, bounding a day and a half of field trips in the Bighorn Basin. Posters remained on display throughout the Conference and viewing took place before or after scheduled oral sessions. On July 4 after a full day of technical scientific presentations, all the participants went to the Churchill Farms for the annual 4<sup>th</sup> of July barbecue. This day is very important in the American history as it happens to be the Independence Day of America.

There were total 170 participants belonging to about 20 countries, namely Argentina, Australia, Austria, Belgium, China, Denmark, Egypt, France, Germany, India, Ireland, Italy, Mongolia, Netherlands, New Zealand, Pakistan, Russia, Spain, Sweden, Switzerland, Syria and United Kingdom, besides the host USA.

The present conference provided an opportunity to all the participants working on Paleogene to interact with each other and to know the latest development on different aspects of palaeobotany. Though most of the papers were on isotopes which are useful in deducing the palaeoclimate, sedimentological studies, palaeomagnetism, macrofossils, pollen, dinoflagellates, nannofossils, foraminifera, molluscs, vertebrates and palaeosols etc. were given due importance. The emphasis was on the causes of global warming that began in the Paleogene, 65 million years ago.

During the oral presentations the role of oceans was discussed in maintaining the warm climate. One of the talks was on K/T and P/E boundaries in dinoflagellate perspective. Some of the important papers were on the impact of Palaeocene-Eocene Greenhouse warming on North American Paratropical forests, testing of canonical correspondence analysis (CCA) and regression models developed to predict mean annual temperature (MAT) using leaf morphology and wood anatomy, Europe - Asia mammalian faunal interchange during the early Eocene, the Early Paleogene climate and leaf flora of New Zealand, the palaeoecology of Eocene insects from Central Europe, chronostratigraphic terminology at P/E

boundary and Paleogene West Antarctic climate and vegetational history. The plants from King George Island in Antarctica are the most complete Paleogene terrestrial foliar record in Antarctica. In one of the talks Early Paleogene vegetation of India was presented and position of the Indian Plate during the period was discussed. According to Philip Gingerich of the University of Michigan horses, predators, primates and other mammals emerged during a brief period of extreme warming during the Early Paleogene. Lastly a new locality of K/T boundary was reported which is rich in plant megafossils, pollen, vertebrate and invertebrate.

Powell, the venue of the conference, is surrounded by the best exposed and most intensively studied continental upper Palaeocene-lower Eocene sections in the world and is about 35 miles from the nearest Cody Airport. There were two field trips. The first one was a half day field trip to Cretaceous, Palaeocene and Eocene of Polecat Bench on July 5. Polecat Bench is a flat topped area of high relief north of Powell and the purpose of this trip was to demonstrate the features of the best studied, relatively complete Palaeocene section in the Bighorn Basin. At the east end of Polecat Bench the participants were shown the Maastrichtian Lance Formation, the lower part of the Palaeocene Fort Union Formation and the paraconformable K/T boundary. Historically the K/T boundary in the northern rocky mountains was approximated as the lowest coal bed above the highest dinosaur fossils. More recent work has shown that the onset of coal deposition is always not precisely synchronous with the K/T boundary which is generally recognised by Ir anomaly, shocked quartz and palynofloral change. No Ir anomaly or shocked quartz has been detected in this exposure, but pollen indicates that the K/T boundary is in the carbonaceous shale just below the basal coal of the Fort Union Formation. At the southern end of Polecat Bench the conference delegates examined Palaeocene-Eocene boundary sections of the Willwood Formation. The second field trip was a full day trip to upper Palaeocene-lower Eocene of the Central/Southern Bighorn Basin on July, 6. On this trip the participants saw the extensive fossiliferous hills striped with red and purple and belonging to middle and upper portions of the Willwood Formation. Thousands of fossils- mammal bones, leaves and shells etc. have already been collected from there and are kept in various museums of USA.

The conference was well organised and successful in its objectives.

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### **6<sup>th</sup> International Conference on Biogeochemistry of trace elements**

29 July-2 August 2001

University of Guelph, Ontario, Canada

6<sup>th</sup> International Conference on the Biogeochemistry of trace elements was held at University of Guelph, Ontario, Canada from 29<sup>th</sup> July to 2<sup>nd</sup> Aug. 2001. This conference was successively held in Orlando (1990), Taipei (1993), Paris (1995), Berkeley (1997) and Vienna (1999). The conference meeting held after every three years is dedicated to examine contemporary and emerging research in the biogeochemistry of trace elements, an interdisciplinary science linking phenomena, observed in the biosphere to physical and chemical reactions in the lithosphere. About 700 delegates from all over the world gathered here to discuss on issues related to phytoremediation, bioavailability, ecotoxicity etc. of trace metal contaminants. Four important areas of research were highlighted: (1) chemical modelling and speciation, (2) factors controlling the reductive transformations of trace metals and its immobilization by microbes, (3) risk assessment and ecosystem health covered the relevance of reactivity determinants to environmental and Biological Monitoring of the elements and their Inorganic compounds and (4) biological and chemical remediation and the future of 'Green technology' and metal-contaminated ground water were the main concern of the delegates.

Some of the discussions highlighted during the deliberations were—

In the last decade phytoremediation of trace metal contaminants has changed from a conceptual methodology to a practical and commercially-viable technology for environmental clean-up for both organic and inorganic contaminants. Phytoextraction of metal contaminants in soil/water is potentially an attractive, low cost, '*in situ*' "Green Technology" for the progressive clean-up of metal-polluted soils. Its simplicity has found immediate appeal and acceptance in an environmentally aware and responsible society. The potential is enhanced even further by the excessive costs of existing physico-chemical technology for soil clean-up. It offers the possibility of selectively removing only the metal contaminants leaving a soil in every other way unaffected. Expectations of this developing technology however still far exceed present capabilities.

Worldwide problem of Arsenic, a common toxic metalloid in natural ecosystems and the mining industry was extensively discussed. Its minerals such as Arsenopyrite, Realgar and Orpiment are often associated with coal deposits. The combustion of fossil fuels, particularly lignite, introduces large quantities of arsenic into the environment. Lignite is largely composed of organic matter, but As and other trace elements are connected with inorganic matter. In mineralized rocks it is formed under mesothermal and epithermal

conditions. It can be fixed temporarily or permanently with mineral matter or released in solution into the environment. The bioavailability of arsenic in these situations depends on the physical and chemical conditions of specific sites.

Rivers and Streams carrying inland waters towards the deltaic areas in the coastal region are the sink for trace elements brought from the weathered rocks through which the drainage passes. Metal- oxyhydroxides that settle into the lagoons and estuaries along with organic debris either clastic or '*in situ*' create conducive anoxic depositional environment where specially Arsenic and other trace metals are associated with the microbially mediated reactions. My presentation highlighted trace elements problem in Coastal areas. High concentration of trace elements is found in the estuaries and lagoons of India. Mangroves play a significant role in mitigating coastal trace element contamination. The consequences of its slow poisoning and subsequent fatal end has boggled the minds of the researchers to provide safe drinking water to the environmentally aware local inhabitants in the coastal region and Arsenic contaminated sites.

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### **5<sup>th</sup> International Conference on Biodeterioration of Cultural Property (ICBCP-5)**

12-14 November 2001

Australian Museum, Sydney, Australia

The fifth International Conference on Biodeterioration of Cultural Property was held at the Australian Museum, Sydney, Australia from 12 to 14 November 2001. The conference was organized under the auspices of the International Council for Biodeterioration of Cultural Property (ICBCP) and jointly hosted by the Australian Institute for the Conservation of Cultural Material (AICCM) and the Australian Museum Research Center for Materials Conservation and the Built Environment. The conference was sponsored by Albox Australia Pvt. Ltd., CPM Pest Services, Macmillan Academic & Reference, Australian & Powerhouse Museums. The scientists and museum personnel from many countries such as Japan, Australia, France, Nigeria, Germany, Netherlands, Singapore, Canada, USA, UK, India, etc. participated and discussed the present state-of-art and future strategies on all aspects of biodeterioration and its bioremediation. The conference was held at Australian Museum for three days under fifteen sessions. The level G of the Museum where the

auditorium was situated, the large galleries exhibited huge skeletons of dinosaurs and humans in different postures. Level 1 stores a Grand Chapman collection of 850 dazzling minerals. The level 2 showed the ancient megafauna, human evolution, biodiversity and many types of strange and unique Australian spiders, birds and insects.

Earlier conferences were held at India, Japan, Bangkok and Tehran. The present conference was aimed to investigate the causes and control of biodeterioration across a range of cultural property, with a particular emphasis on the application of findings for small museums and developing countries.

My paper entitled "Sampling and estimate of fungal biodeteriogens of Lucknow India", dealt with technique of international standards for qualification and quantification of air-borne microbes. An efficient and reliable sampling is a prerequisite for the proper identification, quantification and management of such problems. Andersen, Rotorod and Burkard air-samplers were employed over a period of one year (January – December, 1997) in both extramural and intramural environments of Lucknow. Certain predominant fungi such as *Alternaria*, *Aspergillus*, *Cladosporium*, *Chaetomium*, *Curvularia*, *Helminthosporium*, *Penicillium*, *Paecilomyces*, *Torula*, *Trichoderma* etc. are observed to be associated with the biodeterioration of cultural properties. Both quantitative and qualitative estimates of aeromycoflora have been fruitfully utilized in prediction of various fungal biodeteriogens at particular time and place.

Some of the important papers were Heat Eradication of Insect Infestations: The Development of a Low Cost, Solar Heated Treatment Unit by Andrew Pearce, Australia. Experimental Study of Physical Effects of Freezing Method for Insect Control on Artifact Materials by Takeshi Ishizaki, Japan. The Solar Tent – Cheap and Effective Pest Control in Museums by Agnes W. Brokerh, Netherlands. Monitoring Insect Pests Within Buildings Using Traps – Case Studies of The Use of Traps to Monitor Activity, Spatial Distribution and Efficacy of Pest Control by David Rees, Australia and the present situation of Pest Control of Cultural Properties in Taiwan by Su-Fen Yen, Taiwan.

Hideo Arai of ICBCP, Japan, presented his paper entitled 'Biodeterioration on Angkor site in Cambodia'. He reported severe damage to Angkor site in Cambodia due to bats, plants, lichens and microorganisms. *Gleocapsa*, *Scytonema*, *Lyngbya* (Cynophyceae) and *Pyxine*, *Dirinaria*, *Lepraria* and *Buellia* (lichens) were found to be main biodeteriorating agents. Nine kinds of lichenocides, algaeocides and biocides were applied as control measures over sandstones. Chiraporn Aranyanark, Bangkok presented her paper entitled 'Biological Agent in the Weathering of Sandstone Sanctuaries in Thailand'. She inferred that apart from lichens and algae, the other biodeteriorating agents are mosses, liverworts, ferns, grasses and dicot plants. Her studies were based on advanced

technologies such as optical, polarised, scanning electron microscope and x-ray diffractometer studies.

Robert Child of National Museums and Galleries of Wales presented his paper entitled 'Residual Insecticides: The problem with Carriers'. He discussed in his paper that most insecticides are combined with a 'carrier' that aids the transmission of the insecticides to the insects. Solvents, carrier gases, powder, etc., are all used, often with other adjunct substances such as emulsifiers and surfactants to improve the insecticides' action. He discussed the effect of such formulation chemistry on the objects of cultural heritage. One of the Indian participant, Shashi Dhawan, Lucknow presented her paper on 'Study of microbial deterioration of paintings of St. Aloysius Chapel, Mangalore, India'. Her data were based on aeroflora and surface flora of murals and canvases of Chapel and informed that fungal form (*Penicillium citrinum*) and algae (*Pleurocapsa* & *Phormidium*) were the most common and frequently occurring biodetergents of ambient environment and suggested proper control measures for the preservation of valuable paintings.

The conference ended with the realization that lack of conservation centers in different parts of the world and trained personnel are two main bottlenecks in this field. Lack of public awareness and regional literature were also identified as important factors contributing towards biodeterioration of cultural properties. The conference concluded giving emphasis on the need to build up and expand the network among specialists of different disciplines and explore collaborative avenues of research especially on biophysical, biochemical and biological parameters of biodeterioration for long-term preservation of cultural properties.

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### **17th Himalaya-Karakoram-Tibet Workshop**

25-27 March, 2002

Gangtok, Sikkim, India

The first Himalaya-Karakoram-Tibet Workshop was held at Leicester (Great Britain) in 1985. Since then the Himalaya-Karakoram-Tibet Workshops (HKTW) have been held every year in different parts of the world with an aim to exchange and disseminate recently acquired geoscientific information on Himalaya and adjoining regions. It provides the most important forum for the presentation of results by earth scientists working in the Himalaya-Karakoram-Tibet transect

where the tectonic evolution has been controlled by the development of the Himalayan mountain range. It is a well known fact that the Himalaya is a "natural laboratory" for scientists studying the geophysical and geological processes involved in collisional tectonics as well as the effects of high mountains and mountain building processes on climate and environment. The 16<sup>th</sup> Himalaya-Karakoram-Tibet Workshop was held in Graz, Austria from 3-5 April 2001, hosted by the Institut für Geologie und Paläontologie, Universität Graz, Austria. Recently, the 17<sup>th</sup> Himalaya-Karakoram-Tibet Workshop held in Gangtok, Sikkim, India between March 25-27, 2002- the first ever HKTW held in India and that too during the 'Year of Mountains' of the UN. The 17<sup>th</sup> HKTW was sponsored by the Department of Science and Technology, Government of India; International Lithosphere Program; Central Scientific and Industrial Research, Delhi, India; Indian National Science Academy, Delhi, India; Coal India Limited, Calcutta, India; Central Ground Water Board, Government of India; Geological Survey of India and Oil and Natural Gas Corporation, India.

The workshop was organized at Hotel Norkhill, Gangtok, Sikkim jointly by the Department of Geology, University of Delhi, India and the Birbal Sahni Institute of Palaeobotany, Lucknow, India. Over 70 participants attended the workshop and delegates came from different parts of Europe, Iran, Japan, Nepal and India. 70 abstracts were published in a Special Supplement of the Journal of Asian Earth Sciences, Volume 20 (4), however, 22 late abstracts have been published separately as addenda abstracts.

Seven technical lecture sessions having about 60 research papers on different parts of the Himalaya-Karakoram and Tibet were covered over three days, and presentations were arranged on the basis of different geoscientific disciplines i.e. (1). Tectonics and the Geodynamics of the Region; (2). Seismicity and Tectonics; (3). Tectonics; (4). Petrology; (5). UHP and related Metamorphism; (6). Mountain Hazards, Geomorphology and Palaeoclimates; (7). Sedimentary Geology and Palaeontology. About 20 posters were also displayed at this workshop.

During the course of presentations, the complex geodynamic evolution of the Himalayan Range has been explained by Prof. G. Mascle on the basis of opening and closing of the Tethyan oceanic realm, and finally by a saturation, with inversion of the Tethyan structures. Prof. Anshu K. Sinha presented the aspect of mountain building processes and evolution of the Himalaya-Karakoram and uplift of the Tibetan plateau. He further highlighted several key issues and suggested new areas of research to be carried-out in near future along the Himalaya-Karakoram-Tibet transect. In a comparative study of mountain uplift between the Nepal Himalaya and the Hidaka Mountains, Japan Prof. K. Arita found that the Himalaya was formed by fold and thrust tectonics in the old Indian continental crust and the Hidaka

mountains by steep thrusting along a plate boundary between continent-like and oceanic crusts. Using GPS Geodesy and cosmic ray exposure ages of an offset debris flow in Ladakh, Prof. V.K. Gaur suggested the slip rate on the Karakoram fault is ~4mm/yr. According to him it is likely that Tibet does not behave as a rigid body and that plate tectonics, *sensu stricto*, ought not be applied to Tibet. Quantifying displacement on the South Tibetan Detachment normal fault along the Everest profile Prof. Mike Searle demonstrated approximately 200 km of southward displacement of footwall sillimanite + cordierite gneisses, formed at 600-630<sup>o</sup> C and pressures of 4.0-4.9 kbar (14-18 km depth), beneath the STD which acted as a passive roof fault during southward flow of the hot, viscous, ductile middle crust. The active crustal thickening and high topography in south Tibet took place between 32-18 Ma. Prof. Igor Villa presented data on the amphibolitization of granulitized eclogites from the Kharta region in east Himalaya. The Kharta meta-eclogites occur at the top of the Main Central Thrust Zone in the western limb of the Arun mega-antiform, 30 km east of the Everest-Makalu massif Mineral assemblages, reaction textures and geothermobarometry suggest that two supersposed metamorphic events are recorded. The first event was of eclogite facies, the second event was of medium pressure granulite facies. Prof. S.K. Acharyya presented data on the thrust tectonics, evolution of domal windows and significance of concealed Paleogene foreland basin sediments in the eastern Lesser Himalayas. According to him the largest Siang window located at the eastern syntaxis exposes a duplex of early Paleogene sediments interbanded with the Abor Volcanics beneath the arched up MBT. The Himalayan foreland Tertiary sediments may extend northward up to the belt of Lesser Himalayan domal windows. Prof. S.B. Bhatia presented paper on the age and provenance of the Paleogene sediments of the Himalayan foreland basin. Similarly Prof. Ashok Sahni observed ash related catastrophic event at the Subathu-Murree formational boundary.

Similarly, there were several other interesting papers presented by delegates during the three days workshop. The Birbal Sahni Institute of Palaeobotany, Lucknow, India has been represented very well by the participation of six scientists in the workshop. These scientists are Prof. Anshu K. Sinha, Drs. A.K. Srivastava, Neerja Jha, Ram-Awatar, Vandana Prasad and Rajeev Upadhyay. Shri Pawan Katiyar, Technical Officer, supported the projection facility with multimedia projection. Three papers were presented orally whereas other two papers were presented under poster session. Prof. Anshu K. Sinha presented the discovery of the Bathonian-Callovia nannoflora from the eastern Karakoram block. The nannofloral assemblage is dominated by *Watznaueria* spp. However, on the occurrence of marker *Ausulasphaera helvetica*, the presently recorded nannofloral assemblage from the eastern Karakoram Block dates these sediments in the time bracket of

Bathonian-Callovian. Therefore, on the basis of this new findings it is concluded that the Middle Jurassic sedimentary sequence of the eastern Karakoram block and the Reshit Formation of the Chapursan Valley in north Karakoram are equivalent. Similarly, Dr. A.K. Srivastava presented data on morphology, taxonomy and stratigraphical significance of plant fossil assemblages recovered from Permian sequence of Arunachal Pradesh, Darjeeling and Sikkim areas.

Floristic comparison suggest that the plant fossils from Permian sediments of Arunachal Pradesh, Darjeeling and Sikkim of northeast Himalayan region indicates the presence of *Gangamopteris-Noeggerathiopsis* association along with the species of *Glossopteris* in Arunachal and Sikkim. In her presentation Dr Neerja Jha provided additional information on palynological dating of Chhongtash Formation in eastern Karakoram. The palynofloral assemblage suggest typical Gondwana affinity. The dominance of radial monosaccates along with presence of striate and non-striate disaccates suggest an Early Permian age (Late Asselian-Sakmarian).

In her poster presentation Dr. Vandana Prasad discussed the palynology and palynofacies analyses as essential clues to assess and identify palaeoenvironment of Subathu Formation, Tal Valley, Garhwal Himalayas in Uttaranchal. According to her the palaeoenvironment curve reflects different environmental conditions varying from brackish swamp, closed lagoon, estuarine and delta plain in the studied section. Similarly, Drs. Ram-Awatar and Rajeev Upadhyay presented their poster on the discovery of the Late Permian and Early Triassic palynofossils from the Cretaceous trench-slope sediments of the Indus Suture Zone, Ladakh Himalaya, India. According to them the palynofossils bearing older Permian and Triassic Tethyan sediments exposed along the northern margin of the



Fig. 1—Kanchanjanga Peaks of Higher Eastern Himalaya. A view from Gangtok.



Fig. 2—A Buddhist Monestry, Gangtok.

Indian plate have been eroded, recycled and redeposited into the tectonically active Cretaceous trench-subduction complex that existed between the Indian and the Asian plates.

The afternoon session on day three was followed by the 'General Body Meeting'. It was decided that the 18<sup>th</sup> HKTW will be held in Switzerland during the April 2-4, 2003. The organizers deserve all the praise for conducting the 17<sup>th</sup> HKTW for the first time in India in an efficient and successful way.

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## Contact Course on Advanced Training in Palaeobotany

03-19 October, 2001

Lucknow (UP) & Jabalpur (MP), India

Palaeobotany helps in understanding the floristic pattern, evolution (through geological time) and extinction of past vegetation and in deciphering palaeoecology and palaeoclimates. The palaeobotanical knowledge is being utilized to identify the source rock potentiality, particularly for oil and coal. Tree-ring analysis, archaeobotany, forensic palynology and isotopic analysis of rocks cover the broader aspects of palaeobotany. Keeping the academic and applied aspects of the subject, a Contact Course on 'Advanced Training in Palaeobotany' was organized, for the first time, at the Birbal Sahni Institute of Palaeobotany (BSIP), in October, 2001 with an objective to train young researchers, teachers and professional scientists of academic and commercial organizations.

The course was co-sponsored by Oil and Natural Gas Corporation Limited and Jabalpur Administration, M.P. Government. The participating scholars were selected from the universities of Allahabad, Ranchi, Kumaun, Garhwal, Lucknow, and Vadodara and from ONGC.

The aim of the course was:

- to disseminate the latest palaeobotanical and allied discipline's knowledge (in Indian context).
- to acquaint the participants with the fundamental and applied aspects of palaeobotany for industrial and societal needs, and
- to provide field knowledge about the collections of plant fossils and need to preserve the fossil sites as national heritage.

The program was designed to cover the areas— Early life, Gondwana geology, Gondwana floristics, Tertiary floristics, coal palynology, coal seam correlation, Intertrappean flora, micropalaeontology, Quaternary vegetation/palaeoclimate, dendrochronology (tree-ring), archaeobotany, aerobiology, forensic palynology, petrography of coal/lignite in relation to quality and CBM, preservation of fossil sites, besides the fundamental aspects of the palaeobotany.

The course was inaugurated (on 3<sup>rd</sup> October) by Hon'ble Mayor of Lucknow City, Dr. S.C. Rai. In his inaugural message Hon'ble Mayor expressed his pleasure that BSIP is providing latest knowledge of palaeobotany to young generation of scientists and teachers of the country. He very kindly offered to provide space for development of Fossil Park in Lucknow. Prof. A.K. Sinha, Director of the Institute emphasized that during the last 50 years or so palaeobotany has acquired a new dimension and presently the palaeobotanical researches are being utilized in understanding global climatic changes and in prognosticating new source of energy—coal bed methane. He also laid emphasis on classical role of

palaeobotany to decipher the floral succession/extinction of different plant groups in geologic past and its application in biostratigraphy, correlation of coal- and oil-bearing strata. Prof. Sinha suggested the participants to derive maximum benefits from important publications of the Institute and advised them to make utilization of library, laboratories, museum, herbarium and workshop facilities.

The course program was designed and managed in three stages. First part dealt to impart teaching and practical demonstrations at the BSIP from October 3-10, in which eminent scientists of the country and scientists of the Institute delivered about thirty lectures in their respective fields of specialization. The second part of the course was related with a one day Field Workshop organized by the Commissioner of Jabalpur Division at Jabalpur (MP) on 12<sup>th</sup> October. The succeeding phase of course was concerned with an intensive seven days (October 13-19) field training to the participants, in and around Jabalpur to cover the fossil localities of Lower and Upper Gondwana successions and the Infra- and Inter-trappean localities.

The introductory lecture on Gondwana geology, tectonics and terrane accretion highlighted the recent discovery of Gondwana plant fossils in Karakoram region in Himalaya indicating that Karakoram terrane was part of peri-gondwana block. Following the introductory lectures the course was organized to discuss the basic aspects of palaeobotany, i.e. nature and preservation of fossil plants and the various techniques, methodology being used for the study of plant fossils. To cover the palaeobotanical history of plants, the theme related with the earliest record of biota in Precambrian was covered with two lectures on early biosphere and chert microbiota, and Proterozoic carbonaceous macrofossils, highlighting the evolution and adaptations in cyanobacteria and brown, red and green algae. The role of charophyta in geology was also discussed.

The topics related with evolution and radiation of land plants; the *Glossopteris*, *Dicroidium* and *Ptilophyllum* floras of Lower, Middle and Upper Gondwana sequences; comparison of Gondwana flora with contemporaneous floras; origin, antiquity and occurrence of angiosperms; recent advances in fossil pteridophytes; and Tertiary megafossils and palaeopalynological researches carried out in Gondwana and Tertiary basins of India were covered in depth. The application of Quaternary palynology in deciphering palaeoclimate and forest history of Himalayan and peninsular regions were imparted to the participants. Application of botanical knowledge in deciphering palaeoclimate was also highlighted.

The knowledge about new trends of palaeobotanical researches especially application of coal petrology in exploration of coal bed methane, DNA study in palaeobotany, plant remains of archaeological sites and tree-ring analysis were provided. Applied aspects of palaeobotany were also covered with application of palynology in coal exploration,

coal seam correlation and boundary problems, and marine micropalaeontology (diatom and dinoflagellate cysts) and its significance in biostratigraphy and oil exploration. The allied topics like dispersed organic matter (DOM) and biodegradation of Gondwana and Tertiary coals, isotope dating, the use of electron microscopic techniques in fossil plants, and collision tectonics, uplift and climate change in Himalayas were also covered during the teaching program.

The practical demonstrations were conducted to give training in palaeobotanical techniques, such as maceration method (to liberate pollen-spores from rocks), peel and transfer techniques for cuticular study, preparation of ground thin sections (to observe the anatomical details of petrified material), particulate pellet preparation (for coal/lignite petrographic study), and specialized chemical treatment for the recovery of megaspores, nannofossils, acritarch diatoms and phytoplanktons. The method to prepare palaeobotanical samples for electron microscopic study, geochronological dating, tree-ring analysis and archaeobotanical remains were demonstrated in different laboratories of the Institute by the specialist scientists and technicians.

The participants were given an opportunity to examine the type and figured specimens kept in the museum and herbarium of the Institute. They were also provided complimentary copies of the valuable reprints of Professor Birbal Sahni, FRS—the founder of BSIP, and some catalogue, monograph and research articles published by the Institute.



Fig. 3—Delegates of workshop at Jabalpur.



Fig. 4—Director, BSIP attending to field participants.

Shri Arun Gurtu, Vice-Chancellor of Rani Durgawati University, Jabalpur inaugurated the Field Workshop (on 12<sup>th</sup> October) and emphasized the significance and importance of fossil plants and expressed his desire to preserve the fossiliferous rich localities of Madhya Pradesh. Dr. Ram Prasad, Director, Institute of Forest Management, MP, Bhopal

delivered the presidential address and extended his cooperation for locating and preserving the fossil sites. Shri M.M. Upadhyay, Commissioner, Jabalpur Division in his introductory lecture requested the palaeobotanists to suggest ways and means to develop the National Fossil Park at Ghughua.

During the Workshop, scientists of BSIP presented a detail report about the occurrence of fossils in different geological horizons of Madhya Pradesh. The generic and specific identification of plant fossils preserved at National Fossil Park, Ghughua were discussed. Geologist from GSI presented the geological features of Fossil Park. The biodiversity of the area in relation to plant fossils were also discussed. The forest official, teachers of local university and colleges and general public took keen interest in the scientific deliberations.

The field training programme was conducted by a team of scientists of BSIP to cover the Lower Gondwana coal-bearing rocks of Permian age (*Glossopteris* flora), the Upper Gondwana rocks of Lower Cretaceous age (*Ptilophyllum* flora), and Deccan Intertrappean sedimentary sequences associated with the Deccan volcanic of Upper Cretaceous–Palaeocene age (angiospermous flora). Ganjra Nala and Sher River sections, rocks exposed at Chui Hill, Bara Simla, Pat Baba ridge, Lameta Ghat and Deccan Intertrappean sequence exposed between Padwar and Ranipur were selected and visited for the study. The protected area, containing number of petrified fossil assemblages of wood, fruit, leaves, of National Fossil Park, Ghughua (in Dindori district) were also visited by the participants.

During field programme, the party was explained how to identify the rock sequence and other geological features. They were also provided basic information to use the geological parameter and instruments for examining the orientation of rock beds, measurement of dip and identifying fault and fold. The demarcation of fossiliferous horizon, collection of plant

fossils, palynological samples, examination of stratigraphical and lithological successions was amply demonstrated during the field. Interestingly party discovered a sample containing aggregate of 8–10 eggs from Lameta Ghat Section situated on the right bank of Narmada River about 15 km south west of Jabalpur. The specimen is comparable with dinosaurian eggs, however the smaller size of the eggs make it distinct from all the known records and more likely belongs to egg pouch of avian fauna.

The closing ceremony of the Contact Course was held on October 19<sup>th</sup> at Jabalpur under the presidentship of the Director, BSIP. The Chief Guest, Shri Rashid Suhail, Chairman, Jabalpur Development Authority exhorted the local public, forest officials and civic administration to protect the fossiliferous sites of Jabalpur area and assured his full cooperation for development of Fossil Park. Commissioner of Jabalpur Division informed that the MP Government has accepted the site plan for the development of National Fossil Park at Ghughua and sought the guidance and cooperation from the Director of BSIP for proper development of the park. Prof. Sinha assured his support and expressed his desire to work jointly for the protection of fossiliferous sites of Madhya Pradesh.

The course was a successful venture. Participants appreciated the efforts made by the BSIP and suggested to organize such program at regular interval in order to acquaint the young scientists with latest developments in the study of fossil plants.

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