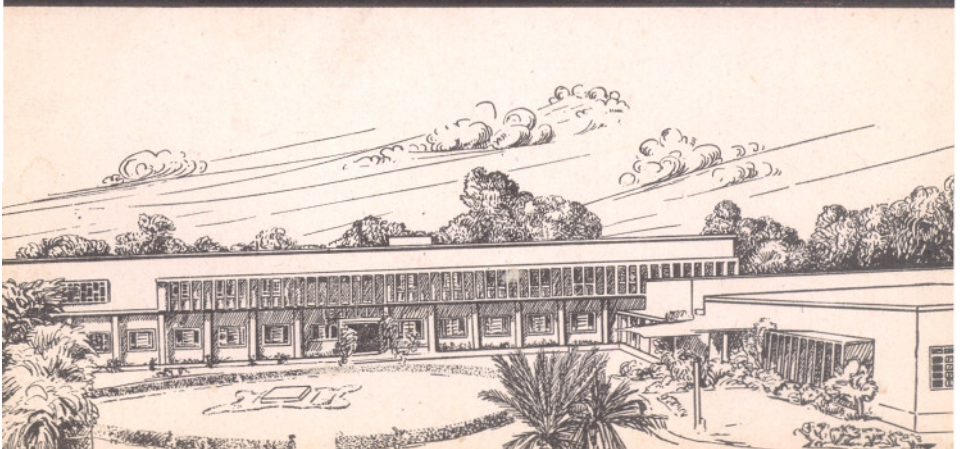
BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY LUCKNOW

ANNUAL REPORT 1971–72



CONTENTS

SILVER JUBILEE CELEBRATIONS

As the Institute was completing twentyfive years of its successful existence in September 1971, it was decided to hold Silver Jubilee Celebrations in 1971. For this purpose an organizing committee was formed with the following members :—

Professor T. S. Sadasivan *Convener*

Mrs. Savitri Sahni	Dr. R. N. Lakhanpal
Prof A. R. Rao	Dr. D. C. Bharadwaj
Prof. A. G. Jhingran	Dr. M. N. Bose
Dr. R. V. Sitholey	Dr. Vishnu Mittre
Prof. D. D. Pant	Dr. S. C. D. Sah

Dr. K. R. Surange *Secretary*

This committee decided that the celebrations should mainly consist of

(a) Taking out the following publications :—

(i) A brochure regarding the Institute.

(ii) Abstracts of Professor Birbal Sahni's publications.

(iii) A catalogue of Indian fossil plants.

(b) Holding the following functions -—

(i) Summer School in Palaeobotany.

(ii) A series of lectures of eminent scientists.

(iii) A scientific exhibition.

(iv) A palaeobotanical conference in the nature of an International meeting.

To be able to devote much needed time and energy in organizing satisfactorily an International palaeobotanical conference, it was decided to postpone the publication of the catalogue of Indian fossil plants and holding of the Summer School in palaeobotany to some later dates after the conference. The other items were to coincide with the palaeobotanical conference.

The palaeobotanical conference was held from 5th to 11th December 1971. It was inaugurated at *Ravindralaya* on the afternoon of 5th December by Dr. B. Gopala Reddi, Governor of Uttar Pradesh. The conference prope was held in the Institute premises. There was a very enthusiastic response to the proposed deliberations from all over the world as evidenced by 135 abstracts of scientific papers which were received and published before the commencement of the conference. Besides, a large number of scientists from India and abroad had expressed their desire to attend it in person. Unfortunately just a day prior to the opening of the conference, war broke out between India and Pakistan. This affected the attendance of foreign delegates very adversely. Still 11 delegates from abroad participated in the deliberations. However, inspite of the troubled conditions in the country, more than 200 delegates representing the various botanical and geological organizations, universities and institutions attended the conference.

The scientific programme consisted of 6 symposia, 9 sessions of contributed papers and five special lectures. The subjects of the symposia were :

1. Early Plant life.
2. Stratigraphical palynology.
3. Origin and phytogeography of angiosperms.
4. Morphological and stratigraphical palaeobotany.

5. Late Quaternary Vegetational developments in extra-Euorpean areas.

6. Structure, nomenclature and classification of pollen and spores.

The symposia will be published as special publications of the Institute. The contributed papers are being published in the regular numbers of the *Palaeobotanist.*

The lecture delivered were:

1. *The strange Bennettitales* (Nineteenth Sir Albert Seward Memorial lecture) read for Prof. T. M. Harris by Dr. A. Wesley.

2. *Airborne surveys in the accelerated search for mineral resources in India* by Dr. K. Jacob.

3. *Nature and origin of plant viruses* by Prof. T. S, Sadasivan.

4. *Geological history of blue-green algae : a paradigm of evolutionary conservatism* by Prof. J. W. Schopf.

5. *Mesozoic floras* by Dr. A. Wesley.

Along with the printed programme and abstracts of the papers received for the conference, the delegates were also given a brochure of the Institute and a printed copy of the abstracts of the scientific papers of Professor B. Sahni. An exhibition was also arranged in one of the museum halls displaying Professor Sahni's works and the important Indian fossil floras arranged stratigraphically. An important feature of the conference was the award of silver medallions to the following scientists and institutions in

commemoration of the Institute's Silver Jubilee :—

1. Professor C. A. Arnold.
2. Professor K. Faegri.
3. Professor T. M Harris.
4. Professor O. A. Hϕeg.
5. Professor A. G. Jhingran.
6. Professor K. N. Kaul.
7. Professor S Leclercq.
8. Professor T. S. Mahabale.
9. Professor D. D. Pant.
10. Professor R. Potonie.
11. Professor A. R. Rao.
12. Professor T. S. Sadasivan.
13. Professor K. R. Surange.
14. Professor A. L. Takhtajan.
15. Geological Survey of India, Calcutta.
16. Botany School, Cambridge.
17. Lucknow University, Botany Department, Lucknow.
18. Lucknow University, Geology Department, Lucknow.

The closing plenary session of the conference was held on the after-noon of 11th December, 1971.

I. RESEARCH

1. PRE-GONDWANA

1.1 Search for the evidence of early plant life in the Vindhyans.

1.1.1 *Maihar area*

Rock samples collected from the Gaddha nala and Sharda Devi Hill were macerated thrice. No organic remains were found.

2. LOWER GONDWANAS

2.1 Morphological studies in the Glossopteris Flora

2.1.1 *Mahanadi and Brahmani Valley and other localities, Orissa.*

Twenty six species of *Glossopteris* have been separated on the morphological basis, their study was nearly completed. About 50 specimens have been photographed.

Two new female fructifications, viz. *Dhenkania* and *Partha* have been described. Few already known fructification, viz. *Lidgettonia, Glossotheca* and *Dictyopteridium* have been re-described on the basis of new specimens.

2.1.2 *Auranga Coalfield, Bihar*

16 diffierent types of *Glossopteris* spp. Glossopteridean fructification, *Gangamopteris* and scale leaves have been identified from Serek—Gurtur village.

Barakaria, Sphenopteris (sterile and fertile), 14 *Glossopteris* spp., 2 scale leaves and seeds have been identified from Churia Fireclay.

Samples from Gurtur-Serek localities were macerated which yielded a rich assemblage of miospores (Barakar).

2.1.3 *A revision of the Lower Gondwana Sphenopteris.*

A critical study on the remains of Lower Gondwana *Sphenopteris* collected from Raniganj, Jharia; South Karanpura, Auranga-Daltonganj and Ib-river coalfields along with the type and other specimens previously described indicates that the *Sphenopteris* forms recorded from the Lower Gondwanas of India represent a new morphological type for which a new generic name *Neomariopteris* has been instituted.

2.1.4 *Palaeozoic lycopsids and sphenopsids*

An exhaustive survey of the literature published on the Indian Palaeozoic lycopsids and sphenopsids was made. The morphological characters of different taxa were analysed. Horizontal and vertical distribution of the different taxa was worked out.

2.2 Sporae dispersae and palynostratigraphy

2.2.1 *Jayanti coalfield*

The dominant genera in the Talchir formation of the area are *Parasaccites*, *Plicatipollenites* and *Virkkipollenites*. The subdominant members are *Vestigisporites*, *Potonieiporites* and *Tuberisaccites* gen. nov.

The mioflora is, in general, comparable with other Talchir miofloras but it is still quite distinct in containing about 25 taxa which are not known elsewhere.

Biostratigraphic considerations of the miofloral assemblages through the sequence indicates that some miofloristic change is evident at the level of the two Talchir Boulder Beds. This evidence demonstrates for the first time the existence of Glossopteris flora during the course of the Talchir glaciation.

2.2.2 *Johilla coalfield*

A section containing the Talchir Boulder Bed and overlying Needle shale in the Johilla Valley, near Mangthar

(M. P.), has been palynologically investigated. The mioflora is rich in monosaccates. Miospores have been found in the Boulder Bed as well. This evidence serves to corroborate the findings from the Jayanti coalfield and supports the existence of Glossopteris flora during the Permocarboniferous glaciation.

2.2.3 *Palaeobotany and age of coal-bearing beds of Jayanti coalfield*

Coal-bearing beds overlying the Talchir Formation in the Jayanti coalfield were investigated for mega and microfossils. The megaflora is characterised by *Noeggerathiopsis*, *Gangamopteris* and seeds as well as by the peculiar presence of *Gondwanidium*. This evidence now indicates a definite Karharbari age for the Coal-bearing strata which were considered as Barakars by some workers. The associated mioflora is characterised by *Punctatisporites* and *Callumispora* together with *Plicatipollenites* and other radial monosaccates.

2.2.4 *Palynostratigraphy of North Karanpura coalfield.*

The Lower Gondwana outcrops exposed in the North Karanpura coalfield, Bihar comprising Talchir, Karharbari, Barakar, Barren Measures and Raniganj formations have been palynologically investigated. The relative dominance or paucity of triletes, monosaccates and bisaccates were found useful for delimitation of various zones. Eight palynological zones have been established. It is observed that change in palynological assemblage from one formation to another is gradual and the palynological demarcation exactly between the uppermost and lowermost parts of two successive formations based on lithology is rather difficult. After this transitional zone, the miospore assemblage gradually differs from one another and the palynological boundary between the two successive formations can be marked satisfactorily.

2.2.5 *Subsurface palynological succession in the bore hole NCKB-19, Korba Coalfield, M. P. India.*

79 samples of different lithologies from a 689 meters deep bore-hole in Korba Coalfield have been palynologically investigated. The succession is divisible into three major zones The oldest zone is dominated by radial monosaccates *(Parasaccites-Plicatipollenites)* along with sporadic presence of stariated saccates and pteridophytic spores. The middle zone is dominated by *Parasaccites* and *Callumispora*, the pteridophytic spores increase and appear more consistently while the striated saccates continue to be sporadic. The top zone. the youngest, is characterized by overall prominence of nonstriated saccates (chiefly *Sulcatisporites*), increased and consistent presence of striated saccates but similar incidence of pteridophytic spores as in the middle zone.

2.2.6 *Palynology of Kamptee Coalfield*

7 bore-hole coal samples were received for palynological analysis from Coal Survey Laboratory, Nagpur. Out of these seven samples, only five have yielded spores. Palynological study has revealed the prominence of *Brevitriletes, Horriditriletes, Microbaculispora, Microfoveolatispora, Indotriradites, Parasaccites, Sulcatisporites* and *Pilasporites.* The overall percentage composition suggests Barakar affiliation for these coals. The report on the present investigations has been sent to Coal Survey Laboratory.

2.2.7 *Studieson geology and palynostratigraphy of Mahpani Coalfield.*

Studies on geology and palynostratigraphy of Lower Gondwana sediments of Mohpani Coalfield have led us to reach on following conclusions.

(a) The Lower Gondwana sediments were locally folded and uplifted in the form of a dome due to the upward humping caused by the intrusion of a dolerite laccolith which was also the source for the dolerite dykes present in the area. The probability of the extension of coal deposits

below the Bagras in the surrounding area has been indicated on the basis of the dome structure.

(b) Palynostratigraphy of the Lower Gondwana rocks has indicated the presence of two main cenozones based on the statistical analysis of the miospores each corresponding to the Talchir and Karharbari Stages. Coal beds present in the Mohpani Coalfield have been grouped with the Lower Karharbari Stage tends to be a part of the Talchir series and represents an interglacial phase similar to that represented by the Rikba plant beds.

2 3 Sporae dispersae in general

2.3.1 *On the classification of gymnospermous sporae dispersae.*

All the directly or indirectly available information on the organization and structure of pollen grains in the various classes of gymnosperms has been synthesized to evaluate the significance of different features for the classification of gymnospermous spurae dispersae. A new classification has been proposed for them which purports to be morphographical.

2.3.2 *Nomenclatural note on some problems concerning Sporae dispersae.*

A nomenclatural note on some problems concerning *Sporae dispersae* has been completed. Aspects of typification from reworked stratum, choice of a name between two taxa of the same rank and date, doubtful name, and orthographic variant etc, have been pointed out.

2.3.3 *A review of the Palaeozoic cryptogamic spores from India.*

A review of the Palaeozoic Cryptogamic spores from India has been compiled. Some of the trends recently recognized in the morphography of the Cryptogamic spores have been evaluated. A series wise review of the trilete and monolete spores have been discussed to evaluate their morphographic importance and relationships.

2.3.4 *A review of the Palaeozoic disaccate pollen from India.*

A review of the Palaeozoic disaccate pollen from India has been compiled. Encompassing a brief historical development of the studies in disaccates, the position of *Striatites*, *Striatopodocarpites*, *Faunipollenites* and *Sulcatisporites* has been evaluated. A need for more objective and practical approach breaking the existing too narrow or too broad lines in morphography of this group has been suggested.

2.3.5 *Permian Palyno-stratigraphy in India.*

In the last decade, parts or whole of the Lower Gondwana sequences occurring in various basins of India have been palynologically studied and the same have been correlated with different stages in the Lower Gondwana succession of peninsular India. A critical analysis of the data reveal the presence of 12 distinguishable assemblages in succession. In the Talchir Stage only one assemblage is known so far, in Karharbari Stage two have been recognised and for the Barakar, Barren Measures and Raniganj Stages three assemblages each have been substantiated. These assemblages differ from each other in quantitative representation of various qualitative groups.

2.4 Petro-palynology of coals

2.4.1 *Petro-palynology of Lower Gondwana coals of India.*

In recent years coals from various stratigraphical horizons have been Petro-palynologically studied and these studies have provided some valuable information which are synthesized in a review providing evidence for the existence of distinct types of vegetational zones with different peat types, and sequential mode of formation of Lower Gondwana coals as revealed by behaviour of maceral and miospore assemblages.

2.4.2 *Some observation on Petrological classification of coals.*

No classification on coals so far devised has proved satisfactory for every country, rank and type. Most of them are based on chemical composition and whilst normally reliable for rank cannot distinguish, e.g., between true and pseudo-anthracite. To an even greater extent within the rank of bituminous coals it is often impossible to distinguish many different types. In fact the vast majority of coals used in industry lies within the bituminous rank. Moreover two coals, one with a high percentage of spores and one made up mainly of woody tissue could have almost identical chemical composition and yet the first would be completely non-coking and good gas coal whilst the second would form good porous Coke. Furthermore composite seams like Lower Gondwana deposits of India comprise several different types and these should be applied to different uses. Thus, these coal varieties or types can only be effectively determined by the analysis of the source material or basic composition in terms of plant entities and efforts are to be made in devising a new classification based on a combination of physical (Megafossils, microfossils and microstructure) and chemical properties which could be applied to every Coal in every country (communication sent to the International Coal Analysis Commission of International Committee of Coal Petrology).

3. PALAEOZOIC FROM ABROAD

3.1 *Megafossils*

3.1.1 *Cordaitalean fructification from U.S.S R.*

The genus *Cladostrobus* from the Permian of the Angara-land was studied. Detailed investigation was made of the

microsporophyll cuticle, sporangia and the *in situ* pollen. A new miospore genus *Cladaitina* has been proposed for dispersed pollen which resemble the *in situ* pollen of *Cladostrobus*. A relationship between *Cladostrobus* and the leaf genas *Rufloria* has been reasoned out.

3.2 Sporae dispersae and palynostratigraphy

3.2.1 *Palynostratigraphy of the Lukuga Series in Zaire.*

On the basis of the work done during the last decade, the palynological zonation of the Lukuga Series has been suggested.

3.2.2 *Palynological analysis of the Devonian (Lower and Middle) from Dingdorf-Wettledorf region.*

The problem on the palynological analysis of the Devonian (Lower and Middle) from classical Dingdorf-Wettledorf region has been completed The taxonomy as well as statistical distribution of various spore species has been done. These results provide important data to fill in some of the present gaps in our knowledge of Devonian Palynology.

3.2.3 *Miospore assemblage from Devonian of P'oshi District, Yunnan, China.*

An assemblage consisting of miospores, Chitinozoa and Scolecodonts has been described from the Devonian of P'oshi District, Yunnan, China. Detailed comparisons with the Devonian assemblages have suggested a Middle Devonian age for this assemblage.

3.2.4 *Miofloral succession in the African Lower Gondwanas.*

A statistical analysis of the miofloral succession in the African Lower Gondwana has been completed. This research has thrown light on the basal assemblage from Dwyka Tillite which is characteristic of a high percentage

of trilete and meager representation of the saccate genera. When compared with the contemporary Indian miofloras, a definite relationship has been established.

3.2.5 *Some observation on the genus Sulcatisporites (Lesch)*

A re-examination of the type slides of the genus *Sulcatisporites* Lesch., has revealed that the Indian species so far described as "*Sulcatisporites*" are totally different from the former. A note on this observation has been communicated to the press.

3.2.6 *Middle Devonian palynology in Czechoslovakia*

Middle Devonian miospore and microplankton association have, for the first time, been recovered from the Srbsko Formation of Czechoslovakia. The microflora is characerized by the prevalence of saccate-zonate miospores. The Eifelian and Givetian assemblages of Czechoslovakia have been compared and evaluated in the light of comparable European microfloras. Nearest resemblance is found with the Russian miofloras of Middle Devonian age. Palaeoenvironmental setting of the Czechoslovakian Middle Devonian is well supported by the palynological evidences.

3.2.7 *Permo-Triassic subsurface palynology from Libya*

This communication incorporates the study of spores, pollen grains and acritarchs recovered from deep well samples in Libya. The palynomorphs have been assigned to 61 genera and 93 species. Out of these three genera and 23 species are new. The distribution and frequency of the composite miofloral constituents have shown that there can be five different palynological zones ranging in age from Middle Permian to Upper Triassic. Libyan Permo-Triassic assemblages show the dominance of striate bisaccate pollen grains in Permian and trilete spores in Lower Triassic. From the percentage count of spores, pollen grains and microplanktons it has been deduced that there must have

been an emergence of new land and minimisation of open sea conditions during the Middle and Upper Triassic times in Libya representing the regressive phase.

4. MESOZOIC

4.1 Megafossil assemblages

4.1.1 *Triassic of Nidpur*

The megaflora is characterised by the overwhelming dominance of the genus *Dicroidium* which is represented by three species. Out of these *D. nidpurensis* and *D. papillosum* are the commonest, whereas, *D. gopadensis* is rather rare. The other genera discovered from these, beds are *Conites*, *Glossopteris*, *Glottolepis* gen. nov., *Lepidopteris*, *Noeggerathiopsis*, *Rhabdotaenia* and *Taeniopteris*. Among these *Glossopteris* and *Taeniopteris* are fairly well represented, while *Glottolepis* is quite common. In addition to these, some unidentified fragmentary conifer shoots are also present.

4.1.2 *South Rewa Basin*

Three new species of *Pagiophyllum*, viz., *P. bansaensis*, *P. marwarensis* and *P. rewaensis* have been identified on the basis of their cuticular features from the Lower Cretaceous beds of Bansa, Shahdol district, M.P. In all the three species leaves are spirally borne and they are amphistomatic with entire margins. However, in *P. bansaensis* the stomata are more on the lower side than the upper. Upper side shows a few stomata arranged in two triangular areas which seem to join near the apex. On lower side stomata are not so regularly arranged, but they are distributed over the entire surface. Individual stomata are sunken. Subsidiary cells are 4-5, rarely 6 and they are slightly more cutinized than ordinary epidermal cells. Whereas, in *P. marwarensis* and *P. rewaensis* the upper side has much more stomata which are arranged in two triangular areas leaving a central astomatic region. But in the former the stomata are mostly transver-

sely orientated, whereas, in the latter they are longitudinally orientated. On the lower surface in *P. rewaensis* stomata are irregularly distributed near apex and base, but in *P. marwarensis* they are confined to the base only in irregular files. In *P. marwarensis* the stomatal apparatus is more or less circular, whereas, in *P. rewaensis* it is oval.

4.1.3 *Indian Mesozoic Pteridosperms*

A review on the Mesozoic *Pteridosperms*, ranging in age from Lower Triassic to Lower Cretaceous, has been completed. It deals mainly with the genera *Lepidopteris*, *Dicroidium*, *Thinnfeldia*, *Pachypteris* and *Cycadopteris*. The genus *Lepidopteris* is extremely rare in the Indian Triassic, whereas, *Dicroidium* is the most common plant.

In the Upper horizons, viz., Jurassic—L. Cretaceous, *Dicroidium* is rather rare. Instead *Thinnfeldia*, *Pachypteris* and *Cycadopteris* are met with. But these latter three genera are not that common as *Dicroidium* in the Triassic.

4.1.4 *The genus Ptilophyllum in India*

A monograph on the genus *Ptilophyllum* has been published. The study was based on all the Indian specimens of *Ptilophyllum* Morris described since 1840 and new specimens collected during the last 20 years. In all 15 species have been identified. They are : *P. acutifolium* Morris, *P. cutchense* Morris, *P. rarinervis* (Feistmantel) Bose & Kasat, *P. tenerrimum* Fiestmantel, *P. oldhamii* Jacob & Jacob, *P. indicum* Jacob & Jacob, *P. horridum* Roy, *P. sakrigalliensis* Sah, *P. distans* (Feistmantel) Jacob & Jacob, *P. institacallum* Bose, *P. jabalpurense* Jacob & Jacob, *P. gladiatum* Bose & Sukh Dev, *P. amarjolense* Bose, *P. sahnii* Gupta & Sharma and *P. nipanica* Vishnu-Mittre.

4.1.5 *Raniganj-Panchet boundary*

For fixation of the Raniganj-Panchet boundary data have been obtained from stratigraphical geology, animal

remains, plant mega remains and also from palynology.

4.2 Sporae dispersae and palynostratigraphy

4.2.1 *Panchet of Asansol*

Intensive palynological investigations of the Panchet from three sections at Noonia Nala near Asansol, W. Bengal, have been carried out. The samples are rich in microfossils, comprising trilete and monolete spores and monosaccate, bisaccate, trisaccate, polyplicate and monocolpate pollen grains. They have been provisionally placed into 35 dispersed spore-pollen genera. It has been observed that in some samples striate bisaccate are dominant while in others triletes are abundant. Among the bisaccates, *Striatopicietes* and *Gondwanipollenites* are dominant while among the triletes

Verrucosisporites is very common.

4.2.2 *Triassic of Nidpur, M.P.*

The Nidpur mioflora is represented by 2 spore and 20 pollen genera. Out of these 4 new genera, viz., *Nidipollenites*, *Praecolpatites*, *Satsangisaccites* and *Weylandites* have been instituted. Bisaccate gymnospermous pollen grains occur in fair abundance in this assemblage, whereas, trilete and monolete spores are very rare. The striated saccates are well diversified.

On the evidence of the assemblage cited above the Nidpur bed is considered to be of Triassic age. The Nidpur miofloral assemblage has been compared with the miofloras of southern and northern hemispheres and on the floristic evidence they are supposed to be slightly younger than the Panchet.

4.2.3 *Triassic microflora of India*

The entire Triassic microflora, so far known from India, has been reviewed. It has been observed that the striate bisac-

cate grains which were dominant during the Upper Permian period, gradually started diminishing in the beginning of Triassic. They were replaced by a number of new trilete spores types. During the late Lower Triassic period even the triletes started to decline and miofloral assemblage was dominated by non-striate bisaccate grains.

4.2.4 *Jurassic of Rajmahal Hills, Bihar*

A shale sample from Mandro, Rajmahal Hills was processed for microfossils. The miofiora obtained seems to be dominated by the genus *Araucariacites*. The study on completion is likely to throw further light on the age of the bed investigated.

4.2.5 *Palynology of Satpura Gondwana Basin*

Preliminary studies of the shale samples from Parsapani area has shown that the assemblage is dominated by the miospore genera *Arucariacites* and *Callialasporites*.

A few samples of white clay from Parsapani region yielded sponge spicules on maceration. As none of the spicules isolated was complete so generic or specific identification was not possible.

4.2.6 *Palynostratigraphy of coal deposits in Jabalpur Stage, Upper Gondwana, India.*

The qualitalive and quantitative analysis of the dispersed miospores in the coal and coaly shales from Lameta Ghat, Sehora and Hathnapur of the Jabalpur Stage, India have been worked out. The miofloral assemblage consists of 58 spores genera (1 new) and 103 (44 new) species. Cryptogamic components are poor in occurrence but the genus *Araucariacites* dominates the whole assemblage while *Callialasporites* and *Cycadopites* occuring as common.

4.2.7 *Mesozoic cryptogamic spores from India*

A selective review of the published records of the dispersed cryptogamic spores in the Mesozoic strata of India was

completed. It deals with the salient features of the spores in terms of evolutionary development, distinctive morphology, organization, dehiscence mechanism, sculptural trends and stratigraphic significance. On the basis of spore morphology many of the dispersed cryptogamic spores have been provisionally assigned to the related botanical families.

4.2.8 *Mesozoic gymnospermous pollen grains from India*

The Indian fossil gymnospermous pollen grains which abound in the Mesozoic strata of India were reviewed. An attempt has been made to highlight their distinctive morphology, organization, sculptural patterns, stratigraphical and evolutionary significance.

The diversity of form in the gymnospermous pollen grains is extraordinarily pronounced. The evolution of the sulcus has been discussed.

4.2.9 *Jurassic-Lower Cretaceous mioflora of India*

The progress of research done so far on the Jurassic—Lower Cretaceous miofloras of India has been reviewed. As apparent from published records, palynologic investigations of Mesozoic strata have lagged far behind those of the Palaeozoic. The momentum gained since 1964, however, is apparently coincident with the development of the subject in other parts of the world. Finally it has been generalized that the Indian Upper Jurassic miofloras are dominated by varying abundance of *Araucariacites* complex and *Callialasporites*. Both the genera maintain their dominance in the succeeding Lower Cretaceous assemblages but are associated with a widely different variety of cryptogamic spore genera. In the older Lower Cretaceous assemblages, the dominance of trilete genera *(Impardecispora)* and schizaeaceous spores is strikingly noteworthy.

4.2.10 *Cretaceous-Tertiary sediments of Assam*

Cretaceous-Tertiary sediments of Pynursla and Thanjinay colliery have been macerated.

Laboratory processing of the rock samples from Cherrapunji area was partly completed.

4.3 Mesozoic from abroad

4.3.1 *Palynological studies on some Zirab coals Persia*

Three coal samples from Zirab were macerated by the Schulz's maceration method. Approximately 16 slides of each samples were prepared and sealed with wax. Scanning process of good miospores was only partly done.

4.3.2 *Palynological studies on some Mesozoic coals of Iran*

Twenty four coal and coaly shale samples from Iran were macerated.

4.3.3 *Cretaceous microplankton from Senegal Basin, N.W. Africa.*

Preliminary results of microplankton study of the Cretaceous (Baremian-Maestrichtian) sequence of Senegal Basin, N. W. Africa are now available. Two new genera viz. *Senegalinium* and *Subtilisphaera*, eleven new species and seven new combinations, have been proposed.

The status of the genus *Deflandrea* has been discussed suggesting its segregation. The stratigraphic importance of these fossils has also been brought to light with the remarks that *Deflandrea* can be treated as Upper Cretaceous (?Albian included)—Tertiary genus.

4.3.4 *Palynology of successive Mesaverde coals near receding shorelines of the Mancos (Upper Cretaceous) Sea, U.S.A.*

A rich assemblage of spores, pollen grains and microplanktons was obtained from coal and other sediments, associated with the Ferron Sandstone member (Drowning Coal Mine) and the Blackhawk Formation (Price River Canyon, Kenilworth, north of Helper, Synnyside and ad joining areas) in the Book Cliffs escarpments at the north end of the San Rafael Swell and west of Castle Valley of

Utah. 58 spore-pollen genera and 107 species have been recognized. 2 pollen genera and 34 species are new. 6 new combinations have been instituted Some existing spore-pollen genera have been briefly reviewed. Correlative significance of these assemblages with those of comparable sediments in United States of America and Canada has been made and these floras are most closely related to those on the coast by the presence of herbaceous angiosperm pollen grains, *Proteacidites* and pteridophytic spores and by the absence of *Aquilapollenites*.

Quantitative analysis of the assemblages was done at generic level and interpretation attempted. But now it is thought necessary to count the palynomorphs at specific level in order to fix the range of distribution of each recognizable taxon in the vertical plane and test its lateral persistency.

5. TERTIARY

5.1 Morphological and Anatomical Studies

5.1.1 *Deccan Intertrappean Flora*

The Intertrappean series are of special interest as the fossil plants are very often exquistively preserved in them. Because of their early Eocene age, some of the plants appear to defy proper generic assignment, probably being in the evolutionary flux. Besides, quite a few forms have not been properly assigned to their systematic position. Therefore, to settle this question and to know more about the Deccan flora a number of big chert blocks were broken and petrified plants like *Rodeites*, *Sahnipushpam*, *Sahnianthus*, *Viracarpon* and *Tricoccites* etc. were examined for correct systematic assignment.

5.1.2 *Fossil plants from Kutch*

Extensive palaeobotanical studies were undertaken to determine the vegetational and climatic history of Kutch

during the Tertiary times. The only fossil records so far known from Kutch are a dipterocarpaceous wood and a palm wood whose exact horizon is doubtful. Both megafossil and microfossils were studied.

From the Lake deposit near village Panandhro, a few well preserved leaf impressions from Kakdi series have been studied. Some of these have been identified tentatively as *Syzygium, Euphorbia, Zizyphus, Madhuca* and *Ficus.*

5.1.3 *Leaf impressions from Khari Series*

Large number of leaf impressions collected from Khari River bed near village Mokra have been studied. These are referable to families Palmae, Euphorbiaceae, Leguminosae, Myrtaceae, Sterculiaceae, Sapindaceae, Lauraceae and Rutaceae. The following tentative generic identifications have been made including *Syzygium, Bauhinia, Cassia, Euphorbia, Zizyphus, Grewia, Dodonaea, Buxus, Tamarindus, Ficus.* A few legume pods have also been recovered.

5.1.4 *Woods from Kankawati Series (Manchar)*

Some woods collected from the village Mothala and Dhaneti have been cut. Their preliminary investigations have revealed the presence of *Terminalia, Sterculia* and some legumes

5.1.5 *Fossil woods from the Siwalik Beds of Nalagarh and Bhakra, Himachal Pradesh.*

About a hundred specimens were sectioned, but only a few of them revealed good preservation to proceed for identification. Out of this, about a dozen new types have been selected which revealed the preponderance of Leguminosae and Dipterocarpaceae. The dipterocarps are represented by the woods of *Dipterocarpus* and *Anisoptera* while the legumes show the presence of *Cynometra* and forms somewhat resembling *Bauhinia, Cassia* and *Hard wickia,*

5.1.6 *Leaf impressions from the Siwalik beds near Bhikna Thoree, Bihar*

In addition to detailed morphological study of already recognized leaf impressions as *Zizyphus jujuba, Bauhinia hookerii* or *Hard wickia binata* and *Cinnamomum tamala* from Bhikna Thoree, dist. Champaran, Bihar, more leaf impressions were examined, and some of them tentatively identified as legumes. These are mostly leaf-lets of small sizes.

5.1.7 *Fossil woods from Tipam Series*

Petrified woods from the Miocene of Tipam sandstones near Hailakandi in Cachar district of Assam further revealed the presence of genera like *Careya* and *Barringtonia* of the family Lecythidaceae. It is interesting to note that modern equivalents of these fossils are still found in the forests of Assam, which further supports the theory that there has been no great shift in the vegetation and ecological conditions of Eastern India since the Middle Tertiary period.

5.1.8 *Fossil woods from Dupitila Series*

Study was continued on the fossil woods from Namsang beds at Deomali in NEFA, which revealed the presence of four distinct types of forms, presumably belonging to legumes and the Sapotaceae or Ebenaceae.

5.1.9 *Fossil woods of the Cuddalor Series*

Further investigation of woods from Murattandichavadi near Pondicherry has revealed the occurrence of three sapotaceous woods. One of them shows close resemblance with that of *Chrysophyllum*, while the affinities of remaining two are yet to be ascertained. Besides these, one sapindaceous wood and few leguminous woods have also been tentatively identified. Revision of some of the woods described by earlier workers was also continued. Type slides of

Pterocarpoxylon arcotense Ramanujam, *Anisteroxylon coromandelense* Navale were critically examined.

5.2 Sporae dispersae and palynostratigraphy

5.2.1 *Palynological studies on the coals of Barail Series—Tikak Parbat Stage of Upper Assam.*

70 coal and non coal (coaly-shale, shaly-coal and shale) samples from the Mukum Coalfield have been macerated. Preliminary scanning of the slides (of 40 samples only) was completed. Slides of 12 samples have been photomicrographed and 350 spore exposures have been printed. Morphographic study of various taxa is being done.

5.2.2 *Palaeogene mioflora of Assam*

Palynological study of the Palaeogene of Assam was taken up. Shale samples (in which leaf impressions were present) from Tura Formation at Damalgiri in district Garo Hills and from Ledo, Tipongpani and Bargolai near Margherita of Tikak Parbat stage were macerated. The samples from Damalgiri yielded rich assemblages of pollen and spores representative of angiosperms, gymnosperms and pteridophytes. In contrast, the samples of Tikak Parbat Stage yielded mostly pteridophytic spores.

5.2.3 *Palynological analysis of shale samples from Madh Series, Kutch.*

Palynological studies on the Tertiary of India have been entirely restricted for stratigraphical purposes, hence artificial system of nomenclature has been invariably followed. However, in the present study, an attempt was made to identify pollen grains and spores in relation to modern taxa, so as to build up the past flora and to deduce the palaeoecology of the region.

Shale samples from Matanumadh (Madh Series, Palaeocene) were palynologically analysed. In this assemblage 47

families of living angiosperms are represented. Among the more dominant families are Meliaceae, Leguminosae, Ranunculaceae, Cruciferae, Proteaceae, Euphorbiaceae, Oleaceae, Orchidaceae, Palmae etc. Some of the tentatively identified genera are *Erythrina*, *Melilotus*, *Lonicera*, *Cedrela*-type, *Cassia*, *Nothofagus* etc. Among pteridophytes, Polypodiaceae, Cyatheaceae, Gleicheniace, Schizeaceae, and genera *Lygodium*, *Cyathaea*, *Schizaea* and *Ceratopteris* appear to be represented. Some gymnospermous pollen and fungal spores are also present.

5.2.4 *Biostratigraphic zonation of the Cherra Formation of South Shillong Plateau*

Three biostratigaphic zones have been recognized in the Cherra Formation. The Lower zone—*Nymphaeoipollis crassimurus* can be distinguished by the high frequencies of *Nymphaeoipollis crassimurus*, *Retialetes emendatus* and *Polypodiisporites mawkmaensis* go together with other forms restricted to this zone. The next *Araliaceoipollenites reticulatus* cenozone can be recognized by the common occurrence of *Corrugatisporites formosus*, *Sestrosporites dettmanni*, *Couperipollis rarispinosus* and the ± absence of *Nymphaoeipollis crassimurus* and *Polypodiisporites mawkmaensis*. This zone is followed by the Upper *Tricolpites reticulatus* cenozone. The characteristic taxa *Tricolpites reticulatus* assemblage zone are *Foveosporites patchyexinus*, *Polycolpites speciosus* and *Engelhardtioidites parvus* etc.

5.2.5 *Age of the Laitryngew, Mawkma Coal-bearing Sandstone and their relationship with Cherra Formation.*

Palynology of the coal bearing sandstones of Laitryngew and Mawkma areas has been worked out. The sedimentary succession exposed in these places have been equated with the Cherra Formation of Cherrapunji Plateau and a tropical, shallow, fresh-water or lagoonal condition of deposition has

been suggested for the accumulation of the Tertiary sediments in these areas.

5.2.6 *Palynological biostratigraphy of the Tura Formation in the Type Area.*

Four assemblage zones, viz. *Retialetes mendatus*, *Dandotiaspora telonata*, *Palmidites plicatus* and *Nymphaeopollis assamicus* have been recognized. Finally, these four cenozones, have been compared with the four palynological horizons of Cherrapunji Plateau.

5.2.7 *Palynological demarcation of the Eocene-Oligocene sediments in the Jowai-Badarpur Road.*

Palynological differentiation have been pointed out in the Kopili and Barail sediments of this area on the basis of the population variation of the spores-pollen taxa. *Cicatricosisporites macrocostatus* is the most abundant form and its dominance increases in the Oligocene. Taxa like *Monolites mawkmaensis*, *Lycopodiumsporites* sp. and *Polycolpites* sp. are found to be confined to the Eocene Kopili Formation only.

Spores and pollen grains recovered from Lakadong sandstones of Mawmluh and Thanjineg areas are being scanned.

5.2.8 *Palynostratigraphy of the Lower Tertiary sediments of northern India.*

Laboratory processing of grab samples frm the Koshalia river section near Baroti and Koti (Kalka) representing Subathu, Dagshai and Kausali formations was completed. Most of the samples were unproductive. However, two productive horizons have been found which contain a variety of microplanktonic forms confirming brackish water to near

shore conditions of deposition. Remaceration of the unfossiliferous material, employing different techniques for the recovery of the organic matter, was started.

Maceration of the Dharampur section samples representing Subathu Formation was completed.

5.2.9 *Tertiary of Rajasthan*

The palynological investigation of the Palana lignite field, Rajasthan has been completed. It comprises 8 genera and 11 species of pteridophytic spores, 24 genera and 36 species of angiospermic pollen grains, 9 genera and 16 species of algal and 3 genera and 4 species of fungal remains. The angiospermic pollen grains (70%) are dominant in the assemblage and the trilete spores are subdominant (20%). Prominent monocot families are : Potamogetonaceae, Palmae and Liliaceae. Among the dicots following families are well represented: Nymphaeceae, Leguminosae, Cruciferae, Rubiaceae, Anacardiaceae, Hippocrateaceae, Guttiferae, Meliaceae, Proteaceae and Onagraceae. Pteridophytic spores are generally represented by Osmundaceae, Matoniaceae, Polypodiaceae, Schizaeceae and Cheilanthaceae. The algal genus *Botryococcus* along with microplanktons are found in abundance in some stratigraphic levels.

5.2.10 *Tertiary of Kutch*

Palynological samples collected from 8 measured sections around Matanamadh, Kutch have been macerated. A rich palynological assemblage, comprising algal and fungal remains, pteridophytic spores. gymnospermous and angiospermic pollen has been recovered.

5.2.11 *Palynostratigraphy of Cauvery Basin*

Grab sampling to locate the productive horizons has been made. The chemical processing of the samples with the preparation of slides of productive samples was done.

5.2.12 *Palynostratigraphy of Western Ghats*

Grab sampling has been made to discover the productive horizons. The chemical processing of samples and the preparation of slides of productive samples was partly completed.

5.3 Petrological studies

5.3.1 *Palaeobotany of Indian lignites*

A review of some recent palaeobotanical studies of Indian lignites especially with regard to physical composition, megafossils, microstructure and microfossils has been compiled. Attention is drawn to the scope for the evaluation of floristics, stratigraphy, correlation, climate, palaeogeography, genesis and utilization of Indian lignites.

5.3.2 *A comparative study of fossil plant remains from Neyveli lignites, South-India*

A comparative analysis of dispersed plant remains such as woods, pollen grains and spores from the Tertiary lignite of Neyveli, South-India has revealed that the lignite has been formed from predominantly angiospermous vegetation specially dicotyledonous taxa. The characteristic families which form the source material of the lignite are Leguminosae, Meliaceae, Sapotaceae, Dipterocarpaceae, Ebenaceae, Graminae, Palmae, and some aquatic taxa belonging to Nympheaceae, Lentibulariaceae, Lecythidaceae and Potamogetonaceae. Apart from above taxa ferns, fungi, microplanktons and various tissues also occur. The evidences provided by the fossil material suggest the existence of a warm, humid, tropical to subtropical climate during the formation of the lignite. The occurrence of fresh water forms coupled with mangrove elements indicate the formation of lignite probably at the confluence of the river with the sea during the Miopliocene period of the Tertiary epoch.

5.3.3 *Petrological studies on the coals of Barail Series-Tikak Parbat Stage.*

For petrographic study coal samples were crushed and 18 araldite embedded pellets were made for maceral and microlithotype analysis. Preliminary study of only 3 pellets was completed.

5.4 General studies

5.4.1 *Palaeoenvironmental analysis of the Tertiary floras of India*

In order to decipher the environments during the Tertiary of India, an attempt has been made to analyse the generic composition of five Tertiary floras of the Indian subcontinent, viz., those of the Deccan Intertrappean Series, the Siwalik beds, The Tipam series, the Cuddalore series and the Dupitila series, which are now known to a greater extent. The genera known from each flora have been classified, (1) native genera now living in the geographic region of the fossil deposit, (2) exotic genera, no longer present in the geographic region of the fossil flora, and (3) those genera which are botanically unidentified or extinct. Their statistical representation in each flora is related to the geologic age. Changing ratios of the three categories indicate floral changes and the plant migrations due to climatic changes during the Cenozoic. Some striking conclusions have been drawn regarding the climatic and floral changes during the Tertiary of India based primarily on the exotic types which effectively measure the difference between the past and the present climate of the region.

5.5 Tertiary from abroad

5.5.1 *Fossil woods from the Tertiary of South Bohemia, Czechoslovakia*

A collection of fossil woods sent by the National Museum, Praha, revealed quite a few forms near Trebon in

South Bohemia. These fossil woods have been derived from the Lipnice series mostly regarded as of oligocene age. As there has been no palaeontological record so far from this series, the present discovery is of great importance. The plants known are a conifer wood, *Cupressinoxylon*, and dicot woods belonging to modern genera *Mimusops Manilkara, Diospyros*, a member of Lauraceae and Burseraceae, and a wood of unknown affinities.

6. QUATERNARY

6.1 Palynology

6.1.1 *Genus Tilia*

The statistical analysis of the pollen characters of the genus *Tilia* has revealed that the two species, viz. *T. platyphyllos* and *T. cordata* can be separated from one another on the basis of size, mesh structure and surface reticulation. The application of these criteria to subfossil pollen of *Tilia* from the postglacial deposits of East Anglian Fenland has established the native status of *T. platyphyllos* in England. Further the evidence reinforces earlier views on the high frequencies for this genus during the Flandrain in East Anglia.

6.1.2 *Family Boraginaceae*

The pollen morphology of thirtyone Indian species distributed over ten genera has shown that the family Boraginaceae is characterized by 3-4 zonicolpate, colporoidate and colporate types of pollen grains with psilate, granulate, retipilariate, faintly reticulate, foveolate or obscure pattern. The pollen grains are either dumb-bell shaped or prolate and subprolate.

The palynological data suggest close relation of the genera *Paracaryum, Lindelofia, Mertensia, Eritrichium, Cynoglossum* and *Macrotomia* and support their inclusion in the subtribe

Cynoglosseae of Borageae. The systematic position assigned to the genus *Cordia* by Hooker (1885) is corroborated by palynology.

6.1.3 *Holoptelea integrifolia Planch*

Beside 4-5 porate pollen grains in *Holoptelea integrifolia*, nearly 15% 6-porate pollen grains have been found in the twelve samples collected from various parts of Lucknow and a sample from Gonda. The 6-porate pollen grains have not been reported earlier. *Holoptelea integrifolia* produces 6307-10843 pollen grains per anther and 44149-1 8430 pollen grains per flower. The frequency of pollen grains in different surface from Lucknow varies between 1.1 to 4.7% and is dependent upon the distance of the sample from the tree/trees of *Holoptelea*.

6.2 Pollen analysis

6.2.1 *Kashmir*

A comparative account of pollen content and megafossils in the Lower Karewa deposits at Ningle Nullah, has revealed a dense oak-wood forest though not a single leaf impression of *Quercus* has been found at this site. At Liddar-marg, Dangarpur and Laredura the dominance of *Quercus* leaf impression is not equally reflected in the pollen spectra. Conifers though absent among the megafossils are represented in pollen spectra. Members of Lauraceae, Rosaceae, Papilio-naceae, Cornaceae and *Trapa* well represented among megafossils are either absent or poorly represented in the pollen spectra. The results reveal the importance of the study of both micro and megafossils for reconstructing of the past vegetation.

6.2.2 *Kumaon Himalaya*

The seed and fruit analysis of postglacial deposits from Naukuchiya Tal and Bhim Tal has revealed the occurrence of

quite a few seeds and fruits belonging to *Potamogeton, Rubus, Rumex. Pseudocyperus, Cyperus, Carex, Nymphaea,* and of *Caryophyllaceae.* Subfossil *Chara* nucules and some bryophytic fragments have been also recovered.

The statistically evaluated seed diagrams show a high frequency of *Chara, Potamogeton, Nymphaea* etc. at the bottom of profile. These are succeeded by mesophytic and moisture loving land plants dominating towards the upper part of the profile.

The seed and fruit analysis has substantiated the findings through pollen analysis of these deposits.

6.2.3. *Himachal Pradesh*

The pollen analytical investigation of postglacial deposits from the Khajiar lake has established the occurrence of dense Oak woods about 4000 years ago (2000 B. C.) and the Oak forest has since remaind dominant until about 700 A. D. when in this area, the Oak forest was disturbed by man and eventually it was replaced by Deodar.

6.2.4 *Bengal*

About sixty different types of diatoms have been recovered from the Calcutta peat. The analysis of diatoms has revealed that most of the forms belong to Pennales and a few to Centrales indicating fresh water to slightly brackish water conditions. The marine diatoms have not been encountered.

Most of the diatoms have been photographed and indentified tentatively.

6.2.5 *Bombay and Salsette Islands*

Over five metres of blue clay has been found in the basins of mangrove swamps at Bombay which are today dominantly populated by the *Avicennia alba* plant community.

Pollen analyses of bore-cores at Madh Islands and Bassein have shown scarcity of pollen in the sediments. Pollen grains of *Avicennia alba, Bruguiera gymnorrhiza, Excoecaria agallocha, Sonneratia apetala* and *Acanthus ilicifolius* together with those of some land plants have been identified. The pollen of *Rhizophora* type are comparatively high, although *Rhizophora* occurs rarely in this region. In spite of the dominance of *Avicennia*, its pollen is extremely rare in the sediments owing to poor pollen production and the biotic factor (human and grazing animals) affecting its flowering shoots.

6.2.6 *Environment of early man in India*

However scattered and stray the palynological and palaeobotanical observations are, they tend to suggest the ever increasing dry climate at least in Western India. Since the Neolithic, the practice of deforestation, clearance of land and increasing pressure ol grazing animals have eventually created the present climate with much loss or modification of original vegetation.

6.3 Archaeobotany

6.3.1 *Early domestication of plants in South and S-E Asia*

As a result of a critical review of both the palynological and palaeobotanical evidences for the early domestication of plants in the Indian sub-continent, Thailand, Taiwan and China, it has been found that the distinction between cereal and noncereal pollengrains has been based upon insufficient data, and the stages of the earliest occupation phase have not been very judiciously inferred from the pollen diagrams.

All the possible evidences in India suggest that the domestication of plants commenced around 3000 B.C. And the earliest record of domestication described from the Spirit Cave in Thailand and radio-metrically dated to 11,500 B.P., on scrutiny suggests a more advanced and discriminating stage in food-gathering rather than domestication.

6.3.2 *Chirand, Patna*

Remains of food plants from bottom layers of Neolithic horizon at Chirand near Patna, Bihar comprise lentil, barely, rice, *Pisum arvense* etc. These constitute the first economy from N. India.

From an array of C14 dates at this site, it appears that the bottom layers are younger (405 B.C.—1570 B.C.) than the overlying layers (1675-1750 B.C.). If no discrepancies are involved, the bottom layers from which the plant remains have been discovered may be dated around 3000-4000 B.C.

6.3.3 *Hallur, Mysore*

The Neolithic plant economy at this site and dated to 1600 B.C. consisted of *Eleasine coracana*, the only record from the world so far. Together with carbonised seeds of Ragi, seeds of *E. indica* have also been recovered from this site. Fruits of *Tectona grandis* have also been fonnd.

During the Iron Age the plant economy at this site consisted of *Oryza sativa* and a millet tentatively identified as *Paspalum scrobiculatum.*

6.4 Aeropalygology

6.4.1 *Spore-pollen Calendar of Lucknow for 1971-72.*

The pollen and spore annual calendar for the year 1971-72 for Lucknow is being constructed. The slides were also exposed at the ground level in the Institute campus to compare the aerospora at ground level with that on top of the building. During the year 1971-72 the rains started earlier and were spread over the entire summer thus causing considerable reduction in the frequencies of pollen and spores in the pollen rain. The rains directly affect the aerospora by bringing down the suspended atmorpheric particles and indirectly by inhibiting the flowering and

dispersal of pollen and spores. There seems to have been an increase in the population of mites during the month of December as indicated by the presence of large number of wings, scales, antennae and other body parts on the slides exposed.

The spores *Dendrophithoe falcata* and *Galphimia gracilis* are new addition to the aerospora of 1971-72 over that of the last two preceding years. Further considerable increase in the frequencies of spores of *Tetraploa* and *Cladasporium* has been observed which may be ascribed to the consistently increasing relative humidity during the year 1971-72.

The bulk collection of pollen of spp. listed below was made and the material given to the Allergy Clinic, Tuberculosis Dept.. King George Medical College. Lucknow, for preparation of antigens and their testing on the patients suffering from Asthama and seasonal shinitis. The clinical results regarding the same are awaited.

Eragrostis tenella, Ageratum conyzoides. Cynodon dactylon, Cyperus rotundus, Lantana camara, Zinnia sp., *Setaria verticillata, Sorghum halepense, Zanthium streemarium, Holoptelea integrifolia, Impateins balsamina, Euphorbia hirta, Zizyphus jujuba, Putranjiva roxburghii* and *Pithecolobium dulce.*

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III ABSTRACT OF THESES

"Stratigraphical and Palaeobotanical Contributions to the Lower Gondwana Formations of South Rewa Gondwana Basin, Madhya Pradesh"

ANIL CHANDRA

The thesis deals with the stratigraphical geology and Palaeobotany of the Lower Gondwana sediments exposed at Umaria Birsinghpur-pali. Anuppur, Manendragarh and Chirimiri areas of South Rewa Gondwana Basin, Madhya Pradesh, India. The areas were selected because of (i) the controversy regarding stratigraphical position of the Karharbari stage (ii) the well developed Talchir sediments and (iii) the lack of palaeobotanical records in those areas.

The thesis has been divided into four chapters. Chapter I deals with the Geology and the Stratigraphy of the areas. The oldest Archaean Metamorphics are successively overlain by the Talchir, the Coal Measure and the Supra Barakar sediments. The youngest member of the sequence is represented by the Lametas and the trap.

Chapter II deals with taxonomy and morphology of the palynological fossils recovered from the Talchir and overlying Coal Measures (Karharbari Stage). The miospore assemblages have yielded 81 species belonging to 50 genera. Of these, two genera—*Sakseneasporites* and *Talchiriletes* and 41 species are new. The megaspores have been reported for the first time from the Talchir Stage of India (Lele, K. M. & Chandra, A., 1967) and have been studied in detail. The Acritarch assemblage, in addition to four known genera, includes one new genus *Fovelites* and 8 new species.

Chapter III records plant megafossils from the Talchir Stage and Coal Measures of the areas under investigation.

In Chapter IV, the data collected from the organic and inorganic sediments are discussed both qualitatively and quantitavely. Field observations indicate that the Umaria Marine Bed represents an Upper Talchir transgression while the Manendragarh marine bed represents a Lower Talchir transgression. The Acritarchs from Umaria marine bed is a significant find (Lele, K. M. & Chandra, A, 1969). More such finds in future may lead to yet another basis for the correlation of the marine strata.

The palaeobotanical and palonological evidences confirm the field observations that the Talchirs within the South Rewa Gondwana Basin are correlatable and that such correlation can be extended to other Lower Gondwana Basins of the Peninsular India.

The present investigations make it clear that lithological recognition of the Karharbaris and Barakars is not reliable. On the other hand, Palaeobotanical and Palynological evidences, appear to form a more reliable basis for the same. Palynological evidence favours the inclusion of Karharbaris within the Talchir Series.

Palynological Studies on some Mesozoic Coals of India

PRAMOD KUMAR

The thesis deals with a palynological study of the Mesozoic coals from the Jabalpur Stage, India. Sixty three outcrop coal and carbonaceous shale samples were collected from 6 different localities viz., Lameta Ghat Sehora, Hathnapur, Marhpiperia, Nimbugarh and Lokartalai belonging to the Jabalpur Stages of the Jabalpur Series, represented in the Satpura Coal Basin, Madhya Pradesh, India.

Tne thesis has been divided into three parts, the first comprises an introductory chapter dealing with the geology of the Jabalpur Stage, distribution of coal in the Jabalpur rocks of India. Material and methods, nature of the Upper Mesozoic megaflora and previous work on Upper Mesozoic Palynology.

The second part deals with the systematic description of spores and pollen grains based on the classification as proposed by Potonie (1956, 1958 and 1960) and subsequently modified by Dettmann (1963). The coal samples from Marhpiperia, Nimbugarh and Lokartalai have not yielded any miospore, excepting black woody shreds.

Fifty nine miospore genera and 105 species of which 7 genera and 52 species have been considered as new.

Among 7 new genera, 5 are trilete viz., *Haradisporites* gen. nov , *Coniatisporites* gen. nov., *Beforemaesporites* gen. nov., *Lametatriletes* gen. nov., *Venusteaesporites* gen. nov., and 2 are monolete viz., *Metamonoletes* gen. nov. and *Dettmannites* gen, nov. The diagnosis of 6 spore genera have also been amended viz., *Neoraistrickia* (Potonie) emend., *Matonisporites* (Couper) emend., *Callispora* (Dev) emend., *Boseisporites* (Dev) emend., *Densoisporites* (Weyland and Krieger) emend. and *Callialasporites* (Dev) emend.

The third part includes the quantitative and qualitative analyses of the dispersed palynotaxa. Qualitatively, the Jabalpur Stage mioflora contains a number of miospore genera which are also known from the Jurassic to Lower Cretaceous deposits of the world viz., *Cyathidites*, *Gleicheniidites*, *Osmundacidites*, *Matonisporites*, *Baculatisporites*, *Lycopodiumsporites*, *Callialasporites*, *Podocarpidites*, *Alisporites*, *Podosporites*, *Araucariacites*, *Cycadopites* and *Classopollis* etc. These genera constitute a major portion of the whole assemblage.

Quantitatively, the miofloral assemblage is characterized by the prominence of *Araucarialites* associated with the common occurrence of *Cycadopides* and *Callialasporites*. The genera distributed in fair amounts are *Podocarpidites*, *Alisporites* and *Classopollis*. The cryptogamic components are poorly represented in the assemblages of the Jabalpur Stage.

A comparison of the various miofloral assemblages reveals that the Jabalpur mioflora closely resembles the mioflora IIb from W. Australia (Balme, 1957) and *Stylosus* Assemblage from SE Australia (Dettmann, 1963) in having a similar association of *Miospores* viz., *Cycadopides*, *Classopollis* and *Alisporites* but with prominent *Araucariacites* rather than *Microcachryidites* which is prominently encountered in the Australian deposits,

The similarity in the Jabalpur and Australian microfloras has led to the conclusion that the two are contemporaneous but for the fact that while *Araucariacites*, continued prominently from the Upper Jurassic into Lower Cretaceous in India, it was replaced by *Microcachryidites* during the Lower Cretaceous in Australia.

Studies in the Late-Quaternary Vegetational History in Himachal Pradesh

CHHAYA SHARMA

The work in the thesis under the above title, embodies the results of pollen-analytical, biostratigraphical and C-14 investigations of Late-Quaternary deposits carried out at the two lake-sites, namely Khajiar and Rewalsar, situated in Chamba and Mandi districts respectively. The pollen profiles from these two lake sites are, so far, the first available C-14 dates Late-Quaternary pollen sequences from the western Himalayas. The work is divisible into seven chapters, of which the first six comprise the main subject matter as under whereas the last one deals only with the references.

Chapter I, is introductory, giving briefly the physiography, climate, and the present-day vegetation of Himachal Pradesh. It also includes a resume of the earlier Late-Quaternary studies carried out in N. W. Himalaya.

Chapter II, includes the various methods and techniques employed during the course of investigations, for example the stratigraphy, laboratory techniques, pollen analysis and zonation etc.

Chapter III, is devoted exclusively to the studies on the present-day pollen rain over Himachal Pradesh, as revealed through the surface sample analyses from different elevations in the area of the investigated sites.

Chapter IV, comprises the basic data on the stratigraphical and pollen.analytical investigations of the lake-sites Khajiar and Rewalsar.

Chapter V, includes brief ecological notes on the plant species, of which the sub-fossil remains have been recovered from the two lake profiles. It further reviews the vertical distribution of the various species represented in the profiles.

Chapter VI, discusses the main conclusions inferred on the basis of surface sample analyses, stratigraphy, C-14 dating, interpretations of the pollen diagrams and the origin of the "floating islands" at the two lakes-Khajiar and Rewalsar.

The vegetational history as deduced on the basis of pollen profiles from Khajiar and Rewalsar, has been discussed separtely for each site. The few C-14 assays available from the upper levels of both the pollen profiles, establish the vegetational history, at each site, tentatively around 5,000 B.P. representing the later part of the Post-gtacial period.

Palynology and Stratigraphy of the Tura Formation in the Type Area

RAM YASH SINGH

The thesis deals with stratigraphic geology and palynology of the Tura Formation, exposed along the southern foot hills of the Garo Hills. Assam. The Tura Formation is a group of coal-bearing sandstones, lithomargic clays and shales. The presence of workable coal seems within the formation has aroused a good deal of geological interest in these strata. Although considerable geological information on Tura Formation is now available, yet its age and stratigraphic position continue to remain a subject of controversy.

The principal objectives of this study are to describe the palynological assemblage and microfioral zones of the Tura Formation and to discuss its age and stratigraphic position. The samples utilized are precisely located stratigraphically, and the biostratigraphic zones proposed are fairly well established. The marker species selected have limited vertical range and wide geographical distribution.

For the present study, Nongwal Bibra has been selected because of the well developed nature of the Tura Formation in this area. Although 9 measured sections form the main basis of erecting the stratigraphic succession of this area, the study has further been supplemented by taking a number of traverse sections from distally placed localities of the Garo Hills.

The first chapter deals with the physiography, drainage, climate, and accessibility, together with the fauna and flora of the area under consideration.

Chapter two incorporates the general geological setting of the Garo Hills. The oldest rock unit is the Archaean gneissic complex. In the extreme western corner of the area, near Halladayganj, a solitary patch of Lower Gondwana outcrop unconformably overlies the Archaeans. Similarly, the volcanic rocks (Sylhet trap) and the Upper Cretaceous sediments are exposed along the Jadukata River in the south-eastern extremity of the Garo Hills. Except for these small local developments, the Tura Formation (Lower Tertiary) is seen to unconformably overlie the metamorphics throughout the region. The Tura Formation is overlain by the Siju Limestone (Upper Eocene) which in turn is conformably succeeded by the Kopili alternations (Upper Eocene). The Kopilis are unconformably overlain by sediments of the Surma group. The youngest sediments of the area are the Dupitilas which unconformably overlie the Surmas.

Later, the stratigraphy of the Nongwal Bibra area has been dealt with in detail. About 5 sq. miles of the area has been geologically mapped and 9 sections have been measured. Finally, the structure of the above area has been discussed, based on available surface and subsurface data.

The third chapter has been confined to the taxonomy and morphology of the palynological fossils recovered from the Tura Formation. Altogether 110 morphological species, assignable to 68 form genera of spores, pollen microplanktons and epiphyllous fungi have been recorded. Of these 2 genera and 24 species are new.

In the last chapter data obtained from both organic and inorganic sediments have been analysed and interpreted. Palynostratigraphic findings indicate that the Tura Formation has been deposited under a transgressive phase of the sea. The microplankton assemblage from all the horizons of the formation indicate near shore brackish-water environment of deposition.

Qualitative and quantitative analyses of the miofloral assemblage clearly demontrate that the Tura Formation is palynologically divisible into four biostratigraphic zones. These are *Retialetes emendatus, Dandotiaspora telonata, Palmidites plicatus Nymphaeopollis assamicus* cenozones.

Biostratigraphic studies have shown that *Retialetes emendatus, Dandotiaspora telonata,* and *Palmidites plicatus* Cenozones of the Tura Formation closely correspond to the three biostratigraphic zones of the Cherra Formation (Dutta & Sah, 1970) lending support to the view that the former is synchronous with the latter. The upper palynological zone of the Tura Formation shows a close floral similarity with the Lakadong palynological assemblage of the Shillong Plateau, indicating that the two might be homotaxial.

Palynological, palaeontological and lithological evidences indicate that the lower tnree palynological zones of the Tura Formation are Palaeocene in age while the upper palynological zone is Lower Eocene. Thus the development of the Tura Formation in relation to the Palaeogene sediments of Shillong Plateau reveals that the former is a condensed representation of the latter.

IV. FIELD WORK

Excursions undertaken by the staff

Two members of Palaeozoic departments visited :

(i) *Daltonganj coalfield*—Samples were collected from Talchir stage of Sadabaha nalla for microfossil analysis.

(ii) *Auranga coalfield*—Megafossils and samples for microfossil analysis was collected from Talchir, Barakar, Raniganj and Panchet formations.

(iii) *South Karaupura coalfield*—Megafossils and samples for microfossil enalysis was collected from Barakar and Barren Measures formations.

(iv) *Ramkola coalfield*—Plant fossils and samples from the Lower Gondwana beds has been collected for study (jointly undertaken with Mesozoic department).

Five members of Palaeozoic department visited :

(i) *Raniganj coaldfield*—Megafossils from Barakar and Raniganj formations has been collected.

(ii) *Jharia coalfield*—Megafossils from Mahuda colliery (Raniganj formation) was collected.

Mesozoic of Madhya Pradesh

Three members of the Mesozoic department visited various localities in the Satpura Basin and Ramkola-Tatapani coalfields in the month of February, 1972. Numerous megafossils, viz., *Equisetites*, *Cladophlebis*, *Gleichenia*, *Hausmannia*, *Sphenopteris*, *Pachypteris*, *Glossopteris*, *Taeniopieris*, *Ctauis*, *Dictyozamites*, *Pteroph llum*, *Ptilophyllum*, *Pagiophyllum*, *Brachyphyllum*, *Desmiophyllum*, *Elatocladus* and *Araucarites* were collected. Many shale samples were also collected for palynological studies.

Deccan Intertrappean Series

Two members of the Tertiary Department visited the famous locality of Mohgaon Kalan in Chhindwara district and collected rich petrified material. They also traversed wide areas in the trap country near Chaurai and Markahandi—Udadon Railway station and discovered some palm woods.

From Mahurzari near Nagpur, a collection of fossil woods was also made.

Cuddalore Series and other Tertiary beds of South India

A member of the Tertiary Department undertook an excursion to Tamil Nadu and Kerala. He collected petrified woods from around Murattandichavadi near Pondicherry. He also made a preliminary survey of the the Tertiary rocks in Kerala, exposed on the western coast. Carbonized woods and leaf impressions were collected from Varkala, Sashtankotta, Kundra and Padappakara.

Siwalik Formation

One member from the Tertiary Department went on excursion to Siwalik beds exposed near Kathgodam and Punyagiri Hill near Tanakpur in the Dist. Naini Tal. He

made good collection of leaf impressions from these localities.

Two members of the Coal department visited the following coalfields :

Auranga Coalfield

Coal and shales exposed along Sukri River, Bagdaga Nala and Jagaldaga quarry have been systematically collected for palynological studies.

Daltonganj Coalfield

Talchir beds are exposed along Lobji Nala. 5 samples were collected for study of the mioflora.

Giridih Coalfield

A systematic collection of shale, coaly shale and coal has been done from Sookni Nala, Khakho Nala, Bhadua and Jatkuti hills in which a complete succession from Talchir to Barakar is expected. The samples have been collected for palynological studies.

West Raniganj Coalfield

(Pusai-Shyampur area)—samples have been systematically collected so as to represent a complete succession from Talchir—Barakar. Extensive collection has been done from Pusai, Sanbad and Khudia nalas.

Two members of the Coal department visited the following coal fields to study geological structure and collection of samples for Palynological analysis.

Shahpur Coalfield

Various coal and shale samples from the exposed sections of L. Gondwana rocks in Sukhi nala and Bhawra nala have been studied and collected.

Pench-Kanhan Coalfield

Collection of coal and shale samples from Talchir, Barakar and Motur rocks has been made from Kanhan and Pench river sections.

Parsapani-Ranipura

Probable Mesozoic and Palaeozoic coal and coaly shale samples from the above lacalities have been collected for palynological analysis.

Foreign Field Work—W. Germany

A member of Coal Department made an excursion to Mosel Valley and Dingdorf-Wettledorf region to collect Devonian material for Palynological work.

Gujarat

Samples for palynological investigation were collected from measured sections around Matanamadh, Panandhro, Nareda, Ber Mota and adjacent places in the district of Kutch, Gujarat. Matanamadh and the adjacent area was mapped geologically.

A field excursion was made to Meghalaya, Assam, Arunachal Pradesh and research material collected from the undermentioned localities :

Meghalaya

Tura Formation of Nongwalbibra, Songsak and Rongrenggiri in Garo Hills.

Eocene, Oligocene and Miocene sediments exposed along the Jowai-Badarpur road in United Khasi and Jaintia Hills.

Assam

Eocene succession of Garampani in North Cachar and Mikir Hills.

Baragolai and Tikak Parbat formations of the Namdang river.

Upper Tertiary succession of Tipangpani.

Arunachal Pradesh

Upper Tertiary sediments of Jaipur anticline.

Southern India

A visit to Pondicherry, Trichinopoly, Dalmiapuram, Sendurai, Virdhachalam, Quilon and Varkala was made to collected palynological samples. This was an attempt to collect grab samples to know precisely the productive horizons in the area.

West Coast

Three members of the Department of Quaternary Palynology undertook an excursion to the western coast and visited several localities in the suburbs of Ahmedabad (Nalsarover) and Surat (Malwan, and Dumas). Surface samples and samples for C14 dating were collected in addition to five profiles for pollen analytical investigation.

Bengal

Two members of the Department of Quaternary Palynology surveyed the Gangetic plains of the Bengal basin and collected surface samples and samples for C14 dating in addition to four profiles for pollen analysis from Uluberia and Kolara in W. Calcutta and Namkhana in S. E. Calcutta.

Allahabad and Mirzapur

A member of the Department of Quaternary Palynology visited river sections along the Belon and Ganga rivers in Allahabad and several rockshelters in Mirzapur district and examined the Pleistocene and Holocene succession of strata and the cultural remains preserved in them. Materials for pollen analysis were also collected.

V. TRAINING PROVIDED TO OUTSIDERS

Training was provided in techniques and research to the following persons.

(i) Mr. R. C. Khare	—	Geology Department, Benaras Hindu University Benaras.
(ii) Dr. Ma Khin Sein	—	Colombo Plan Research Trainee from Burma.
(iii) Mr. V. Jhingran	—	Lecturer, Department of Geology, Delhi University, Delhi.
(iv) Km. Statira Guzder	—	Deccan College, Poona.

VI. TECHNICAL ASSISTANCE TO OUTSIDERS

1.	On the nature and composition of Kutch lignite.	—	Directorate of Geology & Mining, Gujarat Pradesh,
2.	Identification of fossil wood from the Deccan Intertrappean beds and consultation of literature.	—	Mr. R, C. Khattri. Lecturer, Govt. Degree College, Indore M. P.
3.	Palynological advices	—	Oil India Limited, Duliajan, Assam.
4.	Advice on identification of fossil woods and other plant material from the Deccan Intertrappean beds.	— —	Mr. L. C. Singhai, Lecturer, Govt. Degree College, Jagdalpur, Bastar, M. P.
5.	Archaeobotanical Materials from Palanau Bag, N. Luzon.	—	Prof. Wilhelm G. Solheim. Department of Anthropology University of Hawaii, Honolulu.

6.	Non-Nok Tha NW of Khon Kaun N. W. Thailand	}	
7.	Soil samples for pollen analysis	—	Superintendent Archaeology Safdarganj Gate House, New Delhi.
8.	Archaeobotanical material from Inamgaon	—	Prof. H. D. Sankalia. Deccan College, Poona.
9.	Modern Seed Samples of cultivated plants grown by tribal people in Orissa	—	Dr. Norman H. Zide, 4, Jaipur Estate Nizamuddin East, New Delhi
10.	Soil samples and archaeobotanic materials from Afghanistan.		Prof. L. Dupree, Director, Archaeological Mission of the American Museum of Natural History in Afghanistan Post Office Box 3037, Kabul
11.	Information on Archaeobotany	—	Prof. R. C. Whyte, 1604, Star House, Harbour Centre, Kowloon, Hongkong
12.	Sample for pollen analysis from Rajasthan	—	Dr. KTH Hegde, Department of Archaeology, Gujarat University Baroda
13.	Bricks bearing impression of food grains.	—	Mr. M. C. Joshi, Superintending Archaeologist, Archaeological Survey of India, New Delhi.

VII. SPONSORED/COLLABORATIVE RESEARCH

The following collaborative research projects have been undertaken by the Department of Mesozoic Palaeobotany.

1. Palynological investigation of the shale samples from the Triassic of Germany (Bundsandstein) (in collaboration with Coal Department).

2. *Sporae dispersae* from Zaire (in collaboration with the Department of Oil Palynology).

Tertiary Department undertook study of fossil woods from the Tertiary of South Bohemia with the Palaeontology Department, National Museum. Praha, Czechoslovakia.

Different Research projects undertaken by the Coal Department with other Universities and Institutions are in progress (For details Annual Report 1970-71, Birbal Sahni Institute of Palaeobotany).

The Oil Department undertook palynostratigraphical studies of the Tertiary surface and subsurfaces rocks of Upper Assam (Project sponsored by Oil India Ltd., Duliajan.)

Following research projects have been undertaken by Oil Department.

1. The palynological investigations of the Palaeogene sediments of the Shillong Plateau in collaboration with Department of Applied Geology, Dibrugarh University, Assam.

2. Palynology of successive Mesaverde coals near receding shorelines of the Mancos (Upper Cretaceous) Sea, U.S.A. with the Geology Department, Michigan State University, E. Lansing, U. S. A.

In collaboration with Campagnie Francsaise des Petroles, Bordeaux, France the following projects were started in the Oil Department ;

(a) Palynostratigraphy of Libyan Basin, N. W. Africa
(i) Carboniferous Palynology

(ii) Permo-Triassic palynology (completed).

(b) Palaeopalynology of Bedouri Bore Hole, Queensland, Australia.

(c) Microplankton study of Senegal Basin (partially completed).

Following research projects have been undertaken by the Department of Quaternary Palynology with Universities and Institutions.

1. Vegetational history and environmental Archaeology of Marine-Madh Islands. Bombay and Kutch with Tata Institute of Fundamental Research Bombay and Deccan College, Poona.

2. Pollen allergy with Departments of Pharmacology and Tuberculosis of the King George Medical College, Lucknow.

3. Environmental history of Malwan, Gujarat with Archaeological Survey of India and Dr. F. R. Allchin of Cambridge University, U. K.

VIII. PAPERS AND LECTURES AT SYMPOSIA/ CONFERENCES/MEETINGS ETC.

1.	Studies in the Glossopteris flora of India—Fossil plants and miospores from the Karharbari beds of the Jayanti Coalfield, Bihar	K.M. Lele & R. Makada	Palaeobotanical Conference. Birbal Sahni Institute of Palaeobotany Silver Jubilee 1971 December Lucknow

2.	Studies in the Talchir flora of India 8, Miospores from the Talchir Boulder Bed and overlying Needle Shale in the Johilla Coalfield (M. P.)	K.M. Lele & A. Chandra	–do–
3.	The Lower Gondwana Plants and their stratigraphic significance	P. K. Maithy	International Carboniferous Congress, Krefeld
4.	Some Lower Triassic plant remains from Deobar, Auranga river valley	Jayasri Banerji	B. S. I. P. Silver Jubilee palaeobotanical Conference
5.	Palynostratigraphy of Indian Lower Gondwana	Hari K. Maheshwari	Geological Institute Academy of Sciences of U. S. S. R. Moscow.
6.	Palynology across Raniganj Panchet sediments near Asansol, Raniganj Coalfield, Bengal	Hari K. Maheshwari & Jayasri Banerji	B.S.I.P. Silver Jubilee Palaeobotanical Conference, Stratigraphy Symposium
7.	New data on Cladostrobus Zalessky with a discussion on the systematics of cordaitalean leaves	Hari K. Maheshwari & S. V. Meyen	do

8.	Floristic evidence on the age of Gondwana beds near Nidpur. Sidhi District, Madhya Pradesh	Shyam C. Srivastava	do
9.	The flora of the Jabalpur Series	Sukh Dev	do
10.	On some conifer remains from Bansa, South Rewa Gondwana Basin	Sukh Dev & M. N. Bose	do
11.	Geological History of Dipterocarpaceae	R.N. Lakhanpal	do
12.	Age and environment : An analysis of Tertiary floral changes of India	U. Prakash	do
13.	Occurrence of some new dipterocarpacous woods in the Cuddalore series of South India	N. Awasthi	do
14.	Permian Palynostratigraphy in India	D. C. Bharadwaj	III Internatioal Palynological Conference, Novosibirsk, U.S.S.R.

15.	The nature, prevalence and significance of striations in gymnospermous sporae dispersae	D. C. Bharadwaj	B.S.I.P. Silver Jubilee Palaeobotanical Conference
16.	On the classification of gymnospermous Sporae dispersae	D. C. Bharadwaj	do.
17.	A Devonian mioflora from P'oshi Distt. (Yunnan) China	D. C. Bharadwaj, B.S. Venkatachala & R. S. Tiwari	do.
18.	Subsurface palynological succession in the borehole NCKB–19, Korba Coalfield, M. P.	D. C. Bharadwaj & Suresh Srivastava	do.
19.	Some observation on the Nomenclature and classification of coals.	G. K. B. Navale	Int. Nomencl. and Classific. of coals, Krefeld
20.	A comparative study of fossil plant remains from Neyvoli lignite	G. K. B. Navale	do.
21.	Miofloral succession in the African Lower Gondwanas.	R. S. Tewari	III International Palynological Conference, Novosibirsk, U. S. S. R.

22.	On some Nomenclatural problems concerning sporae dispersae.	R. S. Tiwari	B. S. I. P. Silver Jubilee Palaeobotanical Conference.
23.	The Sporae dispersae of Jabalpur Stage, Upper Gondwana, India.	Pramod Kumar	do.
24.	Palynological biostratigraphy of the Tura Formation in the Type Area.	S. C. D. Sah & R. Y. Singh	do.
25.	Palynological demarcation of the Eocene-Oligocene sediments in the Jowai-Badarpur Road.	S. C. D. Sah & M. K. Sein	do.
26.	Palynostratigraphy of the sedimentary formations of Assam. Biostratigraphic zonation of the Cherra Formation of South Shillong Plateau.	S. C. D. Sah & S. K. Dutta	do.

27.	Palynostratigraphy of the sedimentary formations of Assam-4. Age of the Laitryngew-Mawkma coal bearing sandstones and their relationship with Cherra Formation.	S. C. D. Sah & S. K. Dutta	B. S. I. P. Silver Jubilee Palaeobotanical Conference
28.	Palynology of the Tertiary of Palana, Rajasthan	S. C. D. Sah & R. K. Kar	do.
29.	Palynology of successive Mesaverde coals near receding shorelines of the Mancos (Upper Cretaceous) sea, U. S. A.	H. P. Singh & A. T. Cross	do.
30.	Cretaceous microplanktons from Senegal Basin, N. W. Africa—Some new genera, species and new combinations.	K. P. Jain	do.

31.	Palynological delimitation of the Lower Gondwanas in the North Karanpura sedimentary Basin, India.	R. K. Kar	B. S. I. P. Silver Jubilee Palaeobotanical Conference.
32.	Palynostratigraphic correlation of the Palaeogene sediments of Shillong Plateau and Garo Hills, Assam.	S. C. D. Sah	Geological Institute, Moscow, U. S. S. R.
33.	Palynostratigraphic evaluation of the Lower Escene sediments of India.	S. C. D. Sah	do.
34.	Palynological demarcation of the Cretaceous Tertiary boundary in India.	S. C. D. Sah	Geological Institute, Leningrad, U. S. S. R.
35.	On the morphology, taxonomy of spores—pollen, seeds, microplanktons, nannoplanktons and calcareous algae.	S. C. D. Sah	Department of Geology, (M.Sc. Pt. II), Delhi University.

36.	On the characteristic palynological taxa in the geologic time with particular reference to India.	S. C. D. Sah	Department of Geology, (M.Sc. Pt. II) Delhi University.
37.	Role of palynology in Coal and Oil exploration.	S. C. D. Sah	do.
38.	Cereal Vs non-cereal grass pollen in India. The inference of past agriculture.	Vishnu-Mittre	III International Palynological conference, Novosibirsk, U.S.S.R.
39.	The Lower Karewas	Vishnu-Mittre	do.
40.	Problems concerning Polien analysis in Tropics.	Vishnu-Mittre	do.
41.	Quaternary Palaeobotany and Palynology in India—An Appraisement.	Vishnu-Mittre	B. S. I. P. Silver Jubilee Palaeobotanical Conference.
42.	Neolithic plant economy at Chirand.	Vishnu-Mittre	do.
43.	The early domestication of Plants in South and South-East Asia.	Vishnu-Mittre & S. Guzder	do.

44.	Stratigraphy and pollenanalytical investigations of the Mangrove swamps in Bombay and Salsette Islands.	Vishnu-Mittre & S. Guzder	B. S. I. P. Silver Jubilee Palaeobotanical Conference.
45.	Pollen analysis of impression bearing sediments in the Lower Karewa.	Vishnu-Mittre & R. D. Robert	do.
46.	Pollen analysis of Malwan, Gujarat.	Vishnu-Mittre & C. Sharma.	do.
47.	Airborne pollen and fungal spores of Lucknow during 1969-70.	Vishnu-Mittre & A. Khandelwal	do.
48.	Palynology of *Holoptelea integrifolia* Planch.	A. Khandelwal & Vishnu-Mittre	do.
49.	Quaternary vegetational history of Ootacamund, Nilgiris, South India.	H. P. Gupta	do.
50.	Studies in Late Quaternary Vegetational history of Himachal Pradesh.	C. Sharma	do.

51.	An Introduction to Archaeobotany.	Vishnu-Mittre	Botanical Association, D.A.V. (Postgraduate) College, Dehra Dun.
52.	Cultural and environmental evolution in the Belon River Valley, Allahabad.	Vishnu-Mittre	Botany Department, Allahabad University.
53.	An Introduction to environmental Archaeology.	Vishnu-Mittre	Department of Ancient Indian History and Archaeology, Allahabad University
54.	Synthesis of Scientific knowledge.	Vishnu-Mittre	Science Association, B. B. Degree College, Jhansi.

IX. DEPUTATION/TRAINING/STUDY ABROAD

1.	Dr. D. C. Bharadwaj	U. S. S. R., Novosibirsk, to attend III International Palynological Congress.
2.	Dr. Vishnu-Mittre	U. S. S. R., Novosibirsk, to attend III International Palynological Congress.
3.	Dr. S. C. D. Sah	U. S. S. R., Moscow and Leningrad (Under Indo-Soviet Cultural Exchange Programme).

4.	Dr. H. K. Maheshwari	U. S. S. R., Moscow and Leningrad (Under Indo-Soviet Cultural Exchange Programme).
5.	Dr. P. K. Maithy	West Germany, Bonn Institute for Palaontologie (under DAAD Scholarship).
6.	Dr. R. S. Tiwari	West Germany, Frankfurt Forchungs-Institute Senckenberg (Under A.von Humboldt Fellowship).

X. HONOURS AND AWARDS

1.	Mr. Pramod Kumar	"Palynological Studies on some Mesozoic coals of India" (Ph.D. Lucknow University).
2.	Mrs. Chhaya Sharma	"Studies in the Late Quaternary Vegetational history in Himachal Pradesh" (Ph.D Lucknow University).
3.	Mr. R. Y. Singh	"Stratigraphy and Palynology of the Tura Formation in the Type Area" (Ph.D Lucknow University).
4.	Mr. Anil Chandra	"Stratigraphical and Palaeobotanical contributions to the Lower Gondwana formations of South Rewa Gondwana Basin, Madhya Pradesh"

XI. FOUNDERS DAY

Wreaths and flowers were placed on the Samadhi of Professor Birbal Sahni, F. R. S. on 14th November, 1971.

XII REPRESENTATION ON COMMITTEES/ BOARDS

1. Dr. K. R. Surange	Member, Executive Committee, World Organization of Palaeobotany.
	Secretary, Editorial Board, "*The Palaeobotanist*".
	Member of the Sectional Committee VI. of Indian National Science Academy.
	Member, Editorial Board, "Geophytology".
2. Dr. R N. Lakhanpal	Chief Editor "Geophytology". Member, Editorial Board, "The Palaeobotanist".
	Member, Editorial Board, Journal of the Palaeontological Society of India.
3. Dr. D. C. Bharadwaj	Vice-President, International Committee on Palynology.
	Secretary, Subcommission on spores, International Commission on Palaeozoic microfloras.
	Member, International Commission on Carboniferous Stratigraphy of I. U. G. S.
	Convener, Permian Stratigraphy in the International Commission on Palaeozoic microfloras. Secretary, Palaeobotanical Society.

		Member, Editorial Boards of 'Review of Palaeobotany and Palynology', 'Palaeobotanist, and 'Geophytology'. Chairman of Organizing Committee 4th International Palynological Conference, Lucknow (1975).
4.	Dr. M. N. Bose	Member, Editorial Board, "*The Palaeobotanist*". Vice-President, J. Sen Memorial Committee.
5.	Dr. Vishnu-Mittre	Member, Indian Radio-Carbon Dating Committee, Tata Institute of Fundamental Research, Bombay. Member, Executive Council, Indian Quaternary Research Society. Member, Palaeobotanical Society.
6.	Dr. U. Prakash	Member, International Association of Wood Anatomists.
7.	Dr. K. P. Jain	Joint Secretary, Palaeobotanical Society.
8.	Dr. H. K. Maheshwari	Member, Editorial Board, "Geophytology".

XIII. PUBLICATIONS

1. The Journal—**The Palaeobotanist**

During the year the following numbers of the Palaeobotanist were published.

(*a*) Nos. 1 & 2 of Vol. 19.

(*b*) Nos. 3 of Vol. 19 & 1 of Vol. 20 were sent to the Press.

2. Seward Memorial Lecture

The XVII Sir Albert Charles Seward Memorial Lecture was received from the Press. The XVIII Lecture entitled "The Jurassic flora of the Rajmahal Hills" by Prof. A. R. Rao was printed.

3. Sale

During 1971-72 an income of Rs. 17,336 was registered from sale proceeds of Institute's publications. This sum includes the following foreign exchange earned.

US $ —Rs. 1,246.15

£ — 47.95

XIV. LIBRARY

1. Books

Number of books added during the year	78
Total number of books as on 31.3.72	2532

2. Journals

Number of issues of journals received during the year.	188
Total number of issues of journals as on 31.3.72.	5488
New Journals subscribed.	1

3. Reprints

Number of reprints received during the year.	1077
Total number of reprints as on 31.3.72	20,698

4. Microfilms

Total number of microfilms as on 31-3-72.	153

5. **Exchange**

Number of papers purchased for exchange.	24
Number of papers received as gifts.	2
Total number of reprints sent out on exchange.	504
Number of individuals on exchange.	32
Number of institutions on exchange.	61
Sets of papers of Prof. Birbal Sahni sent out.	9

6. **Request for exchange received from the following:—**

1. Head of Department,
   Dibrugarh University Department of Applied Geology, Dibrugarh, Assam.

2. Czechoslovakia Akademia Ved, Geologicky Ustav, Library, Dittrichova 3, Praha-2.

7. As in other years a number of research students and scientists who visited the Institute took the opportunity to consult the latest literature in the Library. Books and Journals were loaned to the Geological Survey of India, Lucknow; Bose Institute, Calcutta; Lucknow Uuiversity, Botany Department and Geology Department, Lucknow; Allahabad University, Botany Department, Allahabad; Indian National Physical Laboratory, (Insdoc) Delhi; Maharashtra Institute of Fundamental Research, Poona; and Government Degree College, Jagdalpur (Bastar), M. P.

The visiting Palaeobotanists and other delegates attending the Palaeobotanical Conference in December, 1971 on the occasion of the Silver Jubilee of the Institute evinced keen interest in the Library especially in the Institute's publications and in the latest palaeobotanical literature. Some of the eminent palaeobotanists of the world as well as lecturers and Post-graduate students of the various Indian Universities who came to attend the lectures and seminar series made the most of their visit here by spending the

maximum available time in the consultation of library literature.

New arrivals were displayed in the Library on every Monday.

XV. EXHIBITION HALLS

1. *Botany Hall*

(1) Total number of specimens displayed-359.

(2) This hall has been completely changed by exhibiting exclusively Indian megafossils representing all horizons from Cuddapah system (Pre Cambrian) up to the Karewas (Quaternary) Apart from mega fossils, typical miospores assemblages and other plant micro remains from different horizons have simultaneously been shown by photographs. Each show case has been provided with legends about mega-microfloras and the stratigraphical back ground of each horizon. Important localities of particular horizon have been shown in each show case.

(3) All the specimens, have been provided with new printed labels.

(4) Prof. Sahni's selected figured specimens have been displayed on two wall show-cases.

(5) New linen clothes have been fixed in all the show-cases.

(6) A chart showing the General Geological succession in different parts of Indian sub-continent and another showing correlation of Gondwana formations of India painted on two hard-boards have been fixed up on the hall.

(7) The geological map of India on Ply-board has been put on the wall.

(8) All the show-cases are distinct with new display (Plastic) plates depicting Indian horizons along with equivalents on Standard Scale.

2. *Geological Hall*

(1) Total number of specimens 567.

(2) Old palaeogeographical maps have been replaced by the latest improved palaeogeographical maps (13) of the world.

(3) Latest figures of absolute age have been filled up in the Geological column and the Geological clock.

(4) Some legends and labels have been replaced by new ones.

3. *Fossil Stores Room*

Catalogued specimens as on 31-3-72	44,785
Specimens from foreign countries as on 31-3-72.	978
Number of types and figured specimens as on 31-3-72.	1,028
Number of figured slides as on 31-3-72	4,437
Number of Negatives as on 31-3-72.	3,065

New additions made during the year :—

A total number of 1381 localities have been traversed by the Institute staff.

Palaeozoic specimens	1,569
Mesozoic specimens	476
Tertiary specimens	988
Coal Samples	259
Oil Samples	289
Quaternary Samples	169
	3,750

4. *Specimens presented to the Institute*

(1) Five plant fossils of permian age by Mr. A.V. Lapo, Moscow.

(2) An animal fossil by Prof. T. Kamei, Department of Mines and Geology, Faculty of Science, Kyoto University, Kyoto, Japan.

(3) A fossil of *Azolla primaeva* from near Princeton in B.C. Canada of Palaeocene age by Dr. C.G.K. Ramanujam.

XVI. HERBARIUM

1. *Woods*

Addition of wood slides during the year	121
Total number of wood slides as on 31.3.72.	1,765
Total number of wood samples as on 31.3.72.	2,327

2. *Fruits and Seeds*

Addition of fruits and seeds during the year	50
Total number of fruits and seeds as on 31.3.72.	676

3. *Herbarium Specimens*

Addition of plant specimens by collection during the year.	750
Addition of plant specimens by gift	223
Total number of plant specimens registered as on 31.3.72.	8,988

4. *Pollen Slides*

Total number of pollen slides as on 31.3.72.	7,540
Other Slides.	4,632

5. *General*

In the year 1971-72 three excursions were held two for the collection of living plants and one for indentification of plant material. One member of the herbarium went on excursion to Ootacamund, Tamil Nadu in the month of April, 1971 and a good collection of herbarium material, woods fruits and seeds from Wellington, Coonoor, Paikara, Palada, Dodabetta, Upper Bhawani and Kotagiri road was brought.

In the month of March, 1972 a party from the herbarium consisting of two members of herbarium went to the Forest Research Institute, Dehra Dun to consult the herbarium and identify the material of old collection in order to clear some of the back-log of the herbarium stock. Collection of plant specimens, fruits and seeds from the neighbourhood of Dehra Dun was also carried out during the stay.

On 31st March, 1972 a party from the herbarium proceeded for plant collection alongwith a party from Tertiary Palaeobotany Department to Haldwani and Tanakpur forests.

Dr. H. A. Khan presented 15 plant specimens, fruits and seeds from Naini Tal. Dr. (Mrs.) M. K. Sein presented 103 unmounted plant specimens to the herbarium which are collected from Assam. A set of 100 plant specimens was received on exchange from Institute of Science, Nagpur. Mounted wood slides were received from Tertiary Palaeobotany Department for incorporation in the Xylarium.

33 Volumes of Index nominum genericorum was received from the Institute Library; these cards were arranged alphabetically for the use of checking recent nomenclature of living and fossil plants.

As per recommendation of the Herbarium Advisory Committee the pollen slides in stock were arranged alphabetically. A separate reference collection has been kept in the slide cabinets for consultation only. The duplicate pollen slides were separated for loan and exchange purposes. The identified palm material gifted by Professor K. N. Kaul has been arranged alphabetically, Poisoning of the herbarium specimens was carried out and the sheets were changed and labelled where ever found necessary. The plant specimens collected during the preceding years by various parties from different parts of the country were sorted out for identification.

XVII. BUILDING

In view of Silver Jubilee Session, special arrangements were made for distempering of Institute Building.

Due to floods, and rise in water level Institute Basement remained in water for complete 6 months. A Diesel pumping Set was purchased for taking out water from the basement. Estimates has been got prepared for the construction of the following :

1. 6 Laboratory rooms on the first floor
2. C-14 Laboratory
3. Reflooring of basement and Library and Palaeozoic Laboratory.

One Soakpit has been constructed behind the new building to take out the water from the basement and arrangements are being made for putting permanently Diesel Pumping Set there.

2. *Garden*

A good number of plants were acquired for the Institute's garden either through donations or purchases.

By Donations	50
Purchased	69

Special decorations of the Institute's campus was made during Silver Jubilee Celebrations of the Institute.

About 50 roses have been propagated in the Institute's campus by means of budding. Besides 45 other plants have also been developed in the garden.

XVIII VISITORS

1. *Distinguished persons*

Mr. Ramesh Dutt Sharma, Editor, "Kheti" New Delhi.	26 6.71
Mr. Tadao Kamei, Kyoto University, Japan.	1.11.71
Mr. Takuo Yokoyama Doshisha, University Kyoto, Japan.	1.11.71
Dr. Prof. F. P. Jonker, Botanical Museum and Herbarium Section of Palaeobotany and Palynology Utrecht, Netherlands.	4.12.71
Mrs. Jonker C/o Dr. F. P. Jonker, Botanical Museum and Herbarium Section of Palaeobotany and Palynology Utrecht, Netherlands.	4.12.71
Prof. and Mrs. A. T. Cross, Lansing, Mich. U. S. A. Michigan University.	4.12.71
Mr. A. Wesley, University of Leeds, England.	6.12.71
Mr. S. Sambe Gowda, Bangalore University, Bangalore.	7.12.71
Mr. B. B. Joshi, University of Allahabad, Allahabad.	16.12.71
Mr. Annapurna Char	31.1.72
Mr. Deshik Char	31.1.72

2. *Educational and other Institutions*

Students and teachers of the following Institutions visited the Museum and the Institute :

Department of Botany, Christ Church College, Kanpur.

Department of Geology, Lucknow University, Lucknow.

Department of Botany, University of Jodhpur.

Department of Botany, University of Burdwan, Burdwan.

Science Department, Regional College of Education, Ajmer.

Department of Botany Nagpur University, Nagpur.

Department of Botany, Cotton College, Gauhati.

Biology Department, Government Girls Inter College, Kotdwara.

Birla Vidya Mandir, Naini Tal.

XIX. THE GOVERNING BODY & THE FINANCE COMMITTEE

1. *The Governing Body*

CHAIRMAN

Professor T. S. Sadasivan,
Director,
Centre for Advanced Studies in Mycology and Plant Pathology, University Botany Laboratory,
Madras-5

MEMBERS

Mrs. Savitri Sahni,
686, Birbal Sahni Marg,
Lucknow
(For her life time)

Dr. R. V. Sitholey,
Assistant Director,
National Botanic Gardens,
Lucknow

Professor S. C. Agarwala,
Head of the Botany Department,
Lucknow University,
Lucknow

Dr. K. Subramanyam,
Director,
Botanical Survey of India,
14, Madan Street,
Calcutta 13

Professor A. G. Jhingran,
Head of the Geology Department,
Delhi University,
Delhi

Mr. M. S. Balasundaram,
Director-General,
Geological Survey of India,
Calcutta-13

Professor D. D. Pant,
Head of the Botany Department,
Allahabad University.
Allahabad

Mr. A. J. Kidwai,
Addl. Secretary to the Govt. of India,
Department of Science and Technology,
Yojana Bhavan,
New Delhi.

Professor A. R. Rao,
No. 2, IX Main Road, IIIrd Block,
East Jayanagar,
Bangalore-11

Professor Sripadrao Kilpady,
1-2-8/8 Street No. 1, Himayat Nagar,
P. O. Hyderabad-29,
Hyderabad.

Professor K. R. Surange,
Director,
Birbal Sahni Institute of Palaeobotany,
Lucknow
(Member Secretary)

Mr. R. K. Khare,
Registrar,
Birbal Sahni Institute of Palaeobotany,
Lucknow
(Non-Member Assistant Secretary).

2. *Finance Committee*

CHAIRMAN

Professor T. S. Sadasivan,
Director,
Centre for Avanced Studies in Mycology and
Plant Pathology, Univ. Botany Laboratory,
Madras-5

MEMBERS

Professor S. C. Agarwala,
Head of the Botany Department,
Lucknow University,
Lucknow

Professor K. R. Surange,
Director,
Birbal Sahni Institute of Palaeobotany,
Lucknow

XX. THE STAFF

Director

Professor K. R. Surange, M. Sc., Ph. D. (Lucknow),
Ph. D. (Cantab), F. Pb. S., F. N. I.

Department of Palaeozoic Palaeobotany

Dr. K. M. Lele, M. Sc., Ph. D.

Dr. P. K. Maithy, M. Sc., Ph. D.
Dr. Mrs. Shaila Chandra, M. Sc., Ph. D.
Dr. Mrs. Rehana Makada M. Sc., Ph. D.
Dr. Anil Chandra, M. Sc., Ph. D. upto 30.7.71,
Mr. A. K. Srivastava, M. Sc. (Research Scholar)

Department of Mesozoic Palaeobotany

Dr. M. N. Bose, M. Sc., Ph. D., F. Pb. S. Head
Correspondant de l 'arsom
Dr. Sukh Dev, M. Sc. (Hons.), Ph. D. (Lucknow),
Ph. D. (Reading).
Dr. H. K. Maheshwari, M. Sc., Ph. D.
Dr. Shyam Chandra Srivastava, M. Sc., Ph. D.
Miss J. Banerjee, M. Sc. (Research Scholar upto 27.12.71). Since 28.12.71 Junior Scientific Assistant.

Department of Tertiary Palaeobotany

Dr. R. N. Lakhanpal, M. Sc., Ph. D., F. B. S., Head
F. Pb. S., F. N. A. Sc.
Dr. U. Prakash, M. Sc., Ph. D.
Dr. N. Awasthi, M. Sc., Ph. D.
Miss S. Pant, M. Sc. (Research Scholar upto 27.12.71) Since 28.12.71 Junior Scientific Assistant.

Department of Coal Palaeobotany

Dr. D. C. Bharadwaj, M. Sc., Ph. D. (Lucknow) Head
Dr. rer Nat. (Bonn), F. B. S., F. Pb. S.
Dr. G. K. B. Navale, M. Sc., Ph. D., F. G. S.,
F G. M. S.
Dr. R. S. Tiwari M. Sc., Ph. D.
Dr. Suresh Chandra Srivastava, M. Sc., Ph. D.
Dr. Anand Prakash, M. Sc., Ph. D.
Dr. Pramod Kumar, M. Sc., Ph. D.
Mr. B. K. Misra, M. Sc. (Research Scholar upto 27.12.71) Since 28.12.71 Junior Scientific Assistant.
Miss Archana Dwivedi M. Sc. (Junior Scientific Assistant from 22.3.72)

Department of Quaternary Palaeobotany

Dr. Vishnu-Mittre, M. Sc., Ph. D. (Lucknow) Head
Ph. D. (Cantab)
Dr. H. P. Gupta, M. Sc., Ph. D.
Dr. Mrs. Chhaya, Sharma, M. Sc., Ph. D.
Miss Asha Khandelwal M. Sc. (Research Scholar upto 27.12.71) Since 28.12.71 Junior Scientific Assistant.

Department of Oil Palynology

Dr. S. C. D. Sah, M. Sc., Ph. D. Head
Dr. Haripal Singh, M. Sc., Ph. D.
Dr. K. P. Jain, M. Sc., Ph. D.
Dr. R. K. Kar, M. Sc., Ph. D.
Dr. R. Y. Singh, M. Sc., Ph. D.
Mr. R. K. Saxena, M. Sc. (Research Scholar upto 28.12.71) Since 29.12.71 Junior Scientific Assistant.

Department of Geology

Mr. N. C. Mehrotra, M. Sc. from 24.3.72.

Administration

Mr. R. K. Khare (Registrar)
Mr. V. P. Gulati (Deputy Registrar)
Mr. S. D. Mehtani (Office Assistant)
Mr. S. K. Suri (Stenographer)
Mr. S. P. Chadha (P. A. to Director)
Mrs. P. K. Srivastava (Receptionist)
Mr. H. S. Srivastava (U. D. C.)
Mr. Bhagwan Singh (U. D. C.)
Mr. Ramesh Chandra (L. D. C.)
Mr. I. J. Mehra (Steno-typist) upto 21.2.72 from 22.2.72 Store-Keeper
Mr. I. J. Singh Bedi (Steno-typist)
Mr. Ayodhya Nath Steno-typist) upto 27.8.71
Mr. Anand Prakash (Steno-typist) from 6.11.71

Accounts

Mr. Ghanshyam Singh (Accounts Officer)
Mr. S. B. Verma (Accountant)
Mr. T. N. Shukla (U. D. C.)
Mr. B. K. Jain (U. D. C.)
Mr. I. J. Mehra (L. D. C.)
Mr. N. N, Joshi (L. D. C.)
Mr. R. K. Takru (L. D. C.)

Publication

Mr. N. N. Moitra (Publication Incharge)

Library

Mr. J. N. Nigam (Library Assistant) upto 20.3.72
Librarian since 21.3.72

Museum

Dr. Anil Chandra, M.Sc., Ph.D. (Museum Curator) from 31.7.71
Mr. T. S. Mohan Shankar (Museum Assistant)
Mr. N. C. Saxena (Junior Museum Assistant)

Herbarium

Dr. H. A. Khan, M.Sc., Ph.D. (Curator)
Mr. G. P. Srivastava (Herbarium Incharge)
Mr. J. C. Srivastava (Herbarium Assistant)

Laboratory Services

Mr. R. C. Gupta (Junior Technical Assistant) on leave with lien upto 16.3.73
Miss Asha Bhardwaj (Junior Technical Assistant)
Miss M. Chowdury ,,
Miss Indra Kumari ,,
Mr. H. N. Boral ,,
Mr. Rajbir Singh ,,

Mr. D. C. Joshi (Junior Technical Assistant)
(Scheme "Palynological Studies from
Oil India Ltd.) from 18.6.71
Mr. N. K. Khasnavis (Laboratory Assistant)

Photography & Drawing

Mr. M. N. Takru (Artist) upto 16.7.71
Mr. S. S. Rana (Artist) from 20.10.71
Mr. P. C. Roy (Photographer)

XXI. BUDGET 1971-72

Head	Actual Expenditure (Rupees in Lakhs approx.)
1. Plan	
(*i*) *Recurring*	
Pay of Officers	0.747
Dearness Pay of Officers	0.099
Pay of Establishment	0.187
Dearness Pay of Establishment	0.101
Provident Fund Contribution	0.068
Allowances and Honoraria	0.309
Maintenance of Vehicles	0.023
Contingencies	0.232
Total	1.766
(*ii*) *Capital*	
Apparatus & Equipment	0.380
Services Ancillary to Research	0.560
Building & Garden	0.070
Furniture & other requirements	0.020
Total	1.030

2. Non-Plan

Recurring

Pay of Officers	1.763
Dearness Pay of Officers	0.157
Pay of Establishment	1.176
Dearness Pay of Establishment	0.529
Provident Fund Contribution	0.281
Allowances & Honoraria	1.209
Contingencies	1.142
Maintenance	0.108
Chemical & Apparatus	0.156
Total	6.523