Early Permian plant fossils from the Barakar Formation of Auranga Coalfield, Bihar

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Plant fossil assemblage of Auranga Coalfield recovered from the fireclay of Barakar Formation being mined in Murup and Datum areas of Palamau District, Bihar is represented by various species of the genera *Neomariopteris, Gangamopteris, Glossopteris, Saportaea, Rhipidopsis* and *Ginkgoites*. Glossopterid-ginkgopsid association is the characteristic feature of this flora, which is closely comparable with the Glossopterid-ginkgopsid association of the Hura Coalfield, Rajmahal Hills, Bihar.

Key-words—Plant megafossils, Glossopteris-ginkgopsid Association, Barakar Formation, Early Permian (India).

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सारांश

बिहार में औरंगा कोयला-क्षेत्र के बराकर शैल-समूह से प्रारम्भिक परमियन युगीन पादप अवशेष

अश्विनी कुमार श्रीवास्तव

बिहार में पलामऊ जनपद के मुरुप एवं डेटम नामक क्षेत्रों में विद्यमान बराकर शैल-समूह के फायरक्ले (मिट्टी) से प्राप्त अश्मित पादप समुच्चय में *निओमेरिऑप्टेरिस, गंगामॉप्टेरिस, ग्लॉसॉप्टेरिस, सैपोर्टिआ, रिपिडॉप्सिस* एवं *गिन्क्गोइटिस* नामक प्रजातियों की विभिन्न जातियाँ विद्यमान हैं। यह प्रेक्षित किया गया है कि ग्लॉसॉप्टेरिड-गिन्क्गॉप्सिड साहचर्य इस वनस्पतिजात का मुख्य लक्षण है जो कि राजमहल पहाड़ियों में हुरा कोयला-क्षेत्र के इसी प्रकार के पादप साहचर्य से घनिष्ठ तुलनीय है।

AURANGA Coalfield is situated between latitudes 23°42'N and 23°52'N and longitudes 84°18'E and 84°21'E. The Gondwana sequence in the area comprises Talchir, Barakar, Raniganj, Panchet and Mahadeva formations (Rizvi, 1972). Mega- and palyno-fossil assemblages and recent geological survey have also proved the presence of Karharbari and Barren Measures formations (Srivastava, 1977; Lele & Srivastava, 1977; Das, 1979). The plant fossils are known from almost all the horizons which typically comprise the elements of Glossopteris flora (Srivastava, 1980). Present investigation demonstrates a fair representation of ginkgophytic leaves alongwith glossopterid elements.

MATERIAL

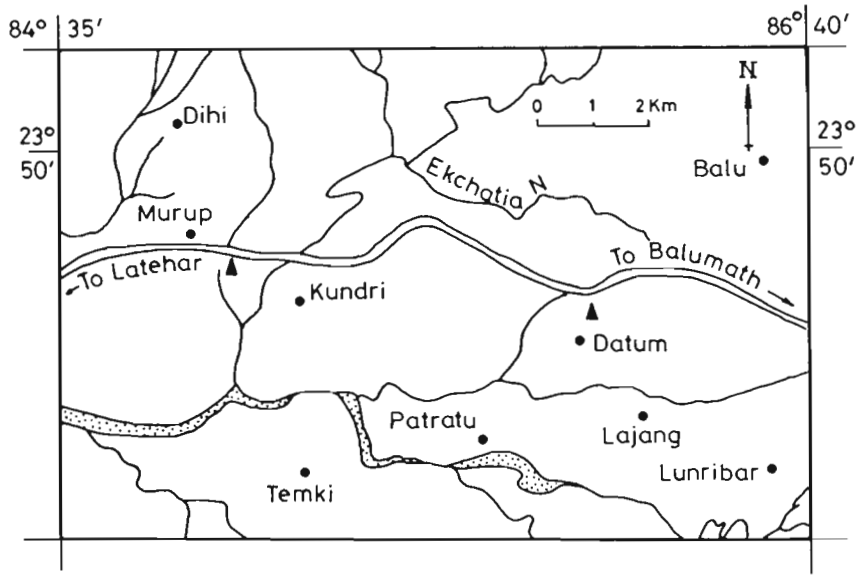
Plant fossils were collected from thinly laminated white to grey fireclay bands (Barakar Formation, Early Permian) in a quarry near Murup and Datum villages in northern part of Auranga Coalfield (Map 1). The leaves are preserved as impressions, most of them are incomplete, though their nature and venation pattern are distinct enough to identify up to specific level. Species of *Gangamopteris* and *Glossopteris* have not been described; they are listed and some remarks have been given.

All the Type and figured specimens are preserved in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

DESCRIPTION

Neomariopteris Maithy 1974

Neomariopteris hughesii (Zeiller) Maithy 1974



Map 1—Fossil locality map of Auranga Coalfield, Bihar.

Three bipinnate, imparipinnate fronds with winged primary rachis are present in the collection. The pinnae are alternate, bearing decurrent, alternate to subopposite, lanceolate to spathulate pinnules having slightly crenulate margin. The median vein of each pinnule bifurcates once or twice, lateral veins alternate-subopposite.

***Gangamopteris* McCoy 1861**

The genus is represented by five specimens of *Gangamopteris angustifolia* McCoy 1861 and *G. cyclopteroides* Feistmantel 1879 in the collection.

Remarks—*Gangamopteris* is usually considered to be a characteristic fossil of Talchir and Karharbari formations. Recent investigations on Deogarh and Raniganj coalfields suggest that the genus ranges in the Lower Barakar sequence also (Bajpai, 1990; Srivastava,1992).

***Glossopteris* Brongniart 1828**

Twenty incomplete leaves belonging to this genus have been investigated from this locality. However, the following species of *Glossopteris,* viz., *G. angustifolia* Brongniart, 1828, *G. barakarensis* Kulkarni 1971, *G. churiensis* Srivastava 1977, *G. communis* Feistmantel 1876, and *G. indica* Schimper 1869 have been recognised.

***Saportaea* Fontaine & White 1880**

In all, there are six specimens in the collection, amongst them two are preserved as part and counterpart. *Saportaea* originally known from the Permian of west Virginia, USA (Fontaine & White, 1880) has also recently been reported from the Barakar Formation of Rajmahal Basin (Maheshwari & Bajpai, 1992).

Saportaea reniformoides Maheshwari & Bajpai 1992

Pl.1, figs 1, 2

Leaf specimens present in the collection lack petiole and complete margin. Largest leaf is reniform to flabellate, 11cm in length and 15.2 cm in width at the widest. Lamina generally shows splits or breaks, the dissected segments are often preserved in different layers of the sediments. Marginal rim-like vascular supply present towards the base in one of the specimens, results into successive proximal forks which after 2-4 dichotomies run more or less perpendicular to the apical margin of leaf. Vein density 30-45 per cm near the apex of leaf.

Leaves having large size, reniform-flabellate shape with irregularly dissected segments, possessing marginal rim-like vascular supply in the basal region and low concentration of veins are comparable with *Saportaea reniformoides* (Maheshwari & Bajpai, 1992; pl.1, figs 1, 3, 4).

***Rhipidopsis* Schmalhausen 1879**

This genus is well known in the contemporaneous floras of Gondwana, i.e., Angara, Cathaysia and Euramerica.

Rhipidopsis densinervis Feistmantel 1881

Pl.1, figs 3-5

Four specimens showing distinct venation pattern and segmented nature of leaves are present in the collection. Leaf segments obovate to obtuse in shape with contracted to cuneate base, petiole not observed in any of the specimens. Maximum length and width in one of the complete leaf segment 9.3 cm and 3.2 cm, respectively. Deep dissections almost reaching to the base of lamina distinct in one specimen. Since the leaf base is not preserved, emergence of veins could not be observed. Parallel running veins, preserved throughout leaf length, show 4-5 dichotomies with a vein concentration of 40- 40 per cm at the apical margin of leaves. Veins runing parallel in the middle portion but lateral veins show slightly arched towards leaf margin.

The shape, size and venation pattern of present leaves are comparable with *Rhipidopsis densinervis* Feistmantel described by Maheshwari and Bajpai (1992; p1. 2, figs 2-4; p1.5, fig. 3) from Rajmahal Basin of India.

***Ginkgoites* Seward 1919**

Leaves of *Ginkgoites* were described by Maheshwari and Bajpai (1992) from the Barakar Formation of Rajmahal Hills, accepting the fact that fossil leaves, irrespective of age, having similarity with the extant form of *Ginkgo biloba* belong to the genus *Ginkgoites* as asserted by Seward (1919), until the discovery of attached fertile structure.

Ginkgoites huraensis Maheshwari & Bajpai 1992

Pl.1, figs 6, 7

Three incomplete leaves are present in the collection, basal part is not completely preserved. Leaves are fan-shaped, divided into two lobes, 2-3 cm long and 3-4 cm broad. Apical margin of leaf entire, sometimes shows a shallow dissection.Two veins entering the base of leaf dichotomise 2-5 times, run parallel to each other towards distal margin of leaves. Density of veins 30-35 per cm in the middle part of leaf.

Bilobed and segmented nature of leaves shows resemblance with *Ginkgoites huraensis* (Maheshwari & Bajpai, 1992, pl. 4, figs 1, 3; pl. 5, fig. 1).

Rotundocarpus sp.

Pl.1, fig. 8

One single circular to oval-shaped wingless seed possessing a deep vertical furrow with corrugated surface recovered in the assemblage is comparable with *Rotundocarpus* type seed but differs in having large size (1.7 x1.00 cm).

DISCUSSION

The glossopterid-ginkgopsid association discovered in the fire clay bands (Barakar Formation) of Murup and Datum areas is similar to the flora of Barakar Formation of Rajmahal Basin and suggests the continuation of similar flora in two basins.

Lack of attached or associated fructifications does not allow to place the true affinity of *Saportaea*, *Rhipidopsis* and *Ginkgoites* with the order Ginkgoales but general shape and venation pattern of leaves place them closely with this group of plants. These leaves are well documented in the contemporaneous flora of Gondwana, i.e., Angara, Cathaysia and Euramerica (Lemoigne, 1988). Their well recorded occurrence alongwith the true representative of glossopterids in Rajmahal and Auranga basins further reflect the mixing of floristic elements, a case almost similar with the distribution of *Sphenophyllum*,

PLATE 1

1, 2. *Saportaea reniformoides* Maheshwari & Bajpai, part and counterpart of the specimen showing reniform to flabellate shape leaves. Specimen no. BSIP 37059 x1.

3, 4. *Rhipidopsis densinervis* Feistmantel, part and counterpart of leaf showing obovate shape and contracted base. Specimen no. BSIP 37060 x 1.5.

5. *Rhipidopsis densinervis* Feistmantel, another leaf showing dense concentration of veins. Specimen no. BSIP 37061.

6, 7. *Ginkgoites huraensis* Maheshwari & Bajpai, part and counterpart of specimen showing fan-shaped, lobed leaf. Specimen no. BSIP 37062 x 1.

8. *Rotundocarpus* sp., circular, oval shaped wingless seed possessing deep vertical furrow. Specimen no. BSIP 37063 x 2.

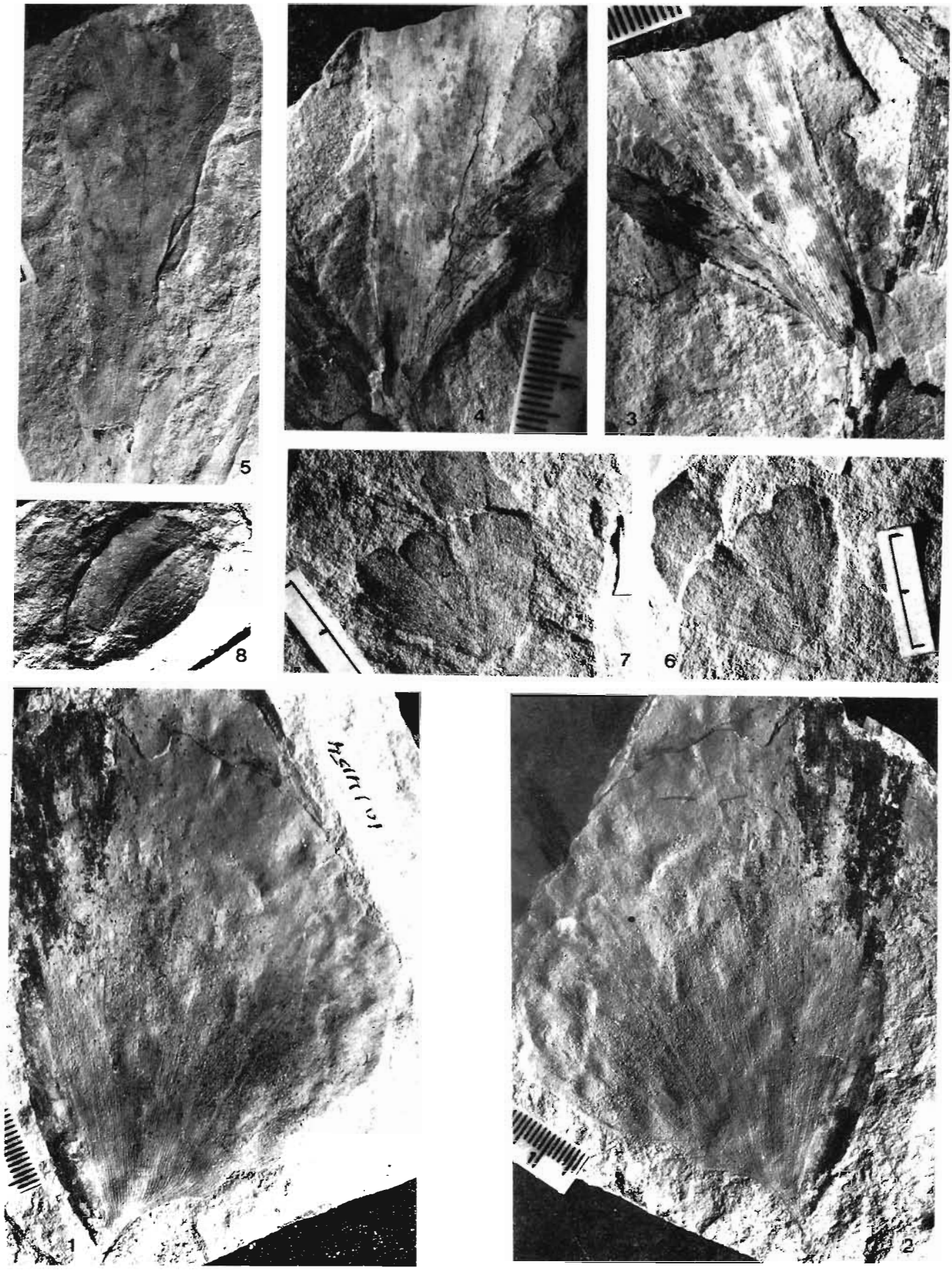


PLATE 1

Schizoneura, Phyllotheca, Barakaria and *Cordaites* (Srivastava, 1992).

With the present state of our knowledge it is difficult to trace out the earliest happening of ginkgopsids in India, but the floristics of Rajmahal and Auranga basins suggest that they were natural ally of Early Permian flora of India (Maheshwari & Bajpai, 1992). The available records of ginkgophytes in the Upper Permian Kamthi Formation (Feistmantel, 1881; Bunbury, 1861), Upper Triassic Parsora Formation (Maheshwari & Banerji, 1978) and Lower Cretaceous beds of Raghvapuram, Sriperumbudur, Bansa Formation (Bose & Dev, 1959), Jabalpur Formation (Seward & Sahni, 1920) and Rajmahal Formation (Sah & Jain, 1965) explain the possible continuation of ginkgophytes in the Indian Gondwana flora.

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