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PRECAMBRIAN AND PALAEOZOIC FLORAS FROM THE HIMALAYA: A REVIEW*

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ABSTRACT

Records of organo-sedimentary structures and microbiota from Precambrians and mega- and micro-flora from the Early and Late Palaeozoic of the Himalaya are reviewed with a brief discussion on the problems and future prospects in the area.

Key-words — Microbiota, Organo-sedimentary structures, Precambrian, Palaeozoic, India.

सारांश

हिमालय से कॅम्ब्रिय-पूर्व एवं पुराजीवी वनस्पतिजात : एक समीक्षा – केशव मुकुन्द लेले एवं प्रभात कुमार माइती

हिमालय के कॅम्ब्रिय-पूर्व से कार्बनिक-अवसादीय संरचनायें एवं सूक्ष्म-जीविता तथा प्रारंभिक एवं उत्तर पुराजीवी से गुरु एवं सूक्ष्म-वनस्पतिजात के अभिलेखों का वर्णन किया गया है। इस क्षेत्र में भावी अन्वेषणों तथा समस्याओं पर एक संक्षिप्त विवेचन भी दिया गया है।

INTRODUCTION

RECORDS of fossil floras from the Precambrian and early Palaeozoic of extra-Peninsula (Himalayas) are scanty. Nevertheless the records of early Palaeozoic are very significant as no where else in India the early Palaeozoic floras are known to occur. Thus, extra-Peninsula has a special significance for the early Palaeozoic floras. In recent years more reliable and better evidence has been obtained which raises the potential of the region for investigation of Precambrian and early Palaeozoic fossils.

Late Palaeozoic floras are also found in the extra-Peninsula which are mainly of *Glossopteris* composition. Stray records of *Glossopteris* are known from several places along the foot hills of Himalaya, i.e. from Kashmir to Arunachal Pradesh, which show the former extension of Gondwana continent up to the Tethyan coast. Sometimes the elements of possible non-Gondwana affinities have also been found. The phytogeographic and floral relationships in Permian between the Indian Gondwana and the contemporary floral provinces thus become highly interesting.

PRECAMBRIAN

Organo-sedimentary structures and microbiota have been reported from Himalayas.

STROMATOLITES

Occurrences of stromatolites in Lesser Himalayan region have been reviewed recently by Valdiya (1980), Srikantia (1980) and Kumar (1980). The entire record is considered here into six distinct geographical areas:

1. The detached belt of Raisi Group of Jammu-Himalaya.
2. Shali, Larji and Deoban belts of Himachal Himalaya.
3. Deoban-Tejam belt of Garhwal-Kumaon Himalaya.

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4. Nawakot belt of the Nepal Himalaya.
5. Baxa belt of the Sikkim-Bhutan Himalaya.
6. Baxa belt of the Arunachal Himalaya.

Jammu Himalaya

Raisi Group — In the Jammu hills of Kashmir Himalaya, within the Palaeogene zone, there is a chain of carbonate inliers variously referred as the ' Sirban Limestone ', ' Jammu Limestone ' and ' Raisi Limestone ', but now designated as the ' Raisi Group '. They are spread between Purl in Punch and Murtal in Udhampur. These carbonate inliers are characterised by prolific growth of stromatolites: *Colonella* Komar, *Conophyton cylindricus* Maslov, *Platella, Baicalia baicalica, Masloviella columnaris, Irregularia* Koroliuk, *Nucleela* Komar (Raha & Sastry, 1973).

Himachal Himalaya

There are three stromatolite-bearing carbonate belts in the Himachal Himalaya. Of the three belts, the Shali occurs in the outer most zone, the Larji in the innermost zone and the Deoban in the intermediate zone. All the three belts unconformably overlie a sequence of purple and grey quartzite-shale with lava flows and are considered homotaxial.

Shali Group— The stromatolites are found in the Ropri, Khatpul, Tattapani and Parnali members of the Shali Group. *Conophyton* is seen to confine to Ropri and Khatpul members, whereas *Baicalica* is seen in Khatpul, Tattapani and Parnali members (Srikantia, 1980).

Simla Group — The Simla Group which overlies the Shali belts along a major unconformity contains *Jurusania himalayica* (Sinha, 1977).

Larji Group — It occurs within a window zone in the Kulu-Rampur area of the Himachal Pradesh. It is divisible into two formations, viz., the Hurla Formation and the Aut Formation. The Aut Formation contains profuse growth of columnar stromatolites of the type *Conophyton, Jurusania* and *Baicalica*. From Aut area *Conophyton*, ex. gr. *cylindricus* (Grabu) and *Colonella* sp. indet have been reported (Sinha, 1977).

Deoban Group — This group occurs in autochthonous zone in the area between Himachal and Garhwal Himalaya. The Bohar and Tiontar formations are characterised by prolific growth of stromatolites (Srikantia, 1980).

The Bohar Formation contains limestone bands, some of which are 20 m thick and are wholly made up of stromatolite reef colonies. *Colonella* and even *Conophyton* have also been seen. *Baicalica* (*Collenia baicalica*) has also been reported from this formation (Valdiya, 1969).

The Tiontar Formation has profuse growth of stromatolites, which are comparable to *Tungussia*.

Garhwal-Kumaon Himalaya

Calc Zone of Pithoragarh — In this zone there are two thick carbonate sequences which show excellent preservation of stromatolites.

Valdiya (1969) reported *Collenia thalkidarensis, C. symmetrica* and ?*Jurasania* from the Thalkedar Dolomite. Kumar (1978) has doubted the identification of *Collenia symmetrica* and ?*Jurassiana*. According to him *C. symmetrica* is a transverse preservation of *C. thalkedarensis* and ?*Jurassiana* is perhaps a new form, which needs redescription.

Kumar and Kumar (1978) have described two stratified stromatolites *Stratifera undata* and *Gongylina differentiata* from Gurna area, Pithoragarh District alongwith *Colonella columnaris* and *Collenia clappii*.

The Gangolighat Dolomite Formation, younger carbonate horizon of the Calc zone, shows good development of stromatolites. Misra and Valdiya (1961) were first to report *Collenia* from this horizon. Dixit (1966) reported *Cryptozoon, Collenia columnaris, C. undosa, C. flagelliformis* from the Girichhina area. Misra and Kumar (1969) recorded *Collenia columnaris* and *C. nailensis* from the Ganai area. Valdiya (1969) reported *Collenia baicalica, C. columnaris, C. kussiensis, Minjaria uralica* and *Collenia symmetrica* from Pithoragarh area. Banerji (1970) described *Collenia columnaris, C. baicalica, C. frequence* var. *kandaensis, C. pseudocolumnaris, C. septentrionalis* and *C. minature* in the Gangolighat Dolomites of the Sarju Pungar Valley area, Almora District. Kumar and Tiwari (1977, 1978) recorded *Conophyton garganicus* and *C. misrai* from the Kathpuria Chhina area. Later Tewari (1979; see Kumar, 1980)

recorded *Stratifera* and *Gongylina* from the same area.

Calc Zone of Tejam — Bhattacharya (1976) recorded the occurrence of *Conophyton cylindricus* from the Kapkot Formation.

Nepal Himalaya

Nawakot Group — The Tejam-Pithoragarh belt continues into the Nepal Himalaya. However, the nature of extension is not clearly known. Stromatolites of *Colonella* and some lower Proterozoic types have been reported from the Formation D of the Nawakot Group. These are yet to be studied in detail.

Sikkim-Bhutan-Arunachal Himalaya

Baxa Group — The Baxa Group is divisible into two formations, viz., the lower Jainti Formation and the upper Carbonate Formation. The Carbonate Formation, as the name implies, is characterised by limestone and dolomite with profuse stromatolites in the dolomite unit. Though these stromatolites have not been studied with regard to the morphological characters, yet a cursory study indicates that they are mainly of *Colonella* and *Baicalica* types.

The observations brings out the scope and utility of stromatolites in the stratigraphy of Proterozoic carbonate formations of the entire Lesser Himalaya. Considering the importance of correlation of the unfossiliferous formations in the Lesser Himalaya, there is greater need for systematic study of stromatolites with accent on the evolutionary trend in the Himalayan belt. However, one particular aspect has to be kept always in notice that the morphology of stromatolites is governed by the biota responsible for its deposition.

Oncolites — Gundu Rao (1970) and Bhattacharya (1976) have reported oncolites from Upper Krol and Kumaon Himalaya respectively.

MICROBIOTA

Prakash (1974) reported acritarchs from the Calc zone of Chamoli in the Lesser Himalaya. The identifications of the palynomorphs need rechecking. Later Sah, Maithy and Bhargava (1977) reported palynomorphs from Jutogh 'B' of Simla Hills. Recently Maithy and Bhargava (1982) have recorded an alga, *Sclerococcus* from Jutogh 'E' of Simla Hills.

The microbiota from Pithoragarh, Kumaon Himalaya belongs to cyanophytic algae (both filamentous and spheroid), Sphaeromorphitae acritarchs and *Baltisphaeridium* (Acanthomorph) (Nautiyal, 1978b, 1980). Nautiyal (1978a, 1979) also reported a few chitinozoans from the Satpuli area, Garhwal Himalaya. Some of the new genera instituted by him need revision. The possibility, however, is that they are similar to the previously recorded forms.

Singh, Tiwari and Gupta (1978) recorded acritarchs from Shali Formation near Mandi (Himachal Pradesh). Raha (1980) reported spherical and filamentous microbiota from the Great Limestone of Raisi.

CAMBRIAN-SILURIAN FLORA

Jacob *et al.* (1953) reported spores and other cutinized material from the Cambrian of Kashmir. From the study of spores, they presumed that the primitive Pteridophytes and Pteridosperms are represented in the Middle and Upper Cambrian sediments of India. Ghosh and Bose (1952) also reported spores and tracheids from the Cambrian of Kashmir.

Srivastava (1975) has recorded the following assemblage from the Cambrian-Silurian succession of Kupwara Tehsil, Baramula District, Kashmir.

Acritarchs: *Arabisphaera*, *Deunffia*, *Deusilites*, *Hemisphaeridium*, *Lacunalites*, *Leiosphaeridia*, *Leiofusa*, *Protosphaeridia*, *Quisquilites*, *Sphaeroporalites*.

Spores: *Apiculatisporites*, *Calamospora*, *Laevigatisporites*, *Leiotriletes*, *Lycospora* and wood tracheids.

Sahni (1953) reported psilophytic-like remains from the Silurian of Spiti. The fossil axes are both unforked and forked. They are either smooth or rough possibly due to minute spines. According to Sahni (1953) the straight unbranched fragments of fossils, whatever their nature, would have had a *Hostimella*-like aspect in smooth form, or *Psilophyton*-like in spiny form. He further opined that the spiny form, however, has perceptible resemblance to various marine hydroids, the suggestion of a vascular core not withstanding, because the core is

not sufficiently continuous to be fully convincing. Gupta (1969) reported *Psilophyton princeps*.

Maithy (1974) doubted the psilophytic affinities of these fossils due to lack of criterion by which the fossils may indisputably be recognised as land plant, viz. (i) occurrence of a xylem element, (ii) an epidermis with cuticle and stomata, and (iii) the presence of spores in sporangia. He considered the possibility that these fossils may belong to the lower group of plants, but Pant (1978) opined that they are animal remains. Therefore, the specimens require proper reassessment to decide their nature.

CARBONIFEROUS FLORA

Till recently the only known Carboniferous flora was from the Thabo Stage (Po Series) of Spiti, Himachal Pradesh (Gothan & Sahni, 1937; Høeg, Bose & Shukla, 1957). For about 40 years, nothing new in the plants or no new localities were found. In recent years workers have been devoting more attention to the Carboniferous sediments, with the result better preserved and more significant fossils have come to light. We are now in a position to compare our Carboniferous floras with greater certainty with the cosmopolitan Lower Carboniferous flora, known now as the 'Lepidodendropsis Flora' (Rhacopteris Flora of old times).

The Thabo Stage flora contains restricted plants, viz., *Rhodea*, *Rhacopteris*, *Sphenopteridium*, *Adiantites* and *Asterophyllites*. The faunal evidence from the Lipak Series, which underlies the Thabo Stage, indicates a Dinantian (Tournasian-Visean) age. A Lower Carboniferous age of Thabo plants as suggested by Gothan and Sahni seems to be in agreement with this.

The Gund Formation exposed in the Charil-Nawagan section, north of Banihal in Kashmir (Pal, 1978), contains a diverse floral assemblage composed of Lycopsida, Sphenopsida and Pteridopsida. The forms are *Archaeocalamites radiatus* (Brongniart) Stur (Sphenopsida), *Archaeosigillaria* sp., *Lepidosigillaria quadrata* Danzé-Corsin, *Lepidodendropsis sigillarioides* Jongmans, Gothan & Darrah, *L. pranabii* Pal, *Lepidodendron gundensis* Pal, *Cyclostigma ungeri* Jongmans, Gothan & Darrah, *C. indica* Pal (Lycopsida), and *Rhacopteris* sp. cf. *R. circularis* Walton, *Rhodea tenuis* Gothan (Pteridopsida).

The Carboniferous floras of the world are well known from U.S.A., East Germany, Czechoslovakia, U.K., Spain, Spitsbergen, Peru, Egypt, China and USSR. However, the assemblages have some local peculiarities by way of emphasis on some taxa. Thus, we have *Lepidodendropsis-Cyclostigma-Triphyllopteris* associations in some areas (Jongmans, 1954), while in others there are *Prelepidodendron-Sublepidodendron*, *Lepidosigillaria* and *Archaeosigillaria* associations (Mensah & Chaloner, 1971) or *Lepidodendron-Sphenopteridium-Rhacopteris* assemblages. It has also become apparent now that the *Lepidodendron-Sphenopteridium-Rhacopteris* assemblage is found in the younger strata (Visean) (Lacey, 1962; Pal, 1978).

The Gund Flora is characterised by the dominance of Lycopsida like *Lepidodendropsis* (2 sp.), *Archaeosigillaria* (1 sp.), *Lepidosigillaria* (1 sp.) and *Lepidodendron* (1 sp.). Pteridophytes are subordinate with one species of *Rhacopteris* and *Rhodea*, while Sphenopsida are represented only by *Archaeocalamites* (1 sp.). Pal (1978) also mentioned the occurrence of *Asterophyllites* sp. in basal part of the Gund Formation (see Litholog) but did not describe it. He compared the Gund Flora with the Lower Carboniferous assemblages of Peru (Jongmans, 1954), Pocono Flora of Pennsylvania and Virginia (Jongmans, Gothan & Darrah, 1973), Egypt (Jongmans & Heide, 1955) and the Thabo beds of Spiti (Gothan & Sahni, 1937; Høeg, Bose & Shukla, 1957). Pal has noted that the Thabo flora is dominantly represented by Filicopsida and the absence of Lycopsida in the assemblage is striking. On the other hand in Gund Flora the lycopsids prevail over the filicopsids. The suggestion of Pal seems to point that the difference in the two floras may be due to difference in age. The Thabo flora with rich fern remains may be younger (Namurian-Westphalian) in age than Gund Flora which has the dominance of lycopsids. The Gund Formation is underlain by Syringothyris Limestone and overlain by Fenestella Shale.

The floral assemblage of Gund closely compares with the *Lepidodendropsis-Cyclostigma-Triphyllepteris* flora as defined by

Jongmans and emended by Lacey (1962) and Mensah and Chaloner (1971). Putting everything together a late Tournas to early Visean age has been assigned to the Gund Formation by Pal (1978). Pal suggested that the Gund Formation (493 m) is entirely continental and that widespread land conditions prevailed during this period. That means these beds can be traced in other parts of Himalayas which may contain floras as well. The floral evidence indicates that a moist and warm climate prevailed during this period in this region.

PERMIAN FLORA

Upper Palaeozoic beds of continental origin are found in several areas along the Tethyan Himalayan belt from Kashmir to the east. These beds are at places associated with glacial or volcanic sediments (Acharya, 1973). In some of these areas typical plants of the Glossopteris Flora, viz., *Glossopteris* and *Vertebraria* have been recorded (Jacob, 1952; Jacob & Banerji, 1954). Several new areas with Permian flora have been surveyed in recent years. The records are as follows.

KASHMIR

The earliest record of Permian floral elements from Kashmir is by Hayden (1907) and Seward (1907, 1912). In recent years our knowledge of the Permian Flora has increased due to painstaking work of Hazra and Prasad (1957) and Kapoor (1969, 1977). Kapoor (1977) recognized five distinct floras above the Carboniferous beds; one below the Panjal Trap and rest above it.

(A) *At the base of the Panjal Trap*

1. *Nishatbagh Bed* — This bed marks the beginning of Gondwana in Kashmir and occurs as isolated outcrops at various localities of which Dal Lake, Basmai, Nagmarg, Bren and Nishatbagh are important. The flora recorded is: *Gangamopteris angustifolia*, *G. kashmirensis*, *Glossopteris angustifolia*, *G. indica*, *Psygmophyllum haydeni*, *Cordaites hislopii*, *Samaropsis*, *Cordaicarpus* and stems.

(B) *On the top of the Panjal Trap*

2. *Vihi Bed* (*Gangamopteris Bed*) — Risin spur of Vihi is supposed to be type area but Hayden (1907) stressed upon the importance of Zewan spur because of its better development than Risin and also due to its position below the marine Zewan Formation. The flora recorded is cones and stems of lycopods, *Gangamopteris kashmirensis* (dominant), *Vertebraria* sp., *Psygmophyllum haydenii*, *P. hollandii* and *Cordaites hislopii*.

3. *Marhoma Bed* — Kapoor (1977) separated this bed from the Vihi Bed due to the presence of a lava flow between the two. The flora includes: *Schizoneura gondwanensis*, *Sphenophyllum*, *Sphenopteris polymorpha*, *Glossopteris*, *communis*, *G. conspicua*, *G. indica*, *Gangamopteris kashmirensis*, *Samaropsis* and *Psygmophyllum haydenii*. Ahmad, Chib and Singh (1978) did not recognize the Marhoma Bed.

4. *Munda Bed* — Hazra and Prasad (1957) studied this bed from the northern slopes of Pir Panzal. Kapoor (1977) traced the bed from Jawhar Tunnel to Ahrbal. The flora known from this bed is: *Pecopteris*, *Glossopteris communis*, *Gangamopteris kashmirensis* (rare), *Taeniopteris kashmirensis*, *T. feddeni*, *Vertebraria indica*, *Cordaites hislopii* and *Psygmophyllum haydenii*. The presence of *Pecopteris* and *Taeniopteris* is significant.

5. *Mamal Bed* — This bed is the youngest floral bed of Permian Gondwana in Kashmir. The type section is exposed on the scrap, and ravine between Mamal and Dunpathari near Pahalgam. The flora includes: *Lepidostrobus kashmirensis*, *Schizoneura*, *Phyllotheca*, *?Sphenophyllum*, *Pecopteris* (several species including fertile), *Kashmiropteris meyenii*, *Glossopteris indica*, *G. angustifolia*, *G. communis*, *Gangamopteris* sp. (extremely rare), *Cordaites*, *Psygmophyllum* and *Kawizophyllum dunpathriensis*. Attempts have been made to correlate the Lower Gondwana sequence of peninsular region with Kashmir Permian plant beds. According to Kapoor (1977) the Nishatbagh and Vihi beds are homotaxial to Talchir, while Chakravarti (1968) suggested that the Vihi beds are closer to Rikba.

The Gondwana affinity of Permian floral beds of Kashmir is undisputable in spite of its having distinct nature. According to Kapoor (1977) the distinction can be due to its position quite far from the mainland. The fact, of its being the part of the Gondwana continents gets the support from the

underlying *Eurydesma* fauna typical of the Gondwana shelf.

The presence of the floral elements of northern hemisphere in the southern and vice versa is an enigma. Besides Kashmir, such mixed floras are also known from South Africa, South America, Australia, Turkey, New Guinea, etc. A group of workers (Sahni, 1935, 1936; Wadia, 1938) believes that the intermixing of the floras is the result of migration of plants in Kashmir region. They presumed the presence of isthumus or dense archipelago in Kashmir region. Other workers oppose this view on the palaeogeographical grounds since the Kashmir region is supposed to have been thousands of kilometers away from the northern continents and separated by the 'Tethys'.

Uttar Pradesh

Tewari and Singh (1980) recorded Permian plant fossils from Infrakrol sediments exposed along nala cuttings in Jeolikot-Bhowali section, Nainital, U.P. According to them the assemblage comprises of typical northern elements like *Lepidodendron*, *Calamites*, *Annularia*, *Sphenophyllum*, *Gondwanidium*, *Schizoneura* and *Phyllotheca* associated with *Gangamopteris* and *Glossopteris*. The assemblage needs careful examination due to extremely heterogeneous floral nature. Moreover, the author has not given any photographs of the fossils with the result it is extremely difficult to judge the authenticity of these records.

Tiwari, Tripathi, Kumar, Singh and Singh (1980) reported miospores from the Kuling Shale of the Malla Johar area, U.P. The records are *Hennellysporites*, *Callumispora*, *Lacinitriletes*, *Apiculatisporites*, *Laevigatisporites*, *Densipollenites*, *Scheuringipollenites*, *Striatopodocarpites*, *Faunipollenites* and *Crescentipollenites*.

Darjeeling

Acharya (1973) reported a flora from the Damuda Subgroup of Darjeeling foot-hills comprising *Phyllotheca* sp., *Glossopteris indica*, *G. communis* var. *stenoneura*, *G. browniana*, *G. conspicua*, *Glossopteris* sp., and *Vertebraria indica*. The predominance of *Glossopteris* and absence of *Gangamopteris* indicate a Late Permian age. This is also corroborated by the dominance of bisaccate miospore with subdominant trilete and monolete.

Sikkim

The black laminated micaceous siltstone of the Damuda Subgroup contains plant fossils. The Damuda sandstone near Khemgon has yielded equisetaceous stems, *Glossopteris* and *Vertebraria* (Dutt, vide Sahni & Srivastava, 1956) whereas in other areas *Schizoneura* has been recorded from these beds (Dutt & Sen, vide Jaboc & Banerji, 1954).

Nepal

Fuchs and Frank (1970) have recorded the occurrence of *Vittatina* and pitted tracheids from phyllitic slates of light green colour, which overlie the Chail Formation in the Phalbaug area of Lesser Himalaya region of western Nepal. Gondwana spores have also been recorded from the Thinichu Formation of the Tethys belt of Nepal (Acharya & Sah, 1975).

Arunachal Pradesh

Srivastava and Dutta (1977) have described palynomorphs from the Lower Gondwana sediments of the Diang District, Arunachal Pradesh. The spore-pollen genera recorded are: *Callumispora*, *Lycopodiumsporites*, *Brevitriletes*, *Lacinitriletes*, *Microbaculispora*, *Indotriradites*, *Jayantisporites*, *Parasaccites*, *Virkkipollenites*, *Plicatipollenites*, *Stellapollenites*, *Rugasaccites*, *Crucisaccites*, *Divarisaccus*, *Caheniasaccites*, *Potonieisporites*, *Illinites*, *Platysaccus*, *Striatites*, *Faunipollenites*, *Striatopodocarpites*, *Vesicaspora* and *Scheuringipollenites*.

Among acritarchs are *Pilasporites*, *Hemisphaerium*, *Balmella*, *Maculatisporites*, *Quadrisporites*, *Leiosphaeridia*, *Spongocystia*?, *Foveofusa* and spinose acritarchs and ?algae *Schizosporis* and *Botryococcus*.

The overall microfloral association has two distinct zones. Zone I is dominated by the radial monosaccate pollen grains. The trilete miospore, striate and nonstriate-disaccates are rare. The mioflora is comparable to the mioflora of Talchir Formation of the Lower Gondwana in Peninsular India. Miofloral Zone II is marked by the domi-

nance of *Callumispora*; *Parasaccites* is subdominant. *Microbaculispora* and *Indotriradites* are significant, whereas *Crucisaccites* is confined to this zone. This miofloral zone has been compared to Lower Karharbari mioflora of the peninsula by Srivastava and Dutta (1977).

Singh (1979) reported Lower Permian miospores from the Garu Formation in Siang District. Two distinct miospore assemblages were recognised, viz., *Parasaccites-Plicatipollenites-Virkkipollenites*, and *Callumispora - Parasaccites - Potonieisporites*. The first assemblage was considered equivalent to the Talchir assemblage and the second to be equivalent to Lower Karharbari assemblage of the Lower Gondwana sequence of peninsular India.

Acharya, Sah, Ghosh and Ghosh (1977) recorded plant fossils from the older Khelong Formation in Kameng District. The record includes: *Phyllotheca*, *Schizoneura*, *Glossopteris indica*, *G. communis* var. *stenoneura*, *G. damudica*, *Gangamopteris cyclopteroides* and *Vertebraria*.

They also recorded *Phyllotheca griesbachii*, *Phyllotheca* sp., *Schizoneura gondwanensis*, *Glossopteris indica*, *G. communis* var. *stenoneura*, *G. angustifolia*, *G. longicaulis*, *G. formosa*, *Dictyopteridium*, *Vertebraria indica* and *Samaropsis* sp. from the Bhareli Formation in Kameng District. The assemblage is characterised by the predominance of *Glossopteris* and absence of *Gangamopteris*.

Assam, Nagaland and Meghalaya

Fox (1935) reported *Vertebraria indica* from Singrimari. Recently, recycled Gondwana palynomorphs have been found at some places either on subsurface or in surface (Banerji, Misra & Koshal, 1973; Datta, 1978).

Garo

Banerji, Mitra and Chakravarty (1977) reported mega- and microflora from the Lower Gondwana rocks exposed near Singrimari Bazar (Hallidayganj), western Garo Hills. The megafossil assemblage includes *Schizoneura*, *Glossopteris communis*, *G. stricta*, *G. parallela* and *Vertebraria*. The miospores are represented by *Leiotriletes*, *Calamospora*, *Punctatisporites*, *Cyclobaculisporites*, *Horriditriletes*, *Microfoveolatispora*, *Laevigatosporites*, *Scheuringipollenites*, *Platysaccus* and *Striatites*. Banerji, Mitra and Chakravarty (1977) compared the fossil records with the Lower Barakar flora of the peninsular region.

CONCLUDING REMARKS

From the foregoing review on the Precambrian and Palaeozoic floras of the Himalaya, we can infer that though the records are poor, yet painstaking search by workers will definitely bring about new information. The time is now ripe to concentrate on the following problems:

1. Evolution of floras in geological time with the morphological complexity of elements. Himalayan region suits best for this sort of investigation because here we find a continuous succession from Precambrian to younger sediments. Such a continuous succession is lacking in peninsular India.

2. Phytogeography of floras during the Palaeozoic times, particularly with reference to the claims or the presence of Angaran and Cathaysian elements in the Carboniferous and the Permian floras of Himalaya.

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