

Seeds, fructifications, bracts and calamitalean axes from the Karanpura and Bokaro Group of coalfields

SHIV MOHAN SINGH

Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India.
Current address: 238, Motimahal Birla Hall, 2 Rana Pratap Marg, Lucknow 226 001.

(Received 07 December 2000; revised version accepted 23 April 2002)

ABSTRACT

Singh SM 2002. Seeds, fructifications, bracts and calamitalean axes from the Karanpura and Bokaro Group of coalfields. Palaeobotanist 51 : 73-79.

The paper deals with fructifications of glossopterids (viz. *Gonophylloides* sp., *Scutum* sp., *Ottokaria* sp., & *Bokarospermum* gen. nov.), seeds (*Cordaicarpus*), bracts and calamitalean axes found in a detached condition from the Barakar Formation of the Karanpura and Bokaro Group of coalfields. *Vertebraria* axes were also observed from the Rikba plant bed of North Karanpura Coalfield. These mentioned taxa are only a small part of an extensive and significant flora of Karanpura and Bokaro Group of coalfields.

Key-words—Fructification, *Bokarospermum*, Calamitalean, *Cordaicarpus*.

करनपुरा तथा बोकारो समूह के कोयला क्षेत्रों से प्राप्त बीज, फलन, सहपत्र तथा कैलामाइटेलियन अक्ष

शिवमोहन सिंह

सारांश

प्रस्तुत शोध पत्र में करनपुरा तथा बोकारो समूह के कोयला क्षेत्रों के बराकर शैलसमूह से विलगित अवस्था में प्राप्त ग्लासोप्टेरिडों के फलनों (जैसे—*गोनोफिल्लोयडीज़* प्रजाति, *स्क्यूटम* प्रजाति, *ऑटोकेरिया* प्रजाति एवं *बोकारोस्पर्मम* नव वंश), बीज (*कॉर्डेकार्पस*), सहपत्र तथा कैलामाइटेलियन अक्षों का विवेचन किया गया है। उत्तरी करनपुरा कोयला क्षेत्रों के रिकबा पादप संस्तर से *वर्टीब्रेरिया* अक्ष भी प्राप्त हुई हैं। ये सूचित वर्गक करनपुरा तथा बोकारो समूह के कोयला क्षेत्रों के सघन एवं महत्त्वपूर्ण वनस्पतिजातों का एक छोटा सा अंश मात्र है।

संकेत शब्द—फलन, *बोकारोस्पर्मम*, कैलामाइटेलियन, *कॉर्डेकार्पस*।

INTRODUCTION

THE term glossopterid is applied to the Lower Gondwana leaf genera *Gangamopteris*, *Glossopteris*, *Palaeovittaria*, and similar leaves, which share similar epidermal features and are associated with comparable fructifications. The first

glossopterid fructification was described and illustrated by Feistmantel (1881) as *Dictyopteridium sporiferum* who thought it to be a fern. Zeiller (1902-1903) reported *Ottokaria* (*Feistmantelia*) *bengalensis*, now known as an ovuliferous capitulum with a long stock and subtended by a glossopterid leaf, probably *Glossopteris communis* (Banerjee, 1978). Bose

re-examined the specimen of Zeiller, i.e., *Ottokaria bengalensis*. From these observations he convinced that the three forms are related to each other. But Bose did not agree with Zeiller's observation because he had found that *O. bengalensis* is definitely attached to the midrib of a *Glossopteris indica* type of leaf (in Plumstead, 1956 on pp. 232-233). White (1908) established the genus *Arberia* for "broadly incised, coriaceous or striate and thick nerved scale leaves whose distant recurvate and truncate lobes appear to owe their abrupt or even slightly ragged terminations to the detachment of some sort of bodies, presumably reproductive in nature". On the basis of association a relationship between *Arberia* and *Gangamopteris* was presumed. Rigby (1972) interpreted *Arberia* as a fructification "that bore large numbers of naked ovules on pinnate branchlets arranged laterally along a forked rachis". Plumstead (1952, 1956, 1958) described and illustrated a large number of fructifications in organic connection with leaves of *Gangamopteris*, *Glossopteris* and *Palaeovittaria*. Several other fructifications of the glossopterids, were described by Surange and Maheshwari (1970), Banerjee (1969, 1984, 1991), Surange and Chandra (1973a, b, 1975), Kov'acs-Enró'dy (1974), Chandra and Surange (1977a, b, c), Pant and Nautiyal (1984), Anderson and Anderson (1985), and others. The taxonomic position and phylogenetic relationship of different types of glossopterid fructification have been analysed by Maheshwari (1990).

In the present collection only a few fructifications in detached condition, are present. These are referable to the genera *Gonophylloides*, *Scutum*, *Ottokaria* and *Bokarospermum* gen. nov.

Feistmantel (1879, 1881, 1882, 1886) reported a number of seeds under the genera *Carpolithes*, *Samaropsis*, *Cardiocarpum*, etc. from the Talchir, Karharbari and Raniganj formations. Subsequently, numerous other seeds were described under the genera *Cardiocarpon*, *Cardiocarpus*, *Cycadospermum*, *Cornucarpus*, *Indocarpus*, *Nummulospermum*, *Eucerospermum*, etc.

The dispersed bracts are now accepted as part of some fertile organs of Glossopterids. These are deciduous in nature and occur singly as protective structures of fertile organs.

The study of large numbers of such scale leaves has revealed significant characteristic features worthy of generic recognition (Banerjee, 1984). The scale leaves which occur singly have been recognised under the new genus *Gondwanolepis*, by Banerjee (1984). Calamitalean and *Vertebraria* axes were also found in large numbers in these coalfields.

MATERIAL & METHODS

The material is preserved as impressions and compressions on grey carbonaceous shales. Most of the specimens belong to the Barakar Formation of the South Karanpura, North Karanpura and West Bokaro coalfields. One *Vertebraria* cast has also been collected from the Talchir Formation of the North Karanpura Coalfield.

The collected specimens have been cleaned, sorted out, photographed and lodged in the repository section of Birbal Sahni Institute of Palaeobotany, Lucknow, India.

SYSTEMATIC DESCRIPTIONS

Glossopterid Fructifications

Genus—**GONOPHYLLOIDES** Maheshwari 1968

(=*Cistella* Plumstead 1952)

GONOPHYLLOIDES sp.

Pl. 1-1, 2

Specimen No.—BSIP 38816 (2/4578), BSIP 38856 (20/4578).

Locality—Sirka Colliery, South Karanpura Coalfield.

Horizon—Barakar Formation.

Plumstead (1952) instituted the genus *Cistella* for a certain type of fructification found 'attached' to the midrib of *Glossopteris* leaves. Maheshwari (1968) observed that the name *Cistella* was preoccupied and hence he instituted a new name *Gonophylloides* for Plumstead's specimens. Plumstead (1956) interpreted *Cistella* as a female bivalved structure comprising a fertile head and a sterile bract. Many later workers thought it to be of strobiloid nature (Surange & Maheshwari,

PLATE 1



- | | |
|---|---|
| <p>1, 2. <i>Gonophylloides</i> (= <i>Cistella</i>) sp., Specimen No. BSIP 38816 (2/4578), BSIP 38856 (20/4578), Barakar Formation, Sirka Colliery, South Karanpura Coalfield, Bihar. x nat. size.</p> <p>3. <i>Scutum</i> sp., Specimen No. BSIP 38857 (S/4578), Barakar Formation, Shales associated with Naditoli Seam, Sirka Colliery, South Karanpura Coalfield, Bihar. x nat. size.</p> <p>4, 8. Bracts. Specimen No. BSIP 38858 (J/5007), BSIP 38859 (J/5004) Barakar Formation, Jharkhand Colliery, West Bokaro Coalfield, Jharkhand. x nat. size.</p> <p>5, 9. <i>Cardiocarpus</i> sp., Specimen No. BSIP 38860 A & B (2/4753), Barakar Formation, Religara Colliery, South Karanpura Coalfield, Bihar. x 3.</p> <p>7. <i>Cardiocarpus</i> sp., Specimen No. BSIP 38861 (J/5007), Barakar</p> | <p>Formation, Jharkhand Colliery, West Bokaro Coalfield, Jharkhand. x nat. size.</p> <p>6. <i>Ottokaria</i> sp., Specimen No. BSIP 38822-A (J/5007), Jharkhand Colliery, West Bokaro Coalfield, Jharkhand. x nat. size.</p> <p>10. <i>Calamitalean</i> axis, Specimen No. BSIP 38862 (9/4739), Barakar Formation, Kuju Colliery, West Bokaro Coalfield, Bihar. x nat. size.</p> <p>11. <i>Calamitalean</i> axis, Specimen No. BSIP 38863 (2/5007B), Barakar Formation, Gidi-C Colliery, South Karanpura Coalfield, Bihar. x nat. size.</p> <p>12. A cast of <i>Vertebraria</i> axis, Specimen No. BSIP 38864 (6/4993), Talchir Formation, Chano-Rikba Basin, North Karanpura Coalfield, Bihar. x nat. size.</p> |
|---|---|

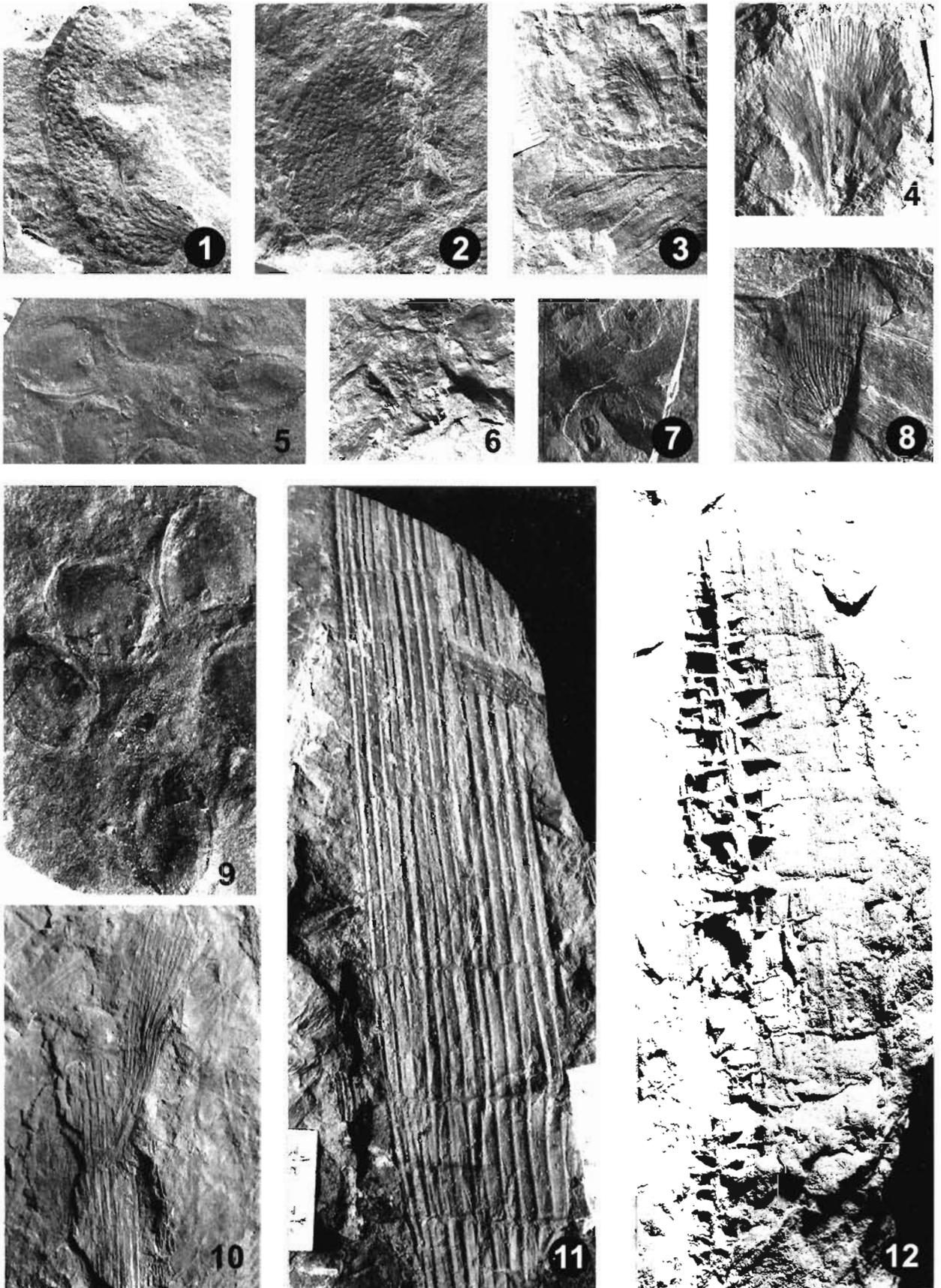


PLATE 1

1970; Surange & Chandra, 1974, and others). Of late opinion is emerging that the female glossopterid fructification may be of foliar nature, bearing ovules on one surface only (Maheshwari, 1965; Gould & Delevoryas, 1977; Maheshwari, 1990). Organisationally there is not much difference between *Dictyopteridium*, *Scutum* and *Gonophylloides*. The main difference lies in their shape and nature of ovule "bases".

Present specimens are incomplete, measuring 3.5-5 cm in length and 1.3-2 cm in width. At the base is a distinct mark of the stalk. The surface is studded with a large number of overlapping, more or less polygonal-circular, elevated areas which appear to have been arranged in close spirals. These probably represent bases of ovules/seeds.

Genus—SCUTUM Plumstead 1952

SCUTUM sp.

Pl. 1.3

Specimen No.—BSIP 38857 (S/4578).

Locality—Sirka Colliery, South Karanpura Coalfield.

Horizon—Barakar Formation.

This genus was established by Plumstead for a type of reproductive organ found attached to *Glossopteris* leaves or unattached. According to her "*Scutum* is a bilaterally symmetrical, two sided cupule usually borne on its own short pedicel which grows, according to the species, from the midrib or from the top of the petiole of a leaf which in every other respect resembles the vegetative leaves of a species of *Glossopteris*. The fructification is believed to be axillary but the pedicel is adnate for the greater part of its length 2 cm, width 1.5 cm. On the out side each half consists of a central part, or head, which is thick or raised and has fan-shaped venation, and a surrounding wing which is often fluted, striated and has a dentate margin. The adaxial half called the fertile half, bears a number of small oval sacs embedded in the tissue of the central head, whilst in the vast majority of cases the opposite abaxial half is empty and apparently only protective".

Genus—OTTOKARIA Zeiller 1902-1903

OTTOKARIA sp.

Pl. 1.6

Specimen No.—BSIP 38822-A (J/5007).

Locality—Jharkhand Colliery, West Bokaro Coalfield.

Horizon—Barakar Formation.

Zeiller (1902-1903) described a fructification consisting of a lobed terminal disc and a slender stalk. Seward and Sahni

(1920) observed that it "consists of a stalk attached in a slightly eccentric position to an almost orbicular lamina 2.5 cm in diameter with sub-acute teeth and traversed by numerous radially disposed irregular striations. The lamina is slightly concave and has the form of a shallow cup. The surface features are more like that of a bract than a regular veined leaf". Later Pant and Nautiyal (1966) and Mukherjee *et al.* (1966) commented on the connection of *Ottokaria* to a leaf of *Glossopteris*. Surange and Chandra (1975), Pant and Nautiyal (1984), Maheshwari (1990), and others have also put forth their ideas about *Ottokaria* Zeiller.

BOKAROSPERMUM gen. nov.

Diagnosis—Semicircular concave disc presents at the median part of leaves. Size variable; 0.5-1 cm, 2-3 labium like structures surrounds the concave disc, probably it bears reproductive organs. At the point of fructification the midrib is not clear. There is only one fructification on one leaf.

BOKAROSPERMUM MAHESHWARI sp. nov.

Pl. 2.1-4

Specimen Nos.—BSIP 38864 (30/5004), BSIP 38865 (13/4746), BSIP 38866 (J/5004), BSIP 38867 (16/5004).

Locality—Jharkhand Colliery, West Bokaro Coalfield.

Horizon—Barakar Formation.

Holotype—Specimen No. BSIP 38866.

Description—Fructification.

Diagnosis—As generic diagnosis.

Remarks—Many leaves of *Glossopteris* spp. showing median location of a fructification type not reported previously. In overall features it does not show resemblance with other fructifications. The fructification looks to be sufficiently distinctive and interesting to be named as *Bokarospermum* gen. nov. Various BSIP Staff and John Rigby's recommendation also supported it as new taxon. Thus *Bokarospermum maheshwari* sp. nov. is erected as a new species.

Seeds

Genus—CORDAICARPUS Geinitz 1862

CORDAICARPUS sp.

Pl. 1.5, 7, 9

Specimen No.—BSIP 38860 (2/4753), BSIP 38861 (J/5007).

Locality—Religara Colliery, South Karanpura Coalfield, Jharkhand Colliery, West Bokaro Coalfield.

PLATE 2 →

- 1-4. Leaves of *Glossopteris* spp. Specimen Nos. BSIP 38865 (30/5004), BSIP 38866 (13/4746), BSIP 38867 (J/5004), BSIP 38868 (16/5004), showing location of *Bokarospermum* fructification type not reported so far, Barakar Formation, Jharkhand Colliery, West Bokaro Coalfield, Jharkhand. x nat. size.

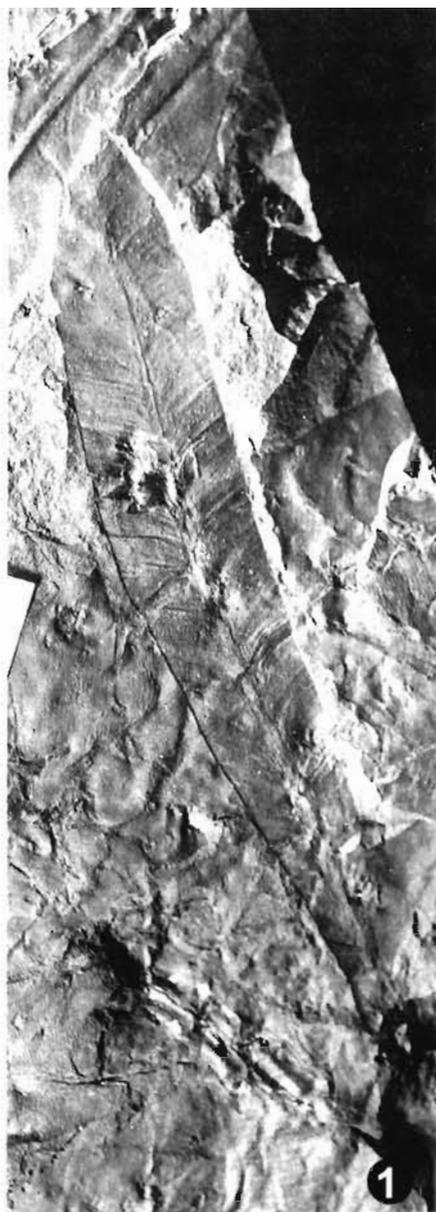


PLATE 2

Horizon—Barakar Formation.

This type of seed was described by Zeiller (1902-1903) as *Cordaicarpus* sp. Seward and Sahni (1920) described them as *Cordaicarpus* sp. cf. *C. cordai* (Geinitz) on the basis of an external morphological resemblance with the northern species. However, the carbonised seed coat of the northern species shows reticulate meshes which are absent in southern forms.

Description—Seeds platyspermic, pear-shaped, base cordate, apex rounded, 0.5-0.9 cm long, 0.2-0.5 cm broad; a narrow border (? sarcotesta), nearly uniform in width, encircles the sclerotesta.

Bracts or Scale leaves

Pl. 1-4, 8

Specimen Nos.—BSIP 38858 (J1/5004), BSIP 38859 (J2/5004).

Locality—Jharkhand Colliery, West Bokaro Coalfield.

Horizon—Barakar Formation.

Description—Shape obovate, length 3.2-3.5 cm, width 2.3-2.6 cm, Apex obtuse, Base truncate, Midrib absent, Margin dented, Veins radiating from base, bifurcating and reaching up to apex.

Calamitalean axes

PARACALAMITES AUSTRALIS Rigby 1966

Pl. 1-10-11

Calamitalean axes are showing ridged and furrows. Nodes and internodes are peculiar features of these elongated cylindrical axes. Length 7.0-14.0 cm, width 5.3-3.2 cm.

Specimen Nos.—BSIP 388662 (9/4739), BSIP 388663 (2/5007B)

Locality—Kuju Colliery, West Bokaro Coalfield, Gidi-C Colliery South Karanpura Coalfield.

Horizon—Barakar Formation.

VERTEBRARIA INDICA Royle 1839 emend. Schopf 1965

Pl. 1-12

Remarks—*Vertebraria indica* was established on the basis of external characters of the axes. Surange and Maheshwari (1962) established two more species, viz., *V. raniganjensis* and *V. myelonis*. Schopf (1965), however, did not consider the difference between anatomy of *V. indica* (Walton & Wilson, 1932) and *V. raniganjensis* to be great enough to separate the two species. He also did not find evidence for the presence of a pith in *Vertebraria* axes and therefore rejected the species *V. myelonis*. He, however, included as a new species, a petrified axis described by Kräusel (1956) from the Karroo Series of South Africa.

Specimen Nos.—BSIP 38864 (6/4993), 3/4995, 10/5003, J1/5007, J2/5007, J3/5007.

Locality—Lurunga Nala, Chano-Rikba Basin, North Karanpura Coalfield; Saunda Colliery, South Karanpura Coalfield, South Tapin and Jharkhand Collieries, West Bokaro Coalfield.

Horizon—Talchir and Barakar formations.

Description—Length 5.7-24 cm; width 0.4-3.7 cm.

Acknowledgements—I am thankful to Dr HK Maheshwari for critically going through the manuscript. I am also thankful to Professor Anshu K Sinha, Director, Birbal Sahni Institute of Palaeobotany, Lucknow for providing necessary research facilities.

REFERENCES

- Anderson JM & Anderson HM 1985. Palaeoflora of Southern Africa. Prodomus of South African megafloras Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam : 1-424.
- Banerjee M 1969. *Senothecha murulidihensis*, a new Glossopteridean fructification from India associated with *Glossopteris taeniopteroides* Feistmantel. In : Santapau H et al. (Editors)—J. Sen memorial Volume, Botanical Society Bengal Calcutta . 359-368.
- Banerjee M 1978. Glossopteridean fructifications: 2. On the revision of *Ottokaria* Zeiller and the occurrence of *O. raniganjensis* Banerjee from the Raniganj Formation (Upper Permian) of India. Indian Journal of Earth Sciences 5 : 129-140.
- Banerjee M 1984. Fertile organs of the *Glossopteris* Flora and their possible relationship in the line of evolution. In: Sharma AK, Mitra GC & Banerjee M (Editors)—Proceedings of the Symposium on Evolutionary Botany and Biostratigraphy. Calcutta 1981. Current Trends in Life Sciences 10 : 29-59.
- Banerjee M 1991. *Glossopteris* leaves, fertile organs, their earliest occurrence, distribution in time and space, and remarks on environment. In: Ulbrich H & Rocha Campos AC (Editors)—Gondwana seven, Institute Geocien. University. São Paulo, Brazil : 483-497.
- Chandra S & Surange KR 1977a. Cuticular studies of the reproductive organs of *Glossopteris*. Part II - *Cistella* type fructification - *Plumsteadirostrobis ellipticus* gen. et sp. nov. attached on *Glossopteris taenioides* Feistmantel. Palaeobotanist 23 : 161-175.
- Chandra S & Surange KR 1977b. Fertile bracts and scales of *Glossopteris* fructifications from the Lower Gondwana of India. Palaeobotanist 24 : 195-201.
- Chandra S & Surange KR 1977c. Cuticular studies of the reproductive organs of *Glossopteris* Part III- Two new female fructifications *Jambadostrobis* and *Venustastrobis* borne on *Glossopteris* leaves. Palaeontographica 164B: 127-152
- Feistmantel O 1879. The fossil flora of the Lower Gondwanas -1. The flora of the Talchir-Karharbari beds. Memoirs of the geological Survey of India, Palaeontologia. indica series 2, 1 : 1-48.
- Feistmantel O 1881. The fossil flora of the Gondwana System (Lower Gondwanas) -3. The flora of the Damuda-Panchet division (conclusion of part 2). Memoirs of the geological Survey of India, Palaeontologia indica, series 12, 3 : 78-149.
- Feistmantel O 1882. The fossil flora of the Gondwana System - The fossil-flora of the South Rewa Gondwana Basin. Memoirs of the geological Survey of India, Palaeontologia indica, series 12, 4 : 1-52.

- Feistmantel O 1886. The fossil flora of the Gondwana System - The flora of some of the coalfields in western Bengal. *Memoirs of the geological Survey of India, Palaeontologia indica, series 12, 4* : 1-66.
- Gould RE & Delevoryas T 1977. The biology of *Glossopteris*: evidence from seed-bearing and pollen bearing organs. *Alcheringa* 1 : 387-399.
- Kovács-Enródy E 1974. Seed-bearing *Glossopteris* leaves. *Palaeontographica Africa* 17 : 11-14
- Kräusel R 1956. Lianer aus den Karru-Schichten Süd-Afrikas. *Senckenberg. leth.* 37 : 1-24.
- Maheshwari HK 1965. Studies in the *Glossopteris* Flora of India - 22. On some species of the genus *Glossopteris* from the Raniganj stage of the Raniganj Coalfield, Bengal. *Palaeobotanist* 13 : 129-143.
- Maheshwari HK 1990. The glossopterid fructifications: an overview. *In*: Douglas JD & Christophel DC (Editors)—Proceedings 3 IOP Conference, Melbourne 1988. International Organization of Palaeobotany Publication 2 : 11-15.
- Maheshwari JK 1968. *Gonophylloides* nom. nov. *Taxon* 17 : 238-239.
- Mukherjee S, Banerjee M & Sen J 1966. Further glossopteridean fructifications from India. *Palaeontographica* 117B : 99-113.
- Pant DD & Nautiyal DD 1966. On two peculiar fossils of Karharbari Stage, India. *In* : Anonymous (Editors)—Symposium on floristics & stratigraphy of Gondwanaland : 98-101. Birbal Sahni Institute of Palaeobotany, Lucknow.
- Pant DD & Nautiyal DD 1984. On the morphology and structure of *Ottokaria zeilleri* sp. nov. - a female fructification of *Glossopteris*. *Palaeontographica* 193 B : 127-152.
- Plumstead EP 1952. Description of two new genera and six new species of fructifications borne on *Glossopteris* leaves. *Transactions of geological Society of South Africa* 55 : 281-328.
- Plumstead EP 1956. Bisexual fructifications borne on *Glossopteris* leaves from South Africa. *Palaeontographica* B100 : 1-25.
- Plumstead EP 1956. On *Ottokaria*, the fructification of *Gangamopteris*. *Transactions of the geological Society of South Africa* 59 : 211-136.
- Plumstead EP 1958. The habit of growth of *Glossopteridae*. *Transactions of geological Society of South Africa* 61 : 81-94
- Rigby JF 1966. The Lower Gondwana flora of the Perth and Collie Basins, western Australia. *Palaeontographica* 118 B : 113-152.
- Rigby JF 1972. On *Arberia* White, and some related Lower Gondwana female fructifications. *Palaeontology* 15 : 108-120.
- Royle JF 1839. Illustrations of the botany and other branches of natural history of the Himalayan mountains and the flora of Cashmere. WH Allen & Co, London 2 : 1-100.
- Schopf JM 1965. Anatomy of the axis in *Vertebraria*. *Geology and Palaeontology of the Antarctica. American Geophysics Union Antarctic Research Series* 6 : 217-228.
- Seward AC & Sahni B 1920. Indian Gondwana plants. A revision. *Memoirs of the geological Survey of India, Palaeontologia indica, series 7* : 1-54.
- Surange KR & Chandra S 1973a. *Dictyopteridium sporiferum* Feistmantel: female cone from the Lower Gondwana of India. *Palaeobotanist* 20 : 127-136.
- Surange KR & Chandra S 1973b. *Denkania indica* gen. et sp. nov., a glossopteridean fructification from the Lower Gondwana of India. *Palaeobotanist* 20 : 264-268.
- Surange KR & Chandra S 1974. Fructifications of *Glossopteridae* from India. *Palaeobotanist* 21 : 1-17.
- Surange KR & Chandra S 1975. Morphology of the gymnospermous fructifications of the *Glossopteris* Flora and their relationships. *Palaeontographica* B149 : 153-180.
- Surange KR & Maheshwari HK 1962. Studies in *Glossopteris* Flora of India - 11. Some observations on *Vertebraria* from the Lower Gondwanas of India. *Palaeobotanist* 9 : 61-67.
- Surange KR & Maheshwari HK 1970. Some male and female fructifications of *Glossopteridae* from India. *Palaeontographica* 129 B : 178-192.
- White D 1908. Fossil flora of the Coal Measures of Brazil. *In* : White IC (Editor)—Final Report, Commissao de estudos das Minas de Carvao de Pedra do Brazil : 339-617. Rio de Janeiro.
- Walton J & Wilson JAR 1932. On the structure of *Vertebraria*. *Proceedings of Royal Society, Edinburgh* 52 : 200-207.
- Zeiller R 1902-1903. Flora fossile des Gîtes de charbon du Tonkin. *Etudes Gîtes Mineraux de la France, Colonies Francaises. Imprimerie Nationale, Paris, Atlas, 1902; Text, 1903, pp. viii+328.*