

# STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA — 23. ON TWO FRUCTIFICATIONS FROM THE RANIGANJ STAGE OF THE RANIGANJ COALFIELD, BENGAL

HARI K. MAHESHWARI

Birbal Sahni Institute of Palaeobotany, Lucknow

## ABSTRACT

The paper contains a description of two glossopterid fructifications from the Raniganj stage of the Raniganj coalfield, Bengal. One of these *Cistella indica* sp. nov. is attached to a *Glossopteris* leaf, while the other — *Dictyopteridium sporiferum* Feistm. is found only in detached condition.

## INTRODUCTION

THERE are not many reports of glossopterid fructifications from India.

Feistmantel (1881, 1882, 1886) figured similar plant organs, though at that time it was not known that they were glossopterid fructifications. Some of them he named as *Dictyopteridium sporiferum* believing them to be the fertile leaflet of some fern. Later Zeiller (1902) described what he believed to be a leaf under the name *Ottokaria bengalensis*. Seward & Sahni (1920), however, thought that *O. bengalensis* was "the cupular investment of a seed." White (1908) had earlier described another species of *Ottokaria*, *O. ovalis* from Brazil and expressed the view that it probably represented the sporangiferous organ of *Glossopteris* or *Gangamopteris*. Thomas (1921) also described a third species of *Ottokaria*, *O. leslei* from Vereeniging. Lacey (1959) reported some specimens of *Ottokaria* from Wankie, South Rhodesia. Plumstead (1956) regarded *Ottokaria* as the fructification of *Gangamopteris*. However, it seems that at least *Ottokaria bengalensis* is attached to a leaf of *Glossopteris* and not to that of *Gangamopteris* (BOSE IN PLUMSTEAD, 1956; Discussions).

Srivastava (1955) described from the Raniganj coalfield, a fossil which he thought was probably a cone of *Schizoneura gondwanensis*. Surange (1958) reported a male fructification bearing monolet spores from the Raniganj stage of the Raniganj coalfield, Bengal. Both these fructifications seem to be of glossopterid type.

The first and so far the only known attached fructification from India was described

by Sen (1955). This fructification, which is of *Lanceolatus* type, is attached to a leaf of *Glossopteris communis*. Plumstead (1958) named this specimen as *Lanceolatus communis* (Sen). Recently Rigby (1962b) described a new fructification, *Plumsteadia microsacca* borne on a leaf of *Glossopteris communis* type and compared the fructification with *Lanceolatus communis* (Sen) Plumst. He differentiated it from the genus *Lanceolatus* Plumst. on the basis of supposed non sac-bearing nature of the so-called adnate organ, which in *Lanceolatus* is said to be sac-bearing. However, the figures of the specimens given by Rigby (1962a, FIG. 1; 1962b, FIG. 5) and by Sen (1955c, FIGS. 2, 3) show distinct circular to ovoid scars on the so-called adnate organs and thus there seems to be no difference between *Plumsteadia* Rigby and *Lanceolatus* Plumst. and as such *P. microsacca* may better be combined with *L. communis*.

Verma (1963) also reported two types of fructifications from the Chintalpuhi Sandstone, S. India and compared them with *Scutum leslium* and *Hirsutum dutoitides*.

The present specimens are from the Raniganj stage of the Raniganj coalfield, Bengal. One of these is attached to a *Glossopteris* leaf, while the others are found in detached condition.

## DESCRIPTION

### Genus *Cistella* Plumst.

#### *Cistella indica* sp. nov.

The specimen is rather incomplete and is attached to a leaf which is unidentifiable due to bad preservation.

Only one specimen without counterpart is known so far. The fructification (PL. 1, FIG. 1) is incomplete, being broken in the upper part, but was probably broadly elliptical. It does not lie in the centre of the leaf, which indicates that the body of the fructification was free from the leaf. Though it is attached to the midrib of the leaf,

there is no indication of an adnate pedicel. It seems that the fructification was either sessile or had a very short and delicate pedicel which on preservation became quite indistinguishable from the midrib of the leaf. The incomplete specimen measures 2.1 cm. in length and 1.1 cm. in width in the widest part. The impression is covered with oval to circular areas which are clearly seen on the left upper corner. In the central region of the fructification there is a median ridge which does not coincide with the midrib of the leaf behind the fructification. From the thickness of the compression it seems certain that harder tissues formed a part of the fructification. A narrow rim is seen surrounding the fructification. Whether this fructification bore ovules or pollen sacs is difficult to establish and infact it has not been possible to demonstrate the presence of any ovules or pollen sacs in any of the glossopterid fructification known so far. Prof. Walton (Personal Communication) believes that most of the glossopterid fructifications suggest strobiloid structures with a central axis bearing cup-shaped structures (?cupules or ?empty sporangia with thin walls).

The leaf which bears this fructification is incomplete with badly preserved carbonized crust and indistinct venation. It was probably asymmetrical and with a petiole which is about 1.7 cm. long. One or two veins which are visible are dichotomous and anastomose to form narrow and elongate meshes of *Glossopteris indica* type. Due to bad preservation cuticular preparations could not be made. Hence, the leaf is simply referred as *Glossopteris* sp.

*Diagnosis* — Fructification ?sessile, broadly elliptical with oval to circular scars; a narrow rim surrounds the fructification.

*Holotype* — 32870, Birbal Sahni Institute of Palaeobotany, Lucknow.

*Horizon* — Raniganj stage.

*Age* — Upper Permian.

*Locality* — West Jamuria Colliery, Raniganj Coalfield, Bengal.

*Comparison* — This species differs from both the known species of *Cistella*. *C. stricta* Plumst. is attached to a leaf of *Glossopteris stricta* Bunb. while the present leaf, though unidentifiable, is definitely not *G. stricta*. The shape of *C. stricta* is ovate-auricular while *C. indica* seems to have been broadly elliptical. Also *C. indica* is comparatively slender of the two. The other species *C.*

*waltonii* Plumst. differs in having a short and strong pedicel which is absent in *C. indica*. Furthermore in *C. waltonii* the surrounding rim is not well-marked, the oval sacs have a central cavity and are surrounded by a scale or wing. *C. indica* completely lacks in these features.

#### Genus *Dictyopteridium* Feistm.

The genus *Dictyopteridium* was created by Feistmantel (1881) for certain linear or lanceolate bodies covered with small tubercles within and larger ones along the margin. The first specimens of this genus came from the Raniganj stage (Upper Permian) of the Raniganj Coalfield and the Barakar stage (Lower Permian) of the Talchir Coalfield. Later it was reported from the Raniganj stage of the Karanpura Coalfield (FEISTMANTEL, 1886) and the Damudas of the South Rewah Gondwana basin (ZEILLER, 1902). Feistmantel's Karanpura specimen, however, is different and may belong to some other genus. Recently the genus *Dictyopteridium* has also been reported from the Pali beds (? Raniganj stage) of the South Rewah Gondwana basin (SAKSENA, 1962). From outside India, this genus is known to occur so far only in Lower Bowen series of Queensland, Australia (WALKOM, 1922; RIGBY, 1962b) and Upper Bowen sediments in Queensland (WHITE, 1962). The specimen which Rigby (*l.c.*) described as *Dictyopteridium sporiferum* is most unlike the said species and appears to be a better preserved specimen of *Lanceolatus* type. However, the specimen which he recognizes as *Cyclodendron leslii* (RIGBY, *l.c.*; FIG. 4) may be a portion of *Dictyopteridium*.

The present specimens come from the Raniganj stage of the eastern sector of the Raniganj Coalfield, Bengal and are found in the form of carbonized compressions with impressions on the counterparts. Though several specimens have been recovered, yet all but one are incomplete.

#### *Dictyopteridium sporiferum* Feistm.

The most complete specimen (PL. 1, FIG. 2) of which the counterpart (PL. 1, FIG. 3) is also available, is a lanceolate structure, 4 cm. long and 0.7 cm. broad at the widest part and possesses a 'pedicel' which is 0.4 cm.

long and 1.5 mm. broad. So far a 'pedicel' was not reported for *Dictyopteridium*. The whole surface of the fossil except for a marginal rim, about 1 mm. broad, is covered with irregularly arranged, more or less 0.5 mm. broad oval to circular 'scars' which become larger towards the periphery. In between the scars a faint net venation can be traced. The other specimens although all incomplete, agree with the above one; some show slightly better preserved details of the scars and venation (PL. 1, FIG. 4).

A Canada balsam transfer of one of the specimens was made. It revealed that the scars are present only on one surface of the specimen. The other surface shows a net venation (PL. 1, FIG. 5) which has a superficial resemblance with that of *Glossopteris angustifolia*.

This particular specimen (PL. 1, FIG. 5) was macerated in nitric acid in the hope of getting cuticle and spores. The cuticle (PL. 1, FIG. 6) shows poorly preserved structures and it was with great difficulty that the cell outlines could be demarcated at a few places. The cells are oblong-polygonal in shape with straight walls. A few stomata appear to be broadly elliptical in shape with irregular orientation and distribution. Guard cells and subsidiary cells are not seen. It is not known whether the two epidermal surfaces are represented. Only a few spores are seen attached to some pieces of the cuticles. The small number of spores may probably be due to the fact that the fructification had shed the spores before it was preserved. The spores (PL. 1, FIG. 7) are disaccate, and some of them show striations on the central body. However, some other spores do not show striations which may be due to bad preservation. The association of these spores with the cuticle of the fructification seems to suggest some relationship between them but it cannot be definitely said that these spores belong to the fructification as in many cases spores have been found in association with the cuticles of 'sterile' *Glossopteris* leaves.

*Remarks* — The specimens of *Dictyopteridium sporiferum* known so far were all incomplete and of variable sizes, the largest one being that of Zeiller (1902) which though incomplete measures 7.7 cm. in length and 1.4 cm. in breadth. Walkom's (1922) specimen is also quite large though narrow. In none of the specimens the presence of a 'pedicel' was recognized. Saksena (1962)

reports that in his specimens the scars are more or less circular and arranged in oblique rows. However, his figures do not show the latter feature and the scars seem to be arranged irregularly as in the present specimens as well as in those of Feistmantel and Zeiller. Walkom's figure is not clear.

The affinities of this species have so far remained uncertain. Feistmantel (1881) considered it to be a fertile leaflet of some fern, the scars being supposed to represent the points of attachment of sori. Zeiller (1902) on the other hand regarded it to be a fleshy rhizome bearing scars of caducous hairs. His objection to Feistmantel's view was because of the absence of sporangia and also because he could not find the net venation. However, Zeiller's view becomes untenable in the light of the present find of a 'pedicel' and the reticulate venation on both sides of the fossil.

Rao (1935) compared *Dictyopteridium* with *Rhizomopsis* Goth. & Sze and remarked that "while *Gigantopteris* has not so far been found in India, an identity or affinity between *Rhizomopsis* and *Dictyopteridium*, if proved, would be of great interest after the suggestion of Gothan and Sze that the former might belong to *Gigantopteris*". There is, however, no point of similarity between *Rhizomopsis* and *Dictyopteridium* as the former is supposed to be a rhizome with bud-like outgrowths whereas *Dictyopteridium sporiferum* is most probably a fructification.

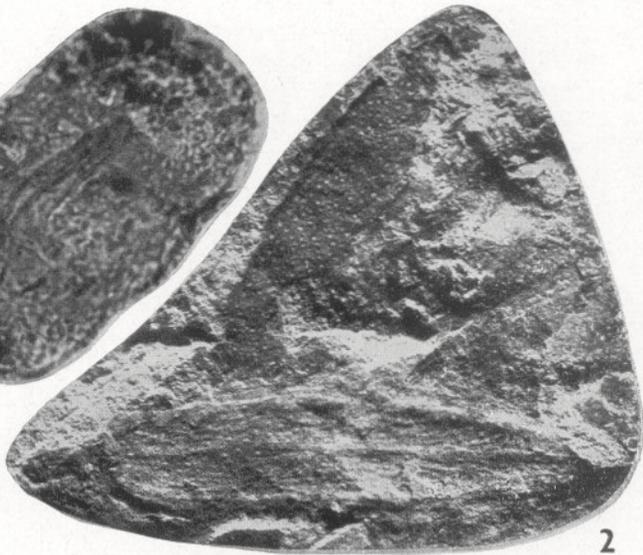
Plumstead (1958) regarded *Dictyopteridium* to be a glossopterid fructification. Recently White (1962) suggested that *Dictyopteridium sporiferum* is the fertile leaf of *Glossopteris angustifolia*. She has derived the fertile leaf from the sterile one through a series of intermediate stages. Her view appears convincing and is confirmed by the presence of scars on one side and of net venation, which is not very much unlike that of *Glossopteris angustifolia*, on the other. But the identification in my case is not substantiated by cuticular evidence. According to Sahni (1923) in *G. angustifolia* the cell walls are sinuous and the subsidiary cells show papillae. In *D. sporiferum* the cell walls are straight and no papillae were observed. The shape of the stomata in two cases is also slightly different. These differences are important enough to separate them. At present it can only be said that *Dictyopteridium sporiferum* seems to represent the fertile stage of a *Glossopteris* leaf.



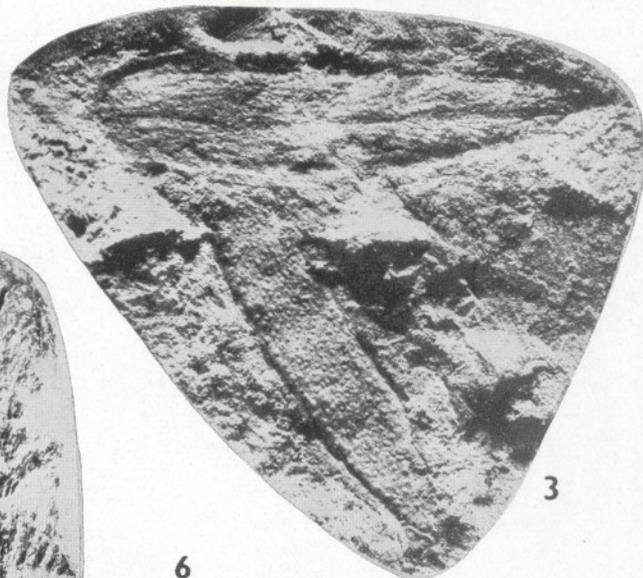
1



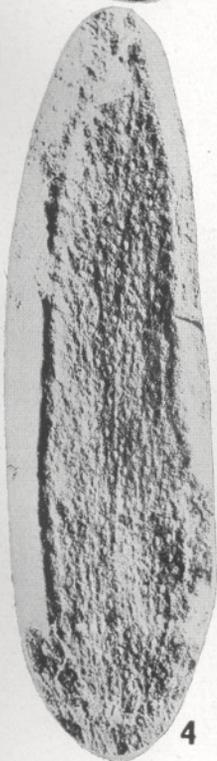
7



2



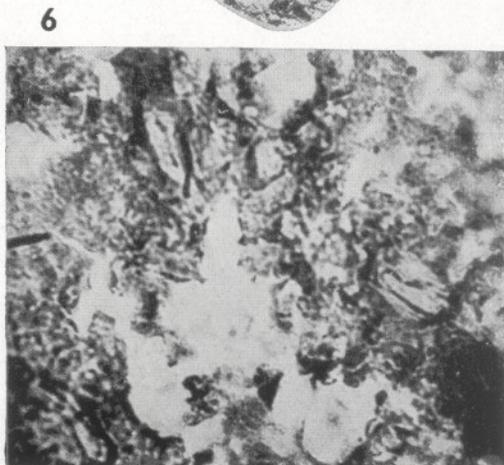
3



4



5



6

ACKNOWLEDGEMENT

I express my gratitude and most sincere thanks to Dr. K. R. Surange for his

inspiring guidance and encouragement during the course of this study. My grateful thanks are also due to Prof. J. Walton for valuable suggestions.

REFERENCES

FEISTMANTEL, O. (1880-1881). The fossil flora of the Gondwana System (Lower Gondwanas) 2. The flora of Damuda-Panchet Divisions. *Palaeont. indica* ser. XII, 3 (2): 1-149.

Idem (1882). The fossil flora of the Gondwana System. 3. The fossil flora of the South Rewah Gondwana basin. *Ibid.* 4 (1): 1-52.

Idem (1886). The fossil flora of the Gondwana System. 4. The fossil flora of some of the coal-fields in Western Bengal. *Ibid.* 4(2): 1-66.

LACEY, W. (1959). Occurrence of Presumed Glossopteridean Fructifications in Rhodesia and Nyasaland. *Nature, Lond.* 184: 1592, 1593.

PLUMSTEAD, E. P. (1956). On *Ottokaria*, the fructification of *Gangamopteris*. *Trans. geol. Soc. S. Afr.* 59: 211-326.

Idem (1958). Further fructifications of the Glossopteridae and a provisional classification based on them. *Ibid.* 61: 51-76.

RAO, H. S. (1935). *Rhizomopsis*, *Gothan* and *Sze* and *Dictyopteridium*, Feistmantel. *Rec. geol. Surv. India* 69: 171-173.

RIGBY, J. (1962a). Occurrence of Glossopteridae Fructifications at Baralaba, Queensland, and their evolution. *Nature, Lond.* 195: 196-198.

Idem (1962b). On a collection of plants of Permian age from Baralaba, Queensland. *Proc. Linn. Soc. N.S.W.* 87: 341-351.

SAHNI, B. (1923). On the structure of the cuticle in *Glossopteris angustifolia* Brongn. *Rec. geol. Surv. India* 54 (3): 277-279.

SAKSENA, S. D. (1962). On some fossil plants from Karkati, Kamtadand and Parsora in the South Rewah Gondwana Basin, Central India. *Palaeobotanist* 10: 91-96.

SEN, J. (1955). On some fructifications borne on *Glossopteris* leaves. *Bot. Notiser.* 108: 244-252.

SEWARD, A. C. & SAHNI, B. (1920). Indian Gondwana Plants — A Revision. *Palaeont. indica* n.s. 7 (1): 1-41.

SRIVASTAVA, P. N. (1955). Studies in the Glossopteris flora of India-1. Some new fossil plants from the Lower Gondwanas of Raniganj coalfield, India. *Palaeobotanist* 3: 70-79 (1954).

SURANGE, K. R. (1958). Studies in the Glossopteris flora of India-9. A male fructification bearing monoete spores from the Lower Gondwanas of India. *Ibid.* 6: 47, 48 (1957).

THOMAS, H. H. (1921). An *Ottokaria*-like plant from South Africa. *Quart. J. geol. Soc. Lond.* 77: 285-288.

VERMA, C. P. (1963). *Glossopteris* fructifications from Chintalpudi sandstone, South India. *Curr. Sci.* 32: 75-77.

WALKOM, A. B. (1922). Palaeozoic floras of Queensland. Part I. The flora of the Lower and Upper Bowen Series. *Qd. geol. Surv.* Publ. No. 270: 1-45.

WHITE, D. (1908). Fossil Floras of the Coal Measures of Brazil (in Part III of Final Report of Dr. I. C. White). *Rio de Janeiro.*

WHITE, M. E. (1962). Reproductive structures of *Glossopteris angustifolia* Bgt. *Nature, Lond.* 193: 192, 193.

ZEILLER, R. (1902). Observations sur quelques plantes fossiles des Lower Gondwanas. *Palaeont. indica* n.s. 2 (1): 1-40.

EXPLANATION OF THE PLATE 1

PLATE 1

1. *Cistella indica* sp. nov. (Holotype). Specimen No. 32870. × 2.
2. *Dictyopteridium sporiferum* Feistm., two specimens showing the scars. The lower specimen is with a pedicel. Specimen No. 32873. × 2.
3. *Dictyopteridium sporiferum*, counterparts of the specimens in Fig. 2. × 2.
4. *Dictyopteridium sporiferum*, another specimen

- enlarged to show details of scars. Specimen No. 32872. × 4.
5. *Dictyopteridium sporiferum*, a transfer preparation to show the venation on the opposite side. × 3.
6. *Dictyopteridium sporiferum*, a cuticle piece obtained by macerating the specimen in Fig. 5. × 250.
7. One of the striated pollen-grains found in association with the cuticles of the specimen in Fig. 5. × 500